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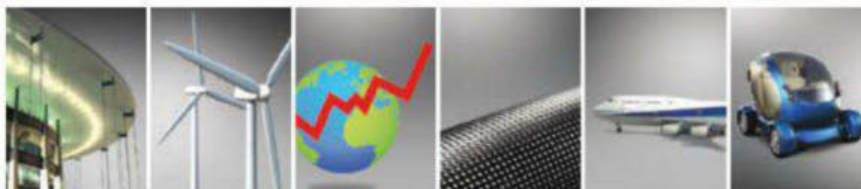


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- 35 **As Boeing closes** on the final design for the 737 MAX, it appears more substantial upgrades than anticipated are in the works to meet performance targets.

SECURE

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Power³



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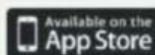
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FROM THE WEB

Comments from readers
on AviationWeek.com

Senior Editor Amy Butler's article "Can USAF Buy a \$550 Million Bomber?" about pursuit of a stealthy aircraft with a capped price, elicited a lively exchange that included:

Sukhoi noting:

NO! Typical game-playing will go on and in the end, if the program survives budget cuts, we'll end up with maybe 10 bombers at \$10 billion apiece . . . and possibly obsolete by the time they are deployed—10-15 years late.

Dave in Rio Rancho concurs:

In today's dollars, even an enlarged Lockheed Martin FB-22 or FB-23 would cost more than \$300 million per aircraft for that small a run.

Zeol wonders:

Does USAF need a long-range bomber, given that the Navy will get a fleet of Northrop Grumman X-47Bs that can be launched from airports and carriers worldwide? Not to mention the 2,500 Lockheed Martin F-35s that will be available.

Raptor recommends:

To control costs, take most of the F-35's systems at full-rate production: radar, electro-optical targeting, computers, etc. [Demand] joint development—Lockheed integrating the systems and Northrop supplying the airframe.

In Ares, our defense-related blog, International Editor Robert Wall reports on RAF commencing MRTT operations.

Airpower notes:

Initial multi-role tanking trials with the Tornado GR4s uncovered unexpected problems. The first "training" mission was a crew familiarization sortie only.



✦ Comment on articles, blogs and photos at: AviationWeek.com

FEEDBACK

ACCEPT WHOSE REALITY?

Reader Capt. Brien Bluhm says in a recent letter (AW&ST April 2, p. 10) that he is worth the price he is asking and that pilots are always blamed for the airlines' financial problems.

I too am a pilot, but I have a different take on the situation. I see unions as the problem. They forced airlines into unproductive contracts that let pilots work less than the FAA minimum while being paid as if they had worked the maximum allowable hours. These unproductive work rules allow pilots to be paid for not working.

I am sure that the pilots who are complaining embrace the capitalist lifestyle in other aspects of their lives. For example, I bet they do not pay a car dealer the sticker price, so why should a carrier pay whatever the pilots ask? Airlines have the right to get the work done well at a negotiated price.

Name Withheld By Request

LAS VEGAS, NEV.

ANOTHER TAKE ON WAGES

Brien Bluhm makes a good case for air crews' wages being commensurate with their responsibilities. I made a somewhat similar argument in the early 1980s, when Boeing was developing the 757. The aircraft—designed as a replacement for the 727—would be flown by a crew of two rather than three, and it was widely touted that elimination of the flight engineer (FE) would save airlines tons of money. But a quick back-of-the-envelope analysis reveals that given the then-yearly starting salary for an FE (mid- to high teens, and most "senior" FEs would've been happy earning \$30,000) and doubling that for overhead, it cost about \$60,000 per year, per FE. The price of the 757 was to be around \$60 million. You don't need a calculator to determine how long it would take, having eliminated the FE, to recoup the cost of the new jet—1,000 years! For each airplane! Plus training costs for pilots, mechanics and cabin crews. Yes, 757s use less fuel than 727s, but compared to the purchase price, all those other things are "in the noise."

Karl Sutterfield

DENVER, COLO.

CONCORDE'S SHADOW

On the basis of the Concorde "trial," which was covered in "Flight Safety Angst" (AW&ST April 2, p. 22), can we expect the Airbus A330-200 fleet to be blamed for the Air France Flight 447

Aviation Week & Space Technology welcomes the opinions of its readers on issues raised in the magazine. Address letters to the Managing Editor, Aviation Week & Space Technology, 1200 G St., Suite 922, Washington, D.C. 20005. Fax to (202) 383-2346 or send via e-mail to: awstletters@aviationweek.com

Letters should be shorter than 200 words, and you must give a genuine identification, address and daytime telephone number. We will not print anonymous letters, but names will be withheld. We reserve the right to edit letters.

accident? Surely there is a common factor somewhere.

Colin Campbell

CORSHAM, ENGLAND

TEAMING TEMPLATE

The "Tanker Teaming" item in the The World section (AW&ST April 2, p. 16) reports that the European Defense Agency (EDA) is eliciting support for the idea of pooling air refueling tanker resources. If so, EDA need look no further for an operational model than the jointly operated C-17s at Papa Air Base in Hungary under the aegis of NATO. In this day of defense spending rollbacks, I predict the teaming idea will cascade into other weapons platforms as well.

Roy Resto

BROOKFIELD, WIS.

DREAMS DENIED

A recent "Up Front" column noted the demise of NASA's human space-flight program (AW&ST April 2, p. 15). Visit the Kennedy Space Center to see the truth of this. The Apollo center showcases the glory days of NASA's history, from the failed rocket launches of the early days of Project Mercury to the amazing success of the Apollo missions. But in the "Explorers Wanted" segment, a NASA employee enthusiastically speaks in extremely vague terms about the agency's exciting partnership with private industry for the next generation of rockets for manned spaceflight. Though designed to inspire kids to dream of going to the Moon and to Mars, the real future seems dismal.

As recently as a year ago, visitors could have seen the shuttle atop the crawler-transporter, slowing making its way to the launch pad—an inspiring workplace with dedicated workers.

Next summer, the space shuttle Atlantis will go on display. A phenomenal sight for sure, but you will now be visiting a museum, not a vital workplace.

Brendan Barrett

TAMPA, FLA.



Jean-Pascal Meo



Briana Nansen



Rudy Morin



Eric Stuck



Gerardo Gomez



Sharon Meadows



Roy Foreman

To submit information for the Who's Where column, send Word or attached text files (no PDFs) and photos to: awinder@aviationweek.com For additional information on companies and individuals listed in this column, please refer to the Aviation Week Intelligence Network at AviationWeek.com/awin For information on ordering, telephone U.S.: +1 (866) 857-0148 or +1 (515) 237-3682 outside the U.S.

Jean-Pascal Meo (see photo) has been named general counsel at *Eurocopter Group*, Marignane, France. He was head of corporate matters in the legal department.

Jeff Davis has joined the Public Safety and Security Div. of San Diego-based *Kratos Defense & Security Solutions* as VP and general manager of the Southwest U.S. region. He comes from Stanley Convergent Security Solutions.

Robert Tavares has been appointed president of the Electronics Group of Lynnwood, Wash.-based *Crane Aerospace & Electronics* and **David Bender** president of Crane's Aerospace Group. Tavares was president of e2V, and Bender was president of both the Aerospace and the Electronics groups.

Briana Nansen (see photos) has been appointed executive flight solutions representative and **Rudy Morin** service planning coordinator at Dallas-based *Business Jet Access*. Nansen was an international recruiter for Real Foundations in Australia, and Morin was aircraft records auditor for Omni-flight Helicopters.

Joseph Mack has been named chief operating officer of Hong Kong-based *Sino Jet Management Ltd.* He is a former pilot proficiency examiner and designated check airman.

Eric Stuck (see photo) has been appointed senior manager for new business development in the product support organization of *Gulfstream Aerospace Corp.*, Savannah, Ga. He has held sales and program management positions at Hawker Beechcraft, Bombardier, Banyon Air Services and AMR Combs.

Craig Hoskins has become VP-safety of *JetBlue Airways*. He was director of flight safety.

Gerardo Gomez (see photo) has joined Dallas-based the *BBA Aviation Engine Repair and Overhaul Group* as sales manager for Mexico.

Normand Sirois has been named president of *Vulcan Electric Co.*, Porter, Maine. He was group VP of Vulcan's Thermal Solutions.

Ted Haugner has become director of sales for Brisbane, Calif.-based *ATP*. He was an area VP at IKON Office Solutions.

Ron de Bos has been appointed

head of sales in North America for *Air France Industries/KLM Engineering & Maintenance*. He was director of integrated services.

USN Rear Adm. (ret.) **James A. Robb** has been named president of the *National Training and Simulation Association*, Arlington, Va., succeeding Rear Adm. (ret.) **Fred Lewis**. Robb was an officer in command of Top Gun and has been an independent consultant specializing in defense acquisition and global political/military affairs.

USAF Maj. Gen. **Michael J. Carey** has been appointed commander of the Twentieth Air Force, Air Force Global Strike Command/commander, Task Force 214 of U.S. Strategic Command, F.E. Warren AFB, Wyo. He was deputy director for command and control and nuclear operations for the Joint Staff at the Pentagon. He will be succeeded by Col. **Timothy G. Fay**, who has been nominated for promotion to brigadier general. Fay has been commander of the 2nd Bomb Wing, Air Force Global Strike Command, Barksdale AFB, La. And, Maj. Gen. **Barbara J. Faulkenberry** has been appointed vice commander of the Eighteenth Air Force of Air Mobility Command (AMC), Scott AFB, Ill. She has been director of logistics at Headquarters U.S. Africa Command, Stuttgart, Germany. Faulkenberry succeeds Brig. Gen. **Lawrence M. Martin, Jr.**, who has been named vice commander of the 618th Air and Space Operations Center of AMC, Scott AFB, Ill.

USAF Maj. Gen. **Anthony J. Rock** has been appointed vice director of the Joint Staff at the Pentagon. He has been special assistant to the deputy chief of staff for operations, plans and requirements at USAF Headquarters. Brig. Gen. **Jon A. Norman** has been named director of U.S. Air Forces in Europe-U.K. of U.S. Air Forces in Europe, RAF Mildenhall, England. He

has been vice commander, of the Twelfth Air Force (Air Forces Southern) of Air Combat Command, Davis-Monthan AFB, Ariz.

HONORS AND ELECTIONS

Northrop Grumman employees **Sharon Meadows** and **Roy Foreman** (see photos) have received top awards at the *National Society of Black Engineers Conference* in Pittsburgh. Meadows, who is the lead systems engineer for the engineering military satellite communications program in Manhattan Beach, Calif., received the Outstanding Woman in Technology award. Foreman, an electrical engineering manager at the company's Information Systems sector in Madison, Ala., received the Distinguished Engineer of the Year award.

Michael L. Coats, director of the NASA Johnson Space Center and former space shuttle astronaut, is the recipient of the 2012 National Space Trophy—the *Rotary National Award for Space Achievement Foundation*. The award is given for furthering national space goals.

Edmundo Olivares Dufoo of Aeromexico, **Gonzalo Yelpe** of the Latin America & Caribbean Transport Association and **Virginia Cordeiro** of Aerolineas Argentinas have been nominated by their peers to receive the Latin

American Counsel Award for aviation, presented by *The International Law Office and the Association of Corporate Counsels*. The award recognizes performances by in-house counsels in the regulatory and non-financial services category. ☺



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AW&ST/S&P Market Indices

(as of 4/11/2012)

PERCENT CHANGE



Weekly Market Performance

Closing Prices as of April 11, 2012

Company Name	Current Week	Previous Week	Fwd. P/E	Tot. Ret. % 3 Yr.	Tot. Ret. % 1 Yr.
AEROSPACE & DEFENSE					
AeroVironment Inc.	25.68	26.03	16.5	4.1	-10.0 ▼
Allegheny Technologies Inc.	39.23	39.75	13.7	45.3	-37.9 ▼
Alliant Techsystems Inc.	50.19	50.41	8.2	-29.4	-27.8 ▼
BAE Systems plc	4.67	4.69	7.4	1.2	-6.8 ▼
Boeing Co.	71.77	73.67	15.7	99.2	0.6 ▲
Bombardier Inc. 'B'	3.92	4.04	8.5	16.4	-40.4 ▼
Cobham plc	3.67	3.60	11.4	37.0	2.1 ▲
Curtiss-Wright Corp.	35.50	36.64	11.9	13.4	5.5 ▲
DigitalGlobe Inc.	12.57	13.00	31.7		-55.8 ▼
EADS NV	39.38	39.86	15.8	230.4	46.8 ▲
Eaton Corp.	46.16	48.49	10.4	131.1	-9.5 ▼
Elbit Systems Ltd.	37.93	37.59	10.5	-24.8	-24.0 ▼
Embraer-Empresa Brasil ADR	34.45	33.52	13.7	117.3	7.2 ▲
Esterline Technologies Corp.	67.28	69.04	11.5	177.2	-0.8 ▼
Exelis, Inc.	11.48	12.23	6.3		
Fimmeccanica SpA.	4.59	4.87	9.4	-58.7	-58.4 ▼
FLIR Systems Inc.	23.83	24.67	14.2	9.4	-27.6 ▼
General Dynamics Corp.	69.35	72.63	9.5	66.8	-2.1 ▼
General Electric Co.	19.01	19.74	12.4	83.9	-1.5 ▼
GKN plc	3.04	3.16	7.5	188.7	0.3 ▲
Harris Corp.	43.81	44.41	8.1	50.9	-10.4 ▼
Hexcel Corp.	24.37	24.68	17.3	200.9	27.5 ▲
Honeywell International Inc.	57.08	60.15	12.9	100.3	1.8 ▲
Huntington Ingalls Industries Inc.	39.02	40.33	12.6		2.5 ▲
L-3 Communications Hldgs. Inc.	68.23	70.05	8.1	1.8	-10.9 ▼
Lockheed Martin Corp.	88.49	90.34	11.3	35.0	15.1 ▲
Moog 'A'	40.32	41.79	12.0	74.5	-8.0 ▼
Northrop Grumman Corp.	60.19	61.45	9.1	63.7	-0.8 ▼
Orbital Sciences Corp.	12.53	13.15	12.3	-5.9	-32.3 ▼
Parker-Hannifin Corp.	82.01	83.47	11.3	121.0	-10.5 ▼
Precision Castparts Corp.	168.20	171.78	17.6	167.2	16.9 ▲
QinetiQ Group plc	2.38	2.42	9.8	19.8	24.6 ▲
Raytheon Co.	51.51	52.44	10.1	33.5	6.7 ▲
Rockwell Collins Inc.	56.07	56.94	11.9	68.3	-10.1 ▼
Rolls-Royce Group plc	12.77	12.88	14.4	148.2	29.7 ▲
Safran SA	34.66	35.35	13.5	250.9	17.8 ▲
SAIC Inc.	12.51	12.80	9.3	-29.4	-27.8 ▼
SIFCO Industries Inc.	19.25	18.85		230.3	14.4 ▲
Singapore Technologies Eng.	2.49	2.52	17.3	44.7	3.4 ▲
Spirit Aerosystems Holdings	23.78	24.67	10.9	88.9	-1.0 ▼
Textron Inc.	26.93	28.38	14.1	101.1	0.6 ▲
Thales	35.00	35.57	10.0	-4.1	-3.2 ▼
Triumph Group Inc.	59.44	62.33	11.5	178.2	42.6 ▲
United Technologies Corp.	79.63	81.92	14.2	81.1	-2.9 ▼

COMMENTARY

Cut Loose, Exelis Faces Tough Times On Its Own

The beginning of a major downturn is not the best time to launch a new company. But the executives who run **ITT Exelis** didn't have much choice. The 20,000-employee defense and information technology operation was spun off last October as part of a breakup of multi-industry ITT Corp. designed to appease restless shareholders. And Exelis, which draws nearly 70% of its sales from defense, clearly was not the piece of ITT that investors saw as a growth play.

McLean, Va.-based Exelis is a case study in the challenges facing many mid-sized defense contractors as they brace for as much as \$1 trillion in cuts to the Pentagon's long-term budgets. Revenues were essentially flat last year at \$5.8 billion and are forecast to decline again in 2012 to \$5.4-5.5 billion. "It is very hard to find areas where you can see growth in almost anything," says John Shephard, chief strategy and corporate development officer. "Even areas of high priority are going to have tight budgets."

Exelis President and CEO David F. Melcher, who joined the company after a 32-year career in the U.S. Army, understands the key to survival in this defense downturn will be execution. And he believes one of the company's advantages is that it is platform-agnostic, with no single program accounting for more than 7% of sales. "We don't build big ships or planes or ground combat vehicles," he says. "But we do supply a lot of the capabilities that go on those," such as radios, jammers, ship radars and night-vision goggles.

With scarce funding expected to force the military services to keep existing platforms in service for decades, Exelis is investing to develop new generations of its products. Winning a competition for a next-generation jammer, for example, could generate as much as \$2 billion in sales.

Exelis also is able to open its checkbook now that it is free from a parent company that felt overweight in defense and essentially halted acquisitions in the sector after the \$1.7-billion acquisition of **EDO Corp.** in 2007. "We're looking at everything from under \$20 million all the way up to a merger of equals," says Melcher. Targets of interest include electronics, composites and air traffic management. But Melcher vows he will not overpay just to get into a "hot" niche, such as cyber. And while the growing commercial market holds strong appeal, "we're not going to make a leap into a purely commercial acquisition that doesn't have grounding in our core capabilities."

ITT Exelis shares have traded between \$8.25 and \$13.50 since the company went public on the New York Stock Exchange last October under the ticker "XLS." The stock closed at \$11.74 on April 12. Whether it rises—or falls—will depend on whether Exelis can execute on Melcher's vision. But he also knows there are variables the company cannot control, such as whether a dysfunctional Congress will really let deep cuts to the Pentagon's budget take effect next January. "It sort of depends on how bad it gets." ☐

Source of financial data: Standard & Poor's and Capital IQ Inc. (a Division of Standard & Poor's) U.S. dollars and cents. Forward P/E ratio uses S&P and Capital IQ forecasts of current fiscal year.

DEFENSE

Saudi Typhoon Sale

The government of Saudi Arabia has given the green light to BAE Systems to build 48 additional Eurofighter Typhoons even as the two parties continue to work out contractual details associated with changes in the program. The company notes that the contract for final assembly of the 48 additional aircraft—on top of the 24 bought initially—now has been signed. In January, the company reported the money for the aircraft had been allocated, but no contract had been completed. The program has changed over time. Initially, BAE was to assemble only the first 24 fighters at its Warton facility in England, with later work shifting to Saudi Arabia. But since then, it was decided to keep final assembly in the U.K., and instead build a maintenance facility in Saudi Arabia that would also be used for upgrades to the multirole fighter. BAE notes that talks over those elements of the contract still are being worked out.

S-500 Surfaces

Russia is planning to field its newest air and missile defense system, the S-500, after 2015. Work on the system, which would be the follow-on to the S-400 now being fielded, will take place at a new facility that manufacturer Almaz-Antey is building in Nizhny Novgorod with around 9 billion rubles (\$30.6 million) in government funding, according to the company. The facility itself is to be completed in 2015. Performance details of the S-500 remain classified, although engineering work on the system has already begun, Russian news agency RIA Novosti says, citing Alexander Sukhorukov, the Russian defense ministry's chief of armaments.

Two AW139s for Egypt

AgustaWestland North America has delivered two U.S.-assembled AW139 search-and-rescue helicopters to the Egyptian air force under a foreign military sales contract from the U.S. Army. The medium twin-turbine helicopters were assembled at the European manufacturer's Philadelphia plant. The Army operates a small number of AW139s overseas under its non-standard rotary-wing aircraft program.



Canada Hosts Initial Flights of Civil Ops UAS

Canada's CAE and Israeli manufacturer Aeronautics have completed initial flights of a Dominator XP twin-engine unmanned aircraft from Alma Airport in Quebec under Project Miskam. The flights from the UAS Center of Excellence at Alma constitute the first phase of an R&D project aimed at demonstrating how unmanned aircraft can be used for civil applications such as inspecting pipelines and hydroelectric installations, monitoring forest fires and natural resources, and assessing disasters. Conducted under a special operating certification, flights of the Miskam UAS, which is based on the civil-certified Diamond DA42 light twin, are being supervised by Transport Canada, Nav Canada and the Royal Canadian Air Force.

SPACE

Chinese Engine Deliveries

China's main rocket engine maker appears to have begun deliveries of production-standard YF-100 engines, the key powerplants of the forthcoming Long March 5, 6 and 7 launchers. A propulsion system for the Long March 5 heavy launcher, comprising two main engines and two auxiliary thrusters, was "recently" delivered by the Academy of Aerospace Propulsion Technology (AAPT), also known as the Sixth Academy, says national space group China Aerospace Science and Technology Corp. (CASC). Although the integrated propulsion set will be used for trials, CASC adds that it is the first "formal product"—apparently meaning that it is not experimental—and that the event "indicates that the delivery of engines burning kerosene and liquid oxygen has entered a normal condition." The delivery was attributed to AAPT's 7103 Factory, which is presumably the engine manufacturer. The report did not name the engine as the 120-metric-ton-thrust (260,000 lb.) YF-100, but its identity was obvious from the reference to kerosene fuel and the double installation.

New WGS Now Operating

Three months after its launch, the U.S. Air Force has accepted control of Wideband Global Satcom-4 following Boeing's in-orbit testing of the spacecraft, which is based on the 702HP commercial

payload. WGS-4 will be the first Block II in operation following USAF acceptance testing. Block II spacecraft include a radio-frequency bypass that allows three times faster data rate transmissions of airborne intelligence, surveillance and reconnaissance imagery than the Block I series for the first three WGSs. WGS-5 is in production and due for launch in 2013. The WGS is the successor to the USAF's Defense Satellite Communications System, which still has eight spacecraft in operation and is expected to last "for several years," says an official with the USAF Space and Missile Command.

Try & Try Again

Cobham has launched another takeover effort of satellite communications equipment maker Thrane & Thrane after an initial bid was rebuffed by the Danish company. Cobham launched a £270 million (\$432 million) bid for outstanding shares in Thrane & Thrane after bringing its own holdings to 25.6%. The move comes after Cobham withdrew an earlier bid last month, after Thrane & Thrane rejected it. Since then, Cobham has acquired shares from Jupiter Asset Management and other entities that represent 22.7% of Thrane & Thrane shares. Cobham says the offer is final unless a rival bid emerges. The offer is expected to be issued next week and be open for four weeks, and could be extended to 10 weeks. Cobham promises investors around £2 million in annual savings from combining the companies and already has improved earnings this year.

Suborbital Openings

NASA's Dryden Flight Research Center is expanding opportunities for payloads that cut across multiple technologies to fly on suborbital reusable launch vehicles or high-altitude balloons. The agency's goal is to help technologies mature, but it is not funding their development, only their chance to fly. NASA also notes that its current manifest for parabolic flights is full through "at least late 2013." Specifics on opportunities may be found at <http://nspires.nasa.gov>

AIR TRANSPORT

Boeing Adds 787 Orders

Boeing has regained some lost ground in 787 sales with the addition of four orders from Russia's Transaero Airlines. But it also reduced its net order count by one as of its April 10

listing, leaving it with 25 lost orders against 19 additions for the year. The company's total order book stands at 415 net orders, including 413 from the 737 NG/MAX series.

MAINTENANCE

MRO Jobs Finished

Finnair is launching labor talks to shed 280 positions as the airline moves to outsource engine and component services to SR Technics. The move is part of a wider Finnair group effort to realign the business and seek €140 million (\$185 million) in savings. The airline did not disclose the value of the outsourcing deal or expected savings. Airline COO Vile Iho says, "This plan is based on a thorough analysis, where we first examined the costs and structures of our own operations, and then compared the results to tens of external service providers."

Aircelle Thrusts Forward

Safran's Aircelle division struck a new accord with Applied Composites Engineering in Indianapolis to repair Aircelle thrust reversers for the Embraer ERJ 145 and E-170 and E-175. Marc Laubreaux, senior vice president for customer service, says Aircelle also is pursuing repairs for parts for other single-aisle aircraft. He sees an opportunity for the nacelle work on first-generation CFM56-5-powered Airbus A320s.

To Be Announced . . .

Moog plans to announce this week that it has selected AeroTurbine to provide global logistics support, including inventory management and distribution, for its Boeing 787 and 747-8 and Airbus A350 components and systems covered through Moog's support programs. AeroTurbine, a subsidiary of International Lease Finance Corp., will provide warehousing for Moog's global parts pools around the world, including in Miami, Los Angeles, Singapore, Beijing, London; Dubai, United Arab Emirates; and Sydney and Melbourne, Australia. AeroTurbine's inventory management portal called Compass will help support these assets.

Prime for Polish

Goodrich has signed a five-year, Prime Solutions nacelle services agreement with LOT Polish Airlines for support of its nacelles and thrust reversers on the GE CF34-10E engines that power its Embraer 195 aircraft. Goodrich is expected to provide nacelle MRO services for thrust reversers, inlet cowls and other components. The deal also includes access to large nacelle components for lease or exchange.

LHT Engine Support

Lufthansa Technik Aero Alzey inked a contract with Villa Air for MRO support and spares on the operator's Pratt & Whitney PW127F engines. It also signed an MRO agreement with Air Europa for its GE CF34-10E engines.

787 Training in London

Monarch Aircraft Engineering Technical Training Academy will start Boeing 787 training this year, investing \$2.4 million in desktop training equipment at its London Luton Airport facility. The training building will be refurbished to add several classrooms for composites and fiber optics training.

Two Bangs for the Lockheed Martin Space Buck

With the ability of heavy-lift rockets to perform piggyback launches, and even after making 100 A2100 geosynchronous communications satellites since 1996, Lockheed Martin has not seen two launched on the same ride.

That string is set to be broken on May 15 when the 100th and 101st satellites in the series, JCSat-13 and Vinasat-12, are scheduled to be lofted by an Ariane 5 from Arianespace's launch facility in Kourou, French Guiana. The two spacecraft were shipped to Kourou on April 12 on the same Volga Dnepr Antonov An-124 freighter.

JCSat-13 for SkyPerfect JSAT Corp. of Japan carries an all-Ku-band payload of 44 high-power channels for coverage of Japan, Indonesia, the Middle East, Southwest Asia and Oceania. It is to be located at 124-deg. E. Long. Vinasat-2 for the Vietnam Posts and Telecommunications Group is smaller, with 24 Ku-band transponders. It is to serve Vietnam and neighboring countries from 131.8-deg. E. Long.



LOCKHEED MARTIN



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COMMENTARY

Quicker Thinking

Faster fielding can make research investments pay off

Budget cuts not only put pressure on the scope of defense research, but also emphasize the speed with which results can be fielded to improve today's weapon systems.

The Office of Naval Research (ONR)—responsible for science and technology (S&T) across sea, air, land and space realms for the U.S. Navy and Marine Corps—is looking to field technologies faster to meet the objectives of the Defense Department's new strategic guidance.

"ONR's strategic plan, released in the fall of 2011, refocused us in the right areas," says Rear Adm. Matthew Klunder, chief of naval research. "We knew anti-access/area-denial would be important, so we refocused our core S&T." Areas that support assured access, he says, include autonomy and unmanned systems, expeditionary and irregular warfare, information and cybersecurity, power projection and integrated defense.

"We knew times are going to be tough, so we reduced from 13 focus areas to nine," Klunder says. ONR also diverted some funds from foundational "discovery and invention" research to programs that could deliver results more rapidly. Some of these ONR has been working on for several years, and could be in the fleet within 1-3 years, he says.

Others are "leap-ahead" technologies that ONR wants to accelerate. "We are absolutely committed to prototypes to get capabilities out to the fleet more quickly," Klunder says. "We feel confident, in a tougher budget, that we have [up to] three leap-ahead technologies that will get into the fleet."

Examples include the electromagnetic rail gun. The Navy was aiming for a weapon with a muzzle energy of 64 megajoules (MJ), an exit velocity



of Mach 7.5 and a range greater than 200 nm, for fielding by 2025. Now the program is focused on a smaller, 32-MJ, 100-nm weapon that can be delivered sooner and integrated more easily onto existing ships such as the DDG 51.

BAE Systems and General Atomics have delivered 32-MJ tactical prototypes for test firings. Now they are developing pulsed-power and thermal-management systems. They plan to deliver prototype multi-shot, actively cooled rail guns for firing tests in 2017, leading to a multi-mission weapon.

The free electron laser (FEL) program has also been restructured. Plans to develop a 100-kw prototype as a step toward the envisioned megawatt-class weapon have been put on the back burner. Instead, ONR will mature solid-state laser technology, already being pursued by the Army and Air Force. A solid-state laser would be less powerful, but smaller and could be adapted more quickly for shipboard use.

The Navy continues to believe FEL is the best solution for a naval directed-energy weapon, as its beam is tunable to minimize atmospheric absorption and distortion in a maritime environment, but "[we] also realize that some of the technologies still have a ways to go," Klunder told Congress last month.

ONR's two newest prototype pro-

grams, meanwhile, have an aviation focus. The Variable-Cycle Advanced Technology (VCAT) effort will take the Air Force Research Laboratory's Adaptive Versatile Engine Technology (Advent) demonstration and apply it to propulsion systems for next-generation manned and unmanned carrier-based strike and surveillance aircraft. Under Advent, Rolls-Royce and General Electric will test variable-cycle engines combining high thrust for supersonic speed with low fuel burn for subsonic endurance.

The Autonomous Aerial Cargo/Utility System (Aacus) program will enable unmanned vertical-takeoff-and-landing aircraft to drop off and pick up loads in adverse weather and harsh terrain. The "platform-agnostic" system will allow the aircraft to autonomously avoid obstacles, select an unprepared landing site and touch down precisely, with the ability to react to unplanned events.

Aacus and VCAT support the newest of ONR's five "national naval responsibilities" (NNR)—sea-based aviation. NNRs are "areas where the other services, the federal research establishment and the private sector may not have the incentive to investigate, [so] the sole responsibility rests with the Navy," says Klunder. Aviation NNRs focus on challenges associated with launch, recovery and deck operations of manned/unmanned aircraft on carriers and other air-capable ships (see photo). A key goal of an NNR is to provide funding stability to maintain an industrial capability unique to the Navy. "Supporting the industrial base is very important," says Klunder. "If we tell them where our priorities are, and don't go off on tangents, industry is then willing to invest its independent R&D dollars. The trend line is getting better; we are providing clearer direction and reducing wasteful dollars." Klunder is also keen to bring the acquisition community into the S&T process earlier, to ease the transition from R&D to procurement. "It is always a challenge integrating new technologies on to platforms," he says. "As we develop prototypes, we need to bring on engineers from the acquisition side to tell us what interface standards they would prefer. We can compress the acquisition process when we work side-by-side." ☛



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COMMENTARY



AIR FRANCE/MICHEL URTADO

Tip of the Iceberg

It will take more than new terminals to make France a dominant force in global aviation

ADP Paris airports authority and Air France are scheduled to jointly inaugurate Roissy-Charles de Gaulle's (CDG) additional passenger terminal, dubbed S4, in July. This initiative is expected to strengthen the country's quest for hub dominance in continental Europe.

With a touch of arrogance but also armed with convincing arguments, ADP President Pierre Graff and Air France Chairman/CEO Alexandre de Juniac jointly assert that Paris in the longer term will become an indispensable asset for the global airline industry.

London Heathrow is Europe's No. 1 airport, Graff and de Juniac acknowledge, but that facility will increasingly suffer from takeoff and landing slot scarcity because it is constrained from building a long-overdue third runway. Similarly, Frankfurt Airport, which recently opened a fourth runway, is no longer authorized to handle nighttime operations. The curfew, imposed this month by politically driven environmentalists, is a blow for the Lufthansa group of airlines and could significantly jeopardize the German gateway's growth.

In the same vein, the International Airlines Group (IAG)—parent of British Airways and Iberia—is acquiring British Midland Airways (BMI), and is therefore implementing more than a consolidation initiative. IAG is be-

lieved to be mostly interested in BMI's invaluable slots at Heathrow.

In sharp contrast with its British and German "competitors," CDG retains ample growth capacity, Graff says. Last year, it handled 506,588 aircraft movements, 61 million passengers and 2.5 million metric tons of cargo. The airport's four runways provide enough slots to sustain traffic growth in the long term, a unique asset. Air France-KLM's strategy, complemented by the Franco-Dutch group's minority share in Alitalia, is based on a three-hub vision of the future—Paris, Amsterdam and Rome—says de Juniac.

ADP invested €580 million (\$761.2 million) in the S4 terminal, an impressive 700-meter-long (2,296-ft.) building that seeks to illustrate an upscale, tasteful, so-called Parisian lifestyle. The

Paris CDG Airport—with four runways and multiple terminals—handled 506,888 passengers and 2.5 million metric tons of cargo in 2011.

terminal will accommodate Air France's capacious business/first-class lounge, exhibitions arranged by the country's top museums and a premium hotel for travelers lost in time zones. An alignment of boutiques is expected to reflect Paris's most prestigious shopping districts. In the next four years, ADP is slated to invest €2.4 billion in revamped facilities and terminal extensions.

Although ADP's influx of funds creates an attractive business environment for customer airlines, Air France is still posting heavy losses in an indication that runways, slots, impressive terminals and the legendary good taste of the French are not enough to sustain profitability. Moreover, this island of savoir-faire is surrounded by a sea of difficulties, including deficient ground transportation between CDG and the city's center. A nonstop fast train, initially planned many years ago, was eventually canceled after the investor/operator, the Vinci group, gave up in the face of repeated delays. In other words, arriving passengers, after entering nearly ideal terminals, have the lion-or-the-tiger choice of interminable traffic jams or uncomfortable, unreliable local trains to take them farther.

The ultimate decision, however, involves the strategic plans of Air France and Air France-KLM. The group's French arm certainly needs an attractive home hub and ADP magnanimously provides that. And it behooves ADP to do so, because it is served by hundreds of airlines and shops and other businesses that pay rent and cede back a fraction of their revenues to the landlord.

But Air France's operating costs are known to be too high, aircraft daily utilization too low and personnel productivity average, at best. To be successful in the short-/medium-haul route system, Air France not only needs top-class terminals and sufficient slots, but lower fares to compete against aggressive competitors such as Ryanair, EasyJet and Emirates.

Although ADP is Air France's best ally, the carrier can count on only itself to build a profitable future. ☛



BY ADRIAN SCHOFIELD

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COMMENTARY

Business Savvy

Inamori shows how airlines can benefit from outside ideas

Kazuo Inamori had no previous airline experience when he took the helm of struggling Japan Airlines in 2010. But the carrier's dramatic turnaround proves once again that good business practices can cross industry boundaries.

Inamori, one of Japan's most successful and well-known entrepreneurs, was asked by the Japanese government to step in to help with JAL's restructuring. As Inamori (pictured) tells *Aviation Week*, his management techniques have worked just as well in the airline world as in other sectors.



KYOCERA

The 80-year-old said when he took the job that he would stay for up to three years. Two years into his tenure, he is shifting from chairman of JAL to the honorary role of chairman emeritus. Masaru Onishi, formerly president, is taking over as chairman. Inamori says the most important thing he can do for the airline now is to step back from a hands-on role while continuing to mentor and train the new leadership team.

JAL emerged from bankruptcy protection a year ago, and the carrier is forecasting an operating profit of ¥180 billion (\$2.2 billion) for its financial year through the end of March (*AW&ST* Feb. 27, p. 17). To put this in perspective, just two years ago the airline's crippling losses caused one of Japan's largest-ever corporate failures.

So why did Inamori come out of retirement to help fix JAL? He says he was motivated by the company's importance to Japan. The Japanese economy was fragile, and if JAL went under it would "have a very negative impact on the economy." He also believes Japan needs to have two major carriers to foster

competition. Another concern was protecting as many jobs as possible.

Inamori says he approached the company's problems as if it were in any other industry. "When I started [at JAL], I had no knowledge of the airline business," he says. "In order to rebuild, it was necessary to know how each division and department was performing, and what the profit and loss was for [each of them]."

Inamori applied the "amoeba" management and accounting system that he had developed for two corporations that he founded—high-tech conglomerate Kyocera and telecommunications company KDDI. Under this system an organization is subdivided into small units with greater autonomy, and employees are given more input. Each unit's performance and contribution to profitability can be accurately measured.

This approach helped JAL determine where restructuring was necessary, and also made it possible to assess the profitability of each route in the network.

Another crucial step was gaining the support and cooperation of JAL employees, despite planned staff cuts

of up to 30%. Inamori believes the fact that he came out of retirement and refused a salary helped win over the workers. It was important to convince them that despite government involvement, it would take efforts from within the company for it to survive.

The government-backed Enterprise Turnaround Initiative Corp. (ETIC) had already laid out broad restructuring goals for JAL before Inamori took over. He believed JAL could outperform the ETIC plan, and exceeded these goals month after month.

Of course, the turnaround did have significant outside assistance. ETIC injected ¥350 billion into JAL and now owns almost all the stock.

However, Inamori argues that this does not give JAL an unfair advantage over other carriers, since ETIC will more than recoup its investment when it relists JAL on the stock exchange and sells its shares.

ETIC is still determining exactly when this will occur, but it will probably be before year-end. Inamori says ETIC is "certain" to recover its capital through this process. Financially, "performance has been excellent" since restructuring began, with "the second year even better than the first."

The industry outlook is likely to still be unsettled when the stock relisting takes place, but ETIC is believed to be targeting a return of at least ¥500 billion. Local media report that JAL's Oneworld partner airlines have been approached to make minor investments. American Airlines and other Oneworld carriers were keen to inject cash when JAL was putting its restructuring plans in place in 2010, but the offer was politely declined.

JAL's turnaround plan has involved more than just judicious cuts. There has also been growth in new areas, such as the joint-venture low-cost carrier (LCC) Jetstar Japan. Inamori says JAL was initially studying LCCs to "figure out how to succeed against them." This morphed into the decision to actually enter the LCC market.

Inamori's approach to JAL's problems is instructive. Sure, there are unique characteristics and challenges in the airline sector. But basing strategies on sound business principles works in any industry. ☺



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COMMENTARY

Four More Years

Funding extension boosts planet-hunter's prospects

Scientists using NASA's Kepler spacecraft (see photo) to look for planets around other stars have been "surprised by the universe," and the value of those surprises has earned the mission a four-year funding extension. Kepler was one of nine astrophysics programs granted peer-reviewed extensions on the recommendation of a NASA Senior Review Committee (SRC). Most of them—including the Hub-

ble Space Telescope and Chandra X-ray Observatory—also will continue operating through 2016. Kepler has detected more than 2,300 possible extrasolar planets orbiting distant stars in a small patch of sky near the constellation Cygnus, with at least 61 of them confirmed as planets by separate observations. Launched three years ago, the spacecraft stares at a field of 150,000 stars and measures the faint flickerings of planetary transits that block a minute portion of a star's light. So far Kepler has found the first rocky planet outside the Solar System, the first small planet in a star's habitable zone (where temperatures permit liquid water) and the first Earth-size planet.

Among unexpected discoveries caught by its 1.4-meter primary telescope mirror is what appears to be a planet orbiting a mid-K dwarf star so closely that it is slowly disintegrating in the heat. Kepler observations of the star KIC 12557548 found variable occultations that recur with a period of 15.7 hr. The changes in the depth of the occultation suggest a tail of dust dragged off the surface of a rocky



BALL AEROSPACE

planet that is perhaps a little larger than Mercury "by a thermal Parker-type wind composed of metal atoms sublimated off the planet's surface at a temperature of [about] 2000K," according to a draft paper prepared by a team under the leadership of Massachusetts Institute of Technology physicist Saul Rappaport.

Another unexpected finding involved a star that is not even targeted by Kepler—the Sun. Sunlike stars in the Kepler field of view turn out to be much "noisier" than Earth's star. They generate more variability in brightness that scientists must take into account when determining that the signatures received by the spacecraft are more likely to be planet candidates than the star's variability itself. That makes the extended mission all the more valuable. "The way you build up signal-to-noise ratio is to get more transits, so we need more time," says Kepler Principal Investigator Bill Borucki of Ames Research Center.

That refinement may help the Kepler team find what has so far eluded it—an Earth-size planet in the habitable zone of a Sunlike star. The

search for a true Earth analog will proceed under the same tight-budget environment that NASA-backed scientists face across the board.

"The Kepler mission is an outstanding success," states the SRC, noting the project's unique place among NASA's overall goals of understanding the evolution of the universe and the prospects for life beyond Earth. "A large fraction of the cost is for science operations, and the mission should consider carefully how they can reduce these and other costs in the extended phase."

That is a far better outcome than senior agency managers warned last year might happen under anticipated budget constraints—a shutdown or reduction in funding for data analysis (*AW&ST* Dec. 12, 2011, p. 16). ☉

COMS UPGRADE

Scientists preparing to use International Space Station facilities for research will have better online access to their experiments after U.S. astronauts finish revamping communications links. The work, intended to support a substantial increase in simultaneous science research, includes a doubling of the downlink data rate, solid-state recording and additional voice loops. Scheduled for completion late this year, the upgrade should increase to 64 from eight the number of experiments that can be supported simultaneously by NASA's Payload Operations Center at Marshall Space Flight Center and by partner control facilities around the globe. Most of the High-Rate Communications System (HRCS) upgrade is focused on the Ku-band system, the primary relay for video and experiment data through NASA's Tracking and Data Relay Satellite System network, according to Diego Serna, a NASA communications and tracking officer. In recent weeks, station commander Don Burbank and flight engineer Don Pettit, both of NASA, have been routing cable for the upgrade in the Destiny laboratory module and other parts of the orbital facility's U.S. segment. Activation must await the arrival of a Ku-band communications unit scheduled for transport aboard a resupply mission this summer, says Mike Suffredini, NASA's ISS program manager. ☉



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COMMENTARY

Critical Mass

Executives say NextGen may be unstoppable

Aerospace executives' skepticism about the prospects for implementing the NextGen air traffic control system is fading. With Congress finally having passed an FAA reauthorization bill that allows for new methods of financing the overhaul of air traffic management—the primary hurdle to persuading the airline industry to invest in NextGen equipment—execs are increasingly pointing to the potential payoff. In fact, the campaign now has so much momentum that it will be difficult to block implementation, says Fedex President and CEO David Bronzcek. "There's

enough momentum and urgency and enough people that really get it," he asserts. "I think this movement is hard to stop." He is hardly alone.

Dennis Muilenburg, the president of Boeing's

defense, space and security division, is touting the merits of technologies such as NextGen, which offer the payoff of lower fuel consumption and carbon emissions. Boeing gained a 20% boost in efficiency by investing in products such as the 787—and with a similar investment in NextGen, all aircraft could become 12% more efficient, Muilenburg declares. "Think of the implications." ☛

UNDER THE MATTRESS

When the business climate turns cold, companies can contract or invest. With the Pentagon staring at a potential \$1 trillion budget reduction during the coming decade, defense company officials are beginning to pursue both options, sometimes simultaneously. Sean O'Keefe, chairman and CEO of EADS North America, says that in this climate the prudent course is to avoid making investments that could amount to nothing as lawmakers wrestle with what level of funding to provide to the military. With an outcome not likely



REUTERS/LANDOV FILE PHOTO

There is an 'awful lot of cash stored under an awful lot of mattresses.'

SEAN O'KEEFE
 CHAIRMAN AND CEO
 EADS NORTH AMERICA

until late this year, if that, O'Keefe says industry is in a wait-and-see mode. There is an "awful lot of cash stored under an awful lot of mattresses," he quips. Gen. (ret.) Ronald Fogleman, a former Air Force chief of staff who is now chairman of ATK, agrees that some companies are hoarding cash to ensure they can fund pension programs. But he notes that they are also placing bets in areas where they see a potential payoff and are spending money to expand their portfolios beyond defense. ☛

SIGNAL RECOVERY

LightSquared, a company that sought to build an advanced 4G telecommunications network, is considering bankruptcy, and several lawmakers are wondering why the Obama administration paid for testing of its system and gave it a waiver to operate in the first place. The tests on LightSquared's network resulted in the determination that it could

interfere with GPS receivers. And the bill for conducting them is at least \$2 million, Deputy Transportation Secretary John Porcari tells Congress, acknowledging that it was "quite unusual" for the government to come to the aid of a private company. Porcari's comments were cited by two Republican lawmakers—Sen. Charles Grassley (Iowa) and Rep. Michael Turner (Ohio)—in a letter last week to President Barack Obama's adviser on telecommunications policy. In addition to a specific cost estimate, they want to know how many government employees helped to test LightSquared's network and whether Uncle Sam will seek reimbursement. ☛

GAME ON

The race is on to become one of the six U.S. sites responsible for testing UAVs in civilian airspace. The contest represents a huge opportunity at the dawn of a new industry, and a call last week from the FAA attracted interest from businesses large and small, universities, airports, lawmakers and the U.S. Army. The FAA says it will choose the test sites by December and is currently looking for comments that will help it winnow the many contenders. The program was established by the Defense Authorization and FAA Reauthorization acts and is approved for five years, according to FAA officials. Although the agency will also provide for safety oversight, it will not be funding the effort. Each test-site operator will propose how to pick up the tab. "It's a free-market operation," the FAA officials note. The agency will consider a few factors when choosing test ranges—including geographic and climatic diversity, the location of ground infrastructure and research needs—and will consult with the Pentagon and NASA. The program will recognize the diversity of systems that exist in the marketplace and the intent of Congress to solicit a broad range of research efforts. The FAA suggests a few areas for research, including command-and-control links, ground and airborne sense-and-avoid technology and environmental impacts, but the onus is largely on the proposer to suggest which areas the agency should be targeting. ☛



Hawker Beechcraft's chairman says selection of the AT-6 for the LAS-program would be a "sensible follow-on" to the aircraft's role in the JPATS program.

Face-Off

Hawker Beechcraft, Embraer gear up for a second battle to win a small contract with big stakes

JOSEPH C. ANSELMO and GRAHAM WARWICK/WASHINGTON

As military procurements go, the U.S. Air Force's competition to supply 20 turboprop light-attack/advanced training aircraft to the Afghan air force is hardly on the cutting edge of technology. Yet a battle for the modest contract has become a political hot potato between the U.S. and one of the world's rising economic powers, Brazil. Last week, it served as a backdrop to Brazilian President Dilma Rousseff's visit to the White House.

In one corner is Brazil's Embraer, whose A-29 Super Tucano won the \$355 million Light Attack Support (LAS) contract in December, only to have it taken away weeks later by the Air Force, which admits it botched documentation supporting its decision. On the other side is Hawker Beechcraft, a U.S. company that filed suit in federal court after its AT-6 was excluded from the competition by the Air Force for vague reasons.

For both companies, the stakes are huge. Embraer, which has partnered on the A-29 with U.S.-based Sierra Nevada

Corp., has long sought to win the Defense Department's stamp of approval for its small but growing military business, which does not have a large home market. Hawker Beechcraft, a storied but struggling business aircraft builder based in Wichita, sees the LAS contract as crucial to its battle to stave off bankruptcy. And hanging in the balance as the Air Force prepares to re-compete the contract this month are perceptions of fairness that center on whether the world's largest defense market is really a level playing field for all contractors worldwide.

"Being able to supply products and services to the U.S. Defense Department has always been one of our most important strategic objectives," Embraer President/CEO Frederico Fleury Curado told reporters during an April 10 meeting in Washington. "The importance of that contract to us is very high."

Curado says USAF has told Embraer and Sierra Nevada that the LAS contract's cancellation had nothing to do with their documentation. As such, he says, there is no justification for changing contract specifications when it is re-bid. "If we have the same specs . . . we have to believe we will be selected again, and that will prove that no politics were involved." But just in case, the Brazilian government is weighing in on the matter with the U.S. at the highest levels. "The Super Tucano is the only aircraft of its size and capability out there," Curado argues.

Not so, counters Hawker Beechcraft Chairman Bill Boisture. He says the original requirements laid out by USAF did not meet standards mandated in other fixed-wing competitions in areas such as

pilot safety and the use of proven U.S. or NATO munitions. And, he complains, the Super Tucano's handling qualities were not a factor in the selection. "I am sure Fred would like the requirements to be the same, because they don't meet the standards of previous fixed-wing U.S. Air Force competitions," Boisture says.

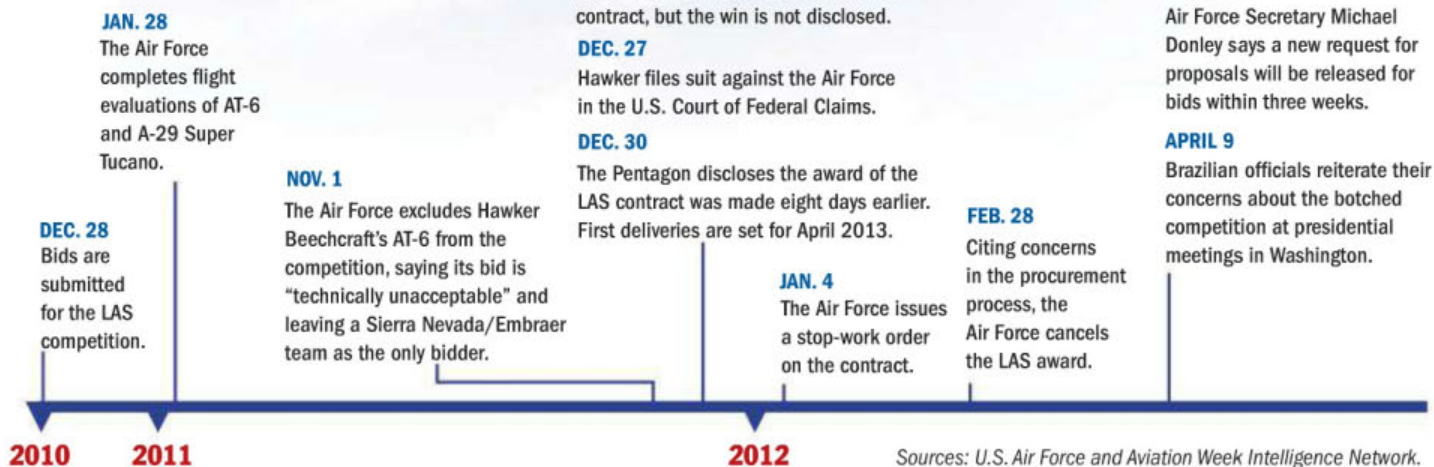
The strange series of twists in the LAS competition began on Nov. 1, 2011, when the Air Force disqualified Hawker, saying that its bid was "technically unacceptable" but refusing to provide details (see timeline). That left the Sierra Nevada/Embraer team as the only bidder, and it was awarded the contract on Dec. 22. Hawker's last-ditch lawsuit against the Air Force in the U.S. Court of Federal Claims forced the service to stop work on, and ultimately cancel, the contract, with USAF admitting it was "not satisfied with the quality of documentation supporting the award decision."

Air Force Secretary Michael Donley announced on April 5 that a rewritten request for proposals would be released within three weeks. The service also is deciding if a second flight evaluation of the two aircraft is necessary. The flight evaluation issue could be the next battleground in LAS. Embraer officials are concerned that if last year's fly-off data are thrown out and a new campaign does not take place, it may be at a competitive disadvantage. They are concerned that USAF personnel have familiarity with the T-6 trainer—from which the AT-6 is derived—but not the A-29.

A U.S. purchase of the Super Tucano would be an important validation for the light attack/advanced training aircraft.



Anatomy of A Mess



The T-6, first delivered in 2000 to the USAF and Navy for their Joint Primary Aircraft Training System (JPATS) program, has been selected for training, navigation and weapons systems use in Canada, Greece, Israel, Chile and Mexico. But Boisture says the Air Force still has not explained to Hawker why its original LAS bid was deemed unacceptable. The company is set to get its first "preliminary briefing" from USAF officials this week.

Hawker's lobbying campaign has centered on the politically sensitive issue of outsourcing U.S. jobs. "Look at the policy guidance in the Quadrennial Defense Review," says Boisture. "U.S. weapons systems are supposed to be used to the maximum extent possible." He estimates the LAS contract would support 1,400 jobs at Hawker and its first-tier suppliers. But Curado counters that the Super

Tucano contains U.S.-made components and would be assembled in Jacksonville, Fla. Embraer calculates its bid would support 1,200 U.S. jobs. Hawker also is quietly working on securing an export order for the AT-6. Such a move would help bolster its case that the aircraft is off-the-shelf and weaken one of its rival's main arguments.

In South America, suspicions remain about the Air Force's decision to terminate the LAS award being politically driven, rather than a sign of incompetence by the service's procurement officials. Hawker's "Buy American" campaign is fanning perceptions of bias against non-U.S. platforms. Critics point to big-ticket procurements such as the Air Force's KC-X tanker, which was initially won by EADS but then lost on appeal and ultimately awarded to Boeing. Embraer had a similar experience:

its ERJ 145 regional jet was to be used for the Army's Aerial Common Sensor until the program was canceled in 2006. Perceptions of alleged U.S. protectionism are also troubling for Boeing. The company is competing against Dassault and Saab in Brazil for the F-X2 fighter program, and is worried its F/A-18E/F bid will be collateral damage in the LAS fight. Brazil's oft-delayed type selection could come as early as June, so Boeing sees some sense of urgency to have the LAS recompetition move forward soon.

No matter which contractor prevails in the second round of LAS, one thing is certain: The first aircraft will not arrive in Afghanistan a year from now as planned. Getting any of them to the war-torn nation in the first half of 2013 is now "virtually impossible," Curado says. ☛

With Robert Wall in London.

Leveraging Boeing, Embraer sign manufacturing agreement

MICHAEL MECHAM/SAN FRANCISCO

Boeing and Embraer, already working together on biofuels research, are extending their cooperation with an umbrella agreement that is more broadly focused on commercial aircraft manufacturing and design.

During a signing ceremony at the U.S. Chamber of Commerce in Washington last week, Embraer President/CEO Frederico Curado characterized the pact as a non-exclusive R&D deal that is a first step toward a broader, but so far largely undefined collaboration. "We will be starting with some research and technological joint work," he said, noting that the companies would explore how best to leverage each other's R&D.

Just minutes earlier, Curado and Boeing Commercial Airplanes President/CEO Jim Albaugh were at the White House to witness the signing of a memorandum of understanding between the U.S. and Brazil on an "aviation partnership" to deepen cooperation in civil aerospace on regulatory issues, environmental issues and open skies.

"Brazil is a market we want to grow in," says Albaugh. "I know Fred feels the same way about the United States."

The U.S. is Embraer's largest market and the Brazilian manufacturer not only has a key office in Fort Lauderdale, Fla., but is establishing a plant in Melbourne, Fla., for its Phenom business jets.

Donna Hrinak, ambassador to Brazil during the George W. Bush administration, was named president of Boeing Brazil and given responsibility for establishing the company's permanent presence in the country. Headquarters will be in Sao Paulo, with a satellite office in Brasilia.

Albaugh says Embraer and Boeing will work in areas of intellectual property (IP), manufacturing and airframe efficiency that they can share on future programs.

Their recent memorandum focuses on three areas: safety, efficiency of aircraft operations and productivity in manufacturing. "There are some other areas we're going to talk about," Albaugh says, adding that there will be more detailed announcements later this year regarding specific joint endeavors.

Cooperation in future programs, rather than enhancing efforts where IP is already deeply embedded, is a standard strategy for Boeing with its foreign partners because it sidesteps sensitive issues concerning proprietary processes and products. "We'll identify specific tasks and then join in IP," Albaugh says.

Both companies will fund research and technology development. The emphasis will be on narrowbody jets, since that is where the companies' product lines overlap.

Such areas as aerodynamics research, lean manufacturing and automation are likely topics, Albaugh says. The focus on future IP and research work likely rules out applications on either of the partners' current development programs, whether Embraer's EX engine upgrade to expand the range and capacity of its E-Jet family or Boeing's planned improvements in the 737 MAX reengining effort.

This latest effort builds on an agreement signed in Geneva last month that links Boeing and Embraer with Airbus on "drop-in" biofuels for aviation, which are fuels that can be delivered to airplanes without special additives or processing. This is in addition to the Boeing/Embraer long-term aviation biofuels research.

Brazil, which makes 100% ethanol fuels derived from sugar cane for use in automobiles, is generally regarded as far more advanced in their production than either the U.S. or Europe, in part because demand for fuels in Brazil is market-based and not supported by subsidies, as corn ethanol is in the U.S.

The new technology agreement coincided with a visit by Brazil's President Dilma Rousseff, her first to the U.S. since taking office in January 2011, with President Barack Obama that centered on bilateral trade issues between the countries. ☛

Eyes Half Open

30-year aviation plan avoids budget realities

JEN DIMASCIO/WASHINGTON

The Pentagon's long-term plan for aviation keeps its eye on recent strategic shifts while largely ignoring the budget situation.

Even as Congress wrestles with how to pare down the deficit, the Pentagon plans to spend \$770 billion on aircraft purchases, operations, maintenance and related construction between fiscal 2013 and 2022, according to a report on the military's 30-year aviation plan sent to Congress in early April by Deputy Defense Secretary Ashton Carter.

Richard Aboulafia, an analyst with the Teal Group, calls the outlook in the aviation document "optimistic."

The Pentagon's road map follows closely the strategic guidance outlined by the military early this year, which continues a focus on intelligence, surveillance and reconnaissance (ISR).

That includes the continuation of major spending on unmanned aircraft. The Defense Department intends to increase the size of its fleet by 45% to 645 aircraft by fiscal 2022, according to the report delivered to Congress. To meet the demand for ISR, the Air Force will purchase enhanced sensors and replace its General Atomics MQ-1 Predators with MQ-9 Reapers. By the end of fiscal 2014, the Air Force plans to establish 65 orbits. The target of 645 unmanned aircraft is down by five from last year's number, but still continues growth from the 445 airframes in fiscal 2013.

In addition to increasing the military's ISR capabilities, four additional investment priorities are noted: providing "enabler capacity" by investing in air mobility and electronic warfare (EW) aircraft, buying fifth-generation fighters while maintaining enough inventory, modernizing long-range strike, and emphasizing modernization and readiness.

As for enabler capacity, the Navy aims to recapitalize its EW aircraft, holding its fleet of Boeing EA-18G Growlers steady at 114.

Aerial refueling tankers will support the aviation "enabler" priority, according to the report. The Air Force plans to buy 83 Boeing KC-46As by 2022 and complete the entire purchase of 179 aircraft seven years later.

The composition of the Air Force's fighter fleet will change over the next decade, with F-35 Joint Strike Fighters compris-

ing 25% of the force by fiscal 2022, rather than the current 7%.

Twenty years later, the military will have retired nearly all of the current force and will have started recapitalizing fifth-generation fighters, according to the report.

Aboulafia sees difficulty maintaining the fleet's size in the long term. The military will be able to manage over the next decade, using life-extension programs and upgrades to keep current platforms alive. But beyond those initial 10 years, "it's a recipe for a diminished superpower," he asserts.

Given the number of airframes that will need to be retired, force structure will have to be significantly reduced, says Aboulafia. "You do it incrementally and hope that it will be below the political horizon," he adds.

Whether any of these ambitions will be realized remains an annual guessing game. And staying away from the dynamics of near-term budgeting makes sense to some.

Loren Thompson, chief operating officer of the Lexington Institute, agrees, saying it is difficult "to incorporate current fiscal concerns when a few changes in the outlook could radically alter the outcome."

For example, if Congress allows the Bush-era tax cuts to expire, about one-third of the federal deficit will disappear, and that could be compounded if automatic budget reductions put into law last summer take place. "What that means is you can't let 30-year plans be driven by the fiscal or the military concerns of the moment."

Projected U.S. Military Aviation Inventory

INVENTORY	FISCAL	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Fighter/Attack		3,567	3,600	3,615	3,614	3,602	3,512	3,465	3,448	3,441	3,416
Attack Helicopter		882	860	882	886	906	881	906	918	957	966
Airlift/Cargo/Utility		4,459	4,556	4,590	4,581	4,528	4,533	4,552	4,605	4,598	4,589
Combat Search and Rescue		152	151	158	162	158	158	149	149	149	149
Air Refueling		528	524	522	521	531	538	531	529	533	536
Long-Range Strike		159	158	157	156	156	156	156	156	155	154
Anti-Surface/Submarine Warfare		603	632	633	637	644	677	683	673	658	654
Trainers		2,377	2,320	2,254	2,210	2,190	2,179	2,158	2,123	2,116	2,081
ISR/Scout/C4		1,169	1,236	1,276	1,333	1,330	1,371	1,399	1,406	1,460	1,418
Special Operations Forces		444	459	473	471	470	470	466	465	460	452
TOTAL		14,340	14,496	14,560	14,571	14,515	14,475	14,465	14,472	14,527	14,415

Source: U.S. Defense Department

However, the concerns of the moment are many, as Washington remains awash in speculation over how the budget for the next fiscal year will play.

Lawmakers and defense industry officials have expressed assurances that Congress will step in to rewrite a law passed last August to hand down an automatic budget cut of \$1.2 trillion across the government before it takes effect in January 2013. But that conventional wisdom regarding the penalty known as sequestration appears to be changing.

Contractors are already seeing a slow-rolling of contractual commitments, Thompson says, adding that they are making contingency plans.

"There's no way that it won't take place," says Gen. (ret.) Ronald Fogleman, former Air Force chief of staff, adding that because the fiscal year begins in October, the penalty of sequestration will impact fiscal 2013. And if Pentagon budgeters fail to plan for the possibility, "It's going to make the rest of the year all that much more difficult." ■

Yo, Robot

Load-toting brings unmanned technology closer to the soldier

GRAHAM WARWICK/WASHINGTON

Unmanned systems have changed military thinking, but mostly they operate out of sight of the common soldier, loitering at 25,000 ft. or higher, monitoring the battlefield and occasionally reaching out to strike a target.

That is changing as the U.S. military experiments with unmanned cargo air and ground vehicles, bringing ground forces into closer contact with autonomous systems and potentially making them more dependent on unmanned technology.

Teams tackling the disposal of improvised explosive devices have come to rely on their backpack-sized PackBots, but the latest machines are different beasts—whether it is a K-Max unmanned helicopter lifting a 4,000-lb. slung load to a remote outpost or a driverless all-terrain vehicle accompanying a patrol and hauling 1,200 lb. of gear troops would otherwise carry on their backs.

Now the Defense Advanced Research Projects Agency wants to take the next step, literally, and develop legged robots that can follow troops anywhere. The bots would be able to: respond to spoken commands, like a trained animal; enter dangerous or compromised environments; and operate available tools and vehicles designed for humans.

Two Lockheed Martin/Kaman K-Max helicopters have logged more than 380 flight hours and carried more than 750,000 lb. of cargo to resupply U.S. Marine Corps outposts since beginning operations in Afghanistan in mid-December. The initial six-month deployment is aimed at demonstrating how unmanned cargo aircraft can take vehicle convoys off dangerous roads.

The helicopters are flying autonomously to two forward locations from a main operating base, carrying food, water, ammunition and other supplies. Loads have averaged 2,500-3,000 lb., but have included a 4,200-lb. generator, says Jim Naylor, director of business development for aviation systems at Lockheed Martin Mission Systems & Sensors.

"The aircraft is controlled from the main operating base and flies auto-

mously to the forward operating base, where it can land or drop the load," he says. While the K-Max can complete the entire mission autonomously, "in most cases someone controls the aircraft [at the forward base] and nudges it to where they want the load dropped." The Navy has also begun retrograde operations, bringing loads back from the forward bases.

One aircraft flies at a time and together they are averaging five flights a day and 95% availability, reaching six a day in March when the mission-capable rate was 100%. Maintenance manhours are averaging less than 1.2/flight hour, dropping to 0.6 in March. "We are demonstrating how low-cost and easy it is to maintain the K-Max," he says. "We are demonstrating the need for the capability, and that K-Max is the right platform. It's a tough mission, but repetitive lift is what this aircraft was designed for."

As a next step in unmanned resupply, Lockheed and Kaman are using a third K-Max in the U.S. as a testbed to develop "platform-agnostic" capabilities to help the cargo mission under the

Darpa's Boston Dynamics-developed Legged Squad Support System (LSSM) demonstrated its climbing ability and vision system in initial outdoor tests in January.

U.S. Army's Autonomous Technologies for Unmanned Air Systems (Atuas) joint concept technology demonstration. "Some of these we could move over to the Marine Corps contract," says Naylor.

Atuas will demonstrate a small beacon that can be placed on the ground at the delivery site. The aircraft will autonomously find the beacon, sense its direction and put down the load a pre-set distance away, avoiding the need for a soldier to take control of the air vehicle at the remote drop site. The program will also demonstrate a lidar-based delivery-site selection system. "No one will need to be there," says Keith Arthur, team lead for teaming and intelligent systems in the systems integration division of the Army's Aviation Applied

Technology Directorate. "They will give it GPS coordinates, the system will scan the area and choose the spot," he says.

Lockheed and Kaman have also bid for the Office of Naval Research's Autonomous Aerial Cargo/Utility System (Aacus) program, with contract awards expected this month. Aacus will develop a capability enabling unmanned vertical-takeoff-and-landing aircraft to drop off and pick up loads in adverse weather and harsh terrain. The platform-agnostic system will allow the aircraft to autonomously avoid obstacles, select an unprepared landing site and touch down precisely, with the ability to react to unplanned events. The system will communicate with ground personnel, who will be able to negotiate a desired landing site.

Already, during their first weeks of operation in Afghanistan, four robotic cargo vehicles built by Lockheed for the Army have been used to resupply outposts and carry loads ranging from radios and batteries to construction and demolition equipment. The



BOSTON DYNAMICS

six-wheeled Squad Mission Support Systems (SMSS) arrived in-theater in mid-January for a four-month military utility assessment. At 11 ft. long, they are the largest unmanned ground vehicles deployed in Afghanistan.

The Army's Rapid Equipping Force, through the Robotics Technology Consortium, awarded Lockheed Martin a \$975,000 contract to deploy the SMSS to Afghanistan for evaluation. A heavily modified commercial all-terrain vehicle, the diesel-powered SMSS can carry a 1,200-lb. payload for 125 mi. on one tank of fuel. The vehicle also can provide portable power for soldiers, recharging up to 14 batteries simultaneously.

The size and terrain capability of the SMSS allows it to accompany foot patrols and carry their heavy equipment long distances, Lockheed says, but without the need for extra personnel to control the driverless vehicle. Using a "follow-me" feature commanded via hand controller, the SMSS paints a 3-D image of a person using its onboard

laser radar and follows that individual to the exclusion of others in the field of view, avoiding the need for a soldier to carry a beacon.

Although the SMSS has the ability to navigate autonomously, for the Afghanistan evaluation the system uses a "bread-crumb-dropping" feature to mark GPS locations every 10 meters (33 ft.) to store routes for reuse. Lockheed has also prototyped voice command, but says this feature was not required on the vehicles deployed to Afghanistan.

Although maneuverable, the SMSS could not follow foot patrols across all terrains, so Darpa is developing a more mobile cargo-carrying robot, the Legged Squad Support System (LS3). Developed by a team led by Boston Dynamics, the prototype robotic "pack mule" completed its first outdoor tests in January and an 18-month platform-refinement test cycle is to begin this summer with Marine and Army involvement.

The four-legged LS3 was developed from Boston Dynamics' BigDog rough-

terrain robot, which demonstrated its ability to walk across rubble, climb slopes up to 35 deg. and reach speeds up to 4 mph. Where BigDog could transport a 340-lb. load and travel 12.8 mi. without stopping or refueling, the goal for the larger LS3 is to carry 400 lb. of payload 20 mi. in 24 hr. without refueling, following a squad through rugged terrain and interacting with troops in a way similar to a trained animal and its handler.

LS3 has vision sensors to track a specific individual or autonomously avoid obstacles and Darpa plans to demonstrate a suite of autonomy settings, including: leader-follower tight, where the LS3 attempts to follow the path a soldier takes; leader-follower corridor, in which the vehicle has freedom to make local path decisions; and go-to-waypoint, where the system uses its computer vision to avoid obstacles en route to a designated GPS coordinate. Voice command will also be added during development. Ultimately, Boston Dynamics will build three prototypes, which will participate in Marine Corps exercises.

Darpa is continuing to push ground-robot mobility and capability. Boston Dynamics has demonstrated Cheetah, a four-legged robot that has reached a speed of 18 mph on the laboratory treadmill, flexing its articulated spine like an animal to increase its stride and speed. Tests of a free-running prototype are planned for this year. Now the defense research agency has launched the Robotics Challenge, offering a \$2 million prize for designing a robot capable of supervised autonomous response to a simulated disaster.

The 18-month competition will involve a series of events in which the robot will be required to drive a utility vehicle to the disaster site, get out and cross rubble, remove debris blocking a doorway, enter a building, climb a ladder and traverse a walkway, break through a concrete panel, locate and close a valve near a leaking pipe and replace a cooling pump.

The goal of the challenge is to improve the ability of robots to operate in chaotic conditions following a disaster and make use of vehicles and tools available in cities to clear rubble or make repairs. "This challenge is going to test supervised autonomy in perception and decision-making, mounted and dismounted mobility, dexterity, strength and endurance in an environment designed for humans but degraded due to a disaster," says Gill Pratt, Darpa program manager. ☐



Stacking the Deck

Canada's defense ministry loses control of F-35 buy as auditor questions procedures

BILL SWEETMAN/WASHINGTON

Canada's government has stripped its Department of National Defense of the lead role in the country's planned acquisition of the Lockheed Martin F-35A Joint Strike Fighter, placed a cap on the program's cost and directed the DND to evaluate alternative ways to sustain Canada's fighter force, in the wake of a scathing report from the country's auditor-general, Michael Ferguson.

The program will now be run by a special secretariat within the Department of Public Works and Government Services Canada, which shares responsibility for all major government programs.

Ferguson's report raised questions about the way the DND sought to use exceptions to Canadian law, which calls for all government procurements to be competed. Since the July 2010 announcement that Canada would acquire the F-35 without evaluating any alternatives, DND leaders and government ministers have repeatedly said the F-35 is the only aircraft that meets the country's requirements.

However, the auditor's report notes that the DND wrote a new statement of operational requirements (SOR) after it had started a push to get government clearance for a noncompetitive buy. Among other changes, the DND added three specific and detailed requirements that (in its view) only the F-35 could meet.

The department made no effort to determine if other competitors could meet those requirements by the specified delivery date, 2020. It has since been disclosed that the F-35 itself may fail to meet one of them.

Moreover, the SOR was not approved by the Royal Canadian Air Force chief of staff, Lt. Gen. Andre Deschamps, until June 2010, after the DND had sent to government ministers its signed recommendation for the F-35 decision.

In the meantime, DND told Public Works that it required a "fifth-generation" fighter and that no other type was available. "The term 'fifth generation' is not a description of an operational requirement," the auditor's report notes, adding, "there is no accepted or objective

definition of fifth-generation capability."

According to the auditor's report, the sequence of events leading to the decision began in 2008 when the DND "identified 14 draft high-level mandatory capabilities" for the CF-18 replacement. The DND then evaluated the F-35 and two competitors—unidentified in the report—and concluded that all three could meet those needs, but that the F-35 provided the best value. "This analysis became pivotal to the decision-making process," the report states, but adds that "there was no documentation supporting the analysis and conclusions."

Subsequently, "between late 2008 and mid-2009, DND led a process to get a government decision to buy the F-35, partly

The department made no effort to determine if any JSF competitor could meet its requirements by 2020

in response to pressure from industry," the report states. The DND warned government leaders that Canadian companies could lose billions of dollars in F-35 business if the decision was delayed.

It further recommended that the F-35 be selected without a competition. Canadian law identifies specific exceptions to the rule that programs should be competed. Until late May 2010—weeks before the announcement—DND relied on one exception that states: "The nature of the work is such that it would not be in the public interest to solicit bids." But at least one government department objected.

DND then turned to another of the permitted exceptions: "Only one person [or contractor] is capable of performing the contract." But its 2008 evaluation had reached the opposite conclusion. So at the same time that Defense Minister Peter MacKay and the cabinet pressed for an early announcement in favor of JSF, DND worked on a new SOR under

which JSF would be the only qualified contender.

The SOR was dated June 30, but Public Works did not see a copy until August, after the decision had been announced.

The SOR itself is not classified but has not been released, even to Parliament. However, sources who have seen the document have described its contents in some detail. It includes 28 mandatory requirements. According to a March 2011 DND presentation, all the aircraft under consideration met all criteria except for three detailed requirements.

One of the requirements sets radar cross-section (RCS) specifications, detailed in a classified annex. The second calls for a directional, secure, low-probability-of-intercept data link—a costly, complex and limited system needed only for a stealth aircraft.

The third calls for a sensor system "capable of providing the pilot with 360-deg., out-of-cockpit visual situational awareness in a no-light environment." The F-35's electro-optical distributed aperture system (EO-DAS), combined with its helmet-mounted display system, is the only known fighter sensor designed to do this, because other solutions rely on light-intensification technology, specifically ruled out in an annex to the SOR, while EO-DAS uses infrared sensors.

In fact, the F-35 itself is currently at risk of failing to meet the third requirement. The baseline Vision Systems International helmet-mounted display and EO-DAS are being redesigned to resolve latency, acuity and other issues, but the effort "remains high technical risk," according to last November's Quick Look Review report on the JSF program. The alternate helmet-mounted display system ordered from BAE Systems in October 2011 will use night-vision goggles.

Last fall, Aviation Week asked the DND how it had determined that no other aircraft, or developments that could meet the 2020 delivery date, would also meet the new mandatory requirements, including RCS. (Boeing, for example, has unveiled the reduced-RCS "international road map" Super Hornet and French officials have mentioned the possible development of a "silent Rafale," but neither company was invited to provide full data to Canada). The DND refused to answer, stating that any material response would go beyond what the department had told the Canadian government, adding that Deschamps, had "directed that the material be briefed to government prior to release to the public." ☐

Diminishing Drag

Flight trials near to explore ways to boost C-130J fuel efficiency

ROBERT WALL/LONDON

Winglets and a lift-distribution control system are next on the agenda as Lockheed Martin and the U.S. Air Force pursue fuel-burn improvements on the large fleet of C-130s.

Although principally aimed at the C-130J, with more than 250 now in operation, some of the features could also find use on older models. The effort fits in with a larger USAF effort to reduce fuel-burn fleetwide.

Interest in such fuel-saving measures goes beyond the U.S., though. Australia also has signaled that it wants to find ways to cut fuel burn on its transport fleet. The Royal Australian Air Force, which was the lead customer for the C-130J, has already signed an agreement with AE2100 engine maker Rolls-Royce to optimize fuel use on the transport. Rolls sees more opportunities for that type of business across the C-130 fleet.

On the aircraft side, the initial work is under way. Already in flight testing are micro-vanes that are aimed at lowering aft-fuselage drag and could yield 25 gal. per flight hour in fuel savings. The micro-vane system comprises 36 vortex generators on the rear fuselage.

Exploring the benefits of other technologies will be next. Wind-tunnel trials have suggested that 5-7% in total fuel-burn improvement may be achievable, says Jim Grant, vice president for new air mobility business at Lockheed Martin Aeronautics.

The company and USAF program office at Warner Robins Air Logistics Center, Ga., are still identifying exactly which C-130J will be used as a test aircraft. "We are anxious to get a no-kid-ding evaluation done," says Grant.

The lift-distribution control system is now ready for flight testing, the company says. It deflects ailerons to reduce lift on the outer wings. The aircraft also is trimmed out during cruise with greater nose-up attitude to improve lift. Benefits could include 1,400 mi. of extra range in a heavy-weight configuration, or a 10% increase in maximum payload or 10 gal. per flight hour of lower fuel flow at long-range cruise.

A roughly 30-day flight-test program for 5-ft.-high blended winglets could start before year-end. They could yield 21 gal. of lower fuel flow per flight hour in optimum circumstances. The improved wingbox now being installed on C-130s should be able to handle the higher loads the winglets will impart on the structure, says Grant.



Lockheed Martin plans flight trials on a U.S. Air Force C-130J with winglets and other devices to help reduce the transport's fuel burn.

The features could gradually be incorporated into the production flow for new C-130s. Lockheed Martin sees the micro-vanes ready for inclusion in 2014, with the lift-distribution control system following the year after and the winglets in 2016.

The company and USAF, meanwhile, are completing flight tests of software load 7.0 that will add enhanced air traffic management capability to the upgraded flight mission computer.

Other design enhancements are being looked at as well, including the potential applications of composites. Lockheed Martin has been working on the Advanced Composite Cargo Aircraft where some of those technologies have been explored under USAF funding.

With about two years of backlog—production is to be sustained at 32 aircraft per year (from a peak of 36)—the company also is looking for new opportunities, including top-up orders from

existing customers. South Korea, for instance, still has an unmet need for three additional airlifters, and the U.S. Air Force Special Operations Command will need to replace AC-130Us toward the end of the decade. The U.K. is another potential customer.

Although London decided to move to a two-airlifter-type fleet of Airbus Military A400Ms and Boeing C-17s, the C-130s could remain in service beyond the planned retirement date of 2022 and perhaps as long as 2030, when the aircraft was initially due to be phased out, says Paul Livingston, director of Lockheed Martin Aeronautics' U.K. business.

The company also has its eye on the U.K.'s unmet maritime patrol need after London decided two years ago not

to field the Nimrod MRA4. In February, the company started promoting its so-called SC-130J Sea Herc concept, a C-130J-30-derived maritime surveillance/patrol configuration.

The U.K. is still exploring how to meet the mission gap. This week, Parliament's defense select committee will hear testimony from senior Defense Ministry officials on the topic of the future of maritime surveillance. Livingston says Lockheed would team with Marshall Aerospace for any work to meet a U.K. need; the Cambridge-based business has promoted its own concept of a C-130 maritime patrol configuration.

Additionally, Grant notes that, globally, 300 older C-130s will reach the ends of their service lives in the next five years. Not all of them will be replaced by J models, but they are seen as an opportunity to further bolster the backlog. ☐

Setting Sail

Aerodynamic modification package will be tested to boost tiltrotor range

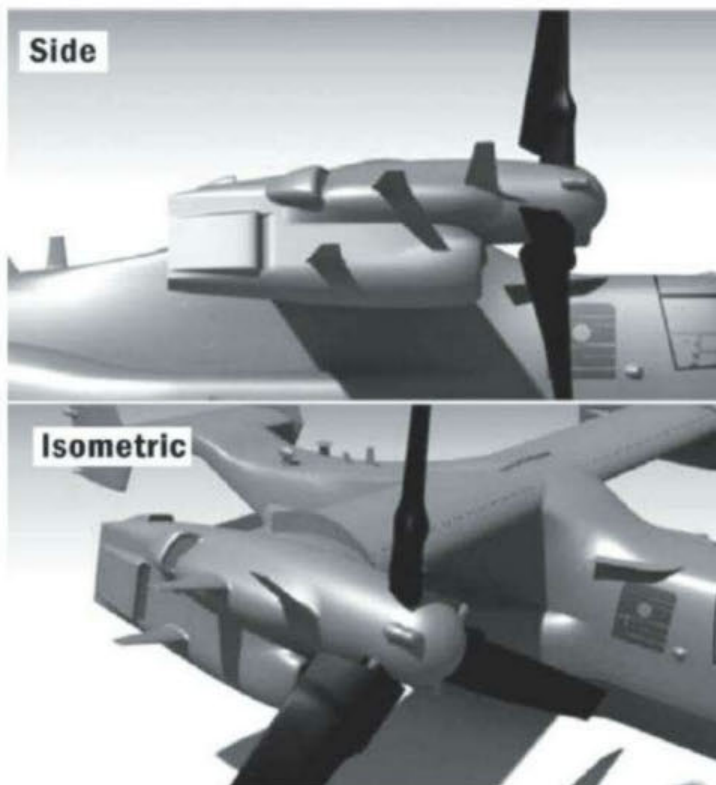
GUY NORRIS/LOS ANGELES

The ability of the Bell Boeing V-22 Osprey tiltrotor to fly farther, as well as faster, than helicopters has been a key factor in its fight for survival for more than a decade. But now, with both CV-22B and MV-22B versions recently pressed into service on longer-range, self-deployed combat and rescue missions in Libya and Afghanistan, the hunt is on for greater unrefueled performance.

Squeezing more range out of the V-22 is not easy, however. Constrained from birth by the need to fit on the restricted decks of U.S. Navy amphibious assault ships, the tiltrotor was necessarily limited to smaller-than-optimal wing and rotor dimensions leading to an inevitable impact on range. Without the options of increasing wingspan or rotor diameter available to them, designers are taking a leaf out of the Boeing Commercial Airplanes playbook and studying nacelle-mounted “sails” that work on the same principle as winglets.

Although Bell Boeing declines to comment on the development, Naval Air Systems Command (Navair) confirms it is preparing to flight test a modified MV-22 with the upgrade which could boost range by almost 5%. The concept, which was studied by Boeing for the Special Operation Forces CV-22 version as far back as 1994, harnesses the energy from the vertical upwash around the wing and nacelle. In the case of the V-22, Bell Boeing’s research indicates upwash angles of 10-20 deg. around the nacelles at the nominal cruise pitch attitude of 8 deg. The additional upwash velocity produces a propulsive force by tilting the lift vector forward.

In the run-up to flight tests, set to be performed by Navair’s V-22 joint program



Bell Boeing wind tunnel-tested configurations ranging from one to five of the winglet-like sails on each nacelle before settling on the three-sail arrangement that will be flown this year.

office, PMA-275, at NAS Patuxent River, Md., starting in November, Bell Boeing has evaluated several configurations for the size, number and positioning of the sails. The locations were initially determined by aerodynamic requirements, before being fine-tuned to reflect places where they could be best attached to the support structure in the nacelle with the least impact on maintainability.

Shipboard “spot” size considerations, the driving factor of the overall aircraft design, also influenced the final choice of 34 in. for the sails’ span. Root chord was set at 18 in. long to fit on a 32-in. panel, which worked within structural considerations. The tip chord is 9 in.

The flight tests, which will be conducted on PMA-275’s aircraft No. 24, are focused on a configuration with three sails per nacelle. This was selected from a variety of options ranging from

a single unit to five sails on each nacelle, all of which were tested in the Boeing vertical-/short-takeoff-and-landing wind tunnel in Philadelphia, during 2008-09. The best combination included a sail mounted forward on the nacelle with a dihedral of 45 deg. and two further aft set at 15-deg. dihedral, and improved the overall lift-drag ratio by 8%. Boeing’s analysis indicates the arrangement reduces drag by 10% and will lead to around a 5% increase in the self-deployment range.

However, the modification does not come without potential issues, which Navair expects to explore during flight testing. Wind tunnel evaluation, for instance, showed a drag increase of 10% with the three-sail configuration while in conversion mode with the nacelles angled at 30 and 60 deg. Given the improvements at higher speeds, and the short

time the aircraft spends in conversion mode, this is not expected to be a factor.

A potentially greater concern is the slight decrease in longitudinal static stability noted at typical cruise conditions. Although this was anticipated because the sails increase effective wing area while leaving the tail area unchanged, the change in stability will be a focus for flight tests, as will an analysis of a slight reduction in yawing moment versus sideslip angle seen in the tunnel.

Other areas for flight-test investigation will include the potential for tail buffet in conversion mode as well as increased nacelle loads. Although Bell Boeing defines both the loads and conversion-mode performance penalty factors as possible “design risks,” it predicts that the tail buffet boundary and stability and control aspects will not be an issue. ☐



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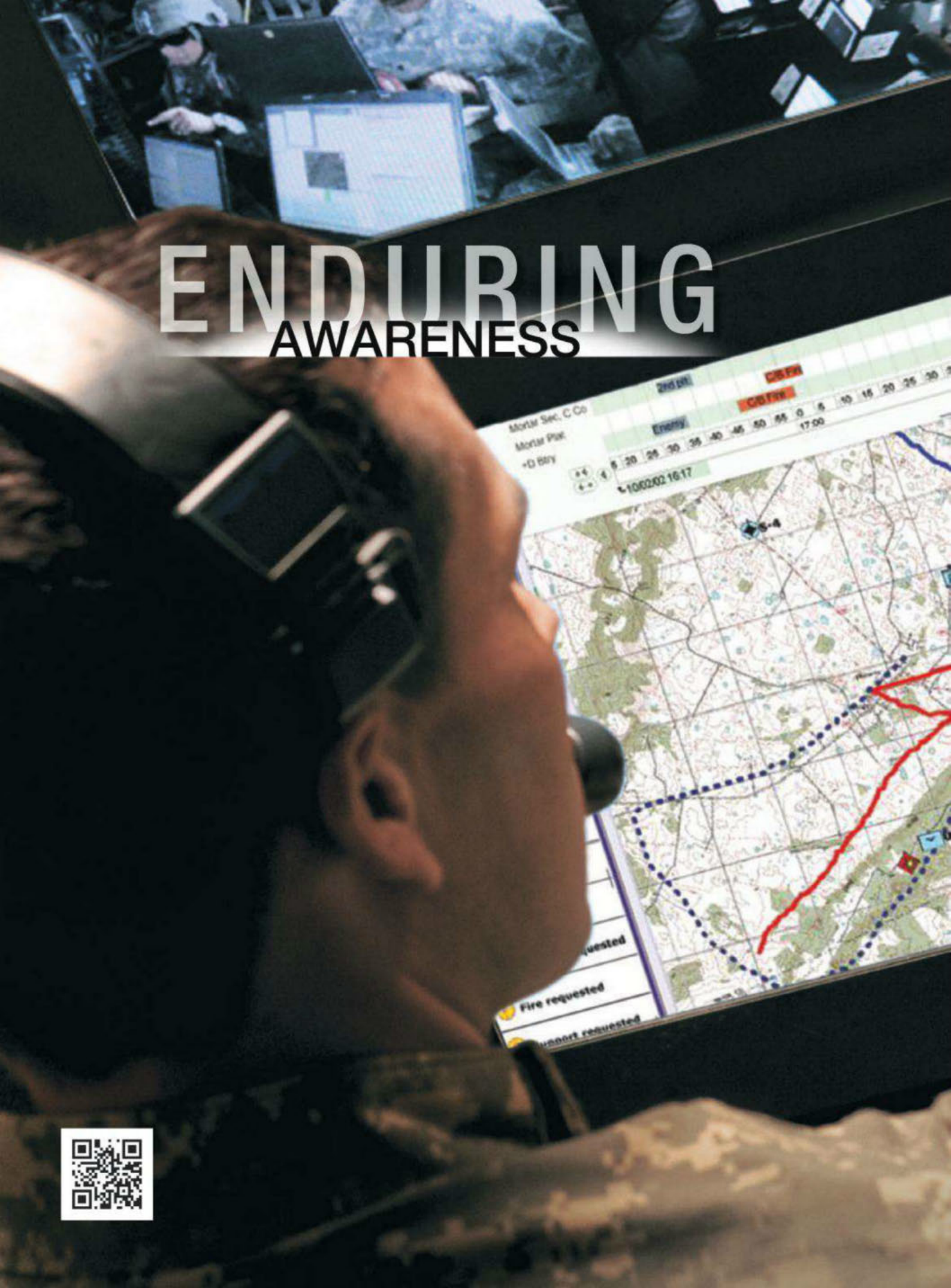
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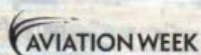


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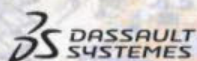
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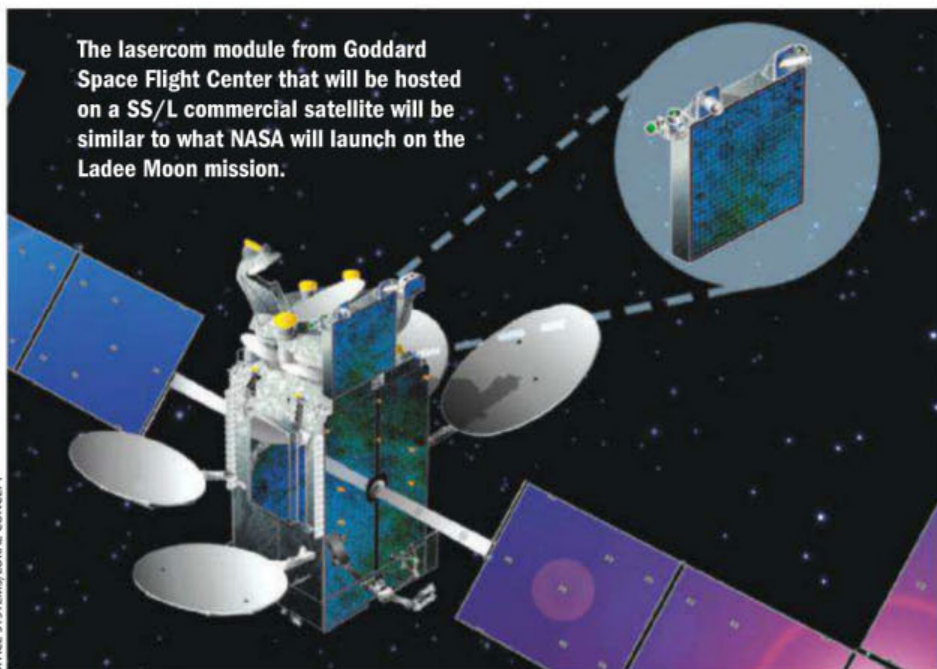
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Laser Onboard

NASA turns to SS/L as host for optical communications payload

MICHAEL MECHAM/SAN FRANCISCO and AMY SVITAK/PARIS



A hosted payload agreement between Space Systems/Loral and NASA's Goddard Space Flight Center offers the U.S. the chance to catch up with Europe's leadership in the use of optical systems, which hold the promise of faster data transmission for space communications and lower power demands.

Calling optical systems "the next era of space communications," Goddard has selected SS/L to host a laser communications (lasercom) payload on a 2016 commercial mission. The technology has two attractions—laser (also called optical) communications use an uncongested portion of the spectrum compared to radio frequencies, and promise orders of magnitude higher data transfer rates while requiring far lower transmitting power.

"We are excited to be a part of this mission, which is particularly interesting because of the great potential for laser communications to revolutionize space exploration as well as the commercial satellite industry," SS/L President John Celli says. SS/L was an early promoter of hosted payloads on commercial spacecraft, including the 2009 launch of the first commercial Internet Router in Space on Intelsat-14 and a ultra-high-

frequency payload for the Australian Defense Force on Optus-C1 in 2003. Hosted payloads are typically purchased by government agencies, but U.S. budgets for their use have lagged behind Europe's.

Goddard Program Manager Michael Weiss says SS/L was attractive because it can demonstrate the new technology on a commercial platform. Once proven, the technology may revolutionize communications systems, particularly in networks. "The use of optical communication technologies in a network environment will meet the growing needs of high data-rate user demands while also enabling lower mass and power for space and ground systems," he says.

But as promising as lasercom is for high-speed bandwidth and low power consumption, it is susceptible to signal interference from cloud cover and bad weather. So besides testing the electronics and optical transmitting quality of the Laser Communications Relay Demonstration (LCRD) payload that Goddard is preparing for the mission, NASA will be especially interested in how well the laser payload is able to maintain high data-rate linkages with ground stations.

Those transmissions will use alterna-

tive base stations from the normal mission control center that SS/L uses at its Palo Alto, Calif., headquarters. To address weather issues, Goddard expects to establish both a primary and secondary receiving station "where we know we have great weather conditions," says Weiss. One early candidate is the Table Mountain ground facility that the Jet Propulsion Laboratory operates for NASA at Wrightwood, Calif.

SS/L has not named which of its commercial geostationary (GEO) satellite customers will host the LCRD payload, but one of the company's signature 1300-series satellites will be used.

Goddard expects to attach the LCRD instrumentation to a mounting plate for a plug-and-play installation, which is just what SS/L wants as it promotes hosting payloads to customers. The LCRD contract is \$32 million, with a first-phase critical design review cost of \$3 million.

Goddard is responsible for the instrument's high-speed electronics and will build the module. It will rely on commercially produced optics based on designs developed by Lincoln Laboratory at the Massachusetts Institute of Technology.

The project for SS/L will be derived from work Goddard and Lincoln Labs are doing for NASA's first high data-rate space lasercom demonstration, which will transmit from the Moon to Earth as part of the 2013 Lunar Atmosphere and Dust Environment Explorer (Ladee) mission.

The payload will include two shoebox-sized controllers for its optics, the optical head and electronics, housed in a toaster oven-sized module that will weigh about 385 lb., Weiss says. The payload has such low power demands—just 600 watts—that when NASA first gave SS/L its requirements, SS/L double-checked them, not believing they could be so low. SS/L's commercial customers frequently require up to 20 kw of end-of-life power.

The promise of lasercom has been recognized for years. In the 1990s, the Japanese space agency JAXA conducted in-orbit optical data transmission tests between satellites.

More recently, Europe has become the leader in this technology. While U.S. and European lasercom teams exchange technical data, the U.S. is pursuing different protocols, Weiss says.

Germany has led efforts to develop a European data relay satellite service utilizing laser terminals and hosting technology demonstrations and operational payloads aboard new civil and military spacecraft. Tesat-Spacecom of Backnang,

Germany, an EADS-Astrium subsidiary, has tested inter-satellite links with low-Earth-orbiting (LEO) spacecraft using Germany's TerraSAR-X radar satellite and the U.S. Missile Defense Agency's 2007 Near Field Infrared Experiment (Nfire) mission.

More recently, Tesat has sold lasercom terminals to the European Space Agency (ESA) as part of the European Data Relay Satellite (EDRS) system. Designed to operate in geostationary orbit (GEO), the satellites would relay data from LEO observation spacecraft to ground stations via a laser optical link. The first EDRS payload will be launched aboard a commercial telecommunications satellite owned and operated by Eutelsat of Paris. The second EDRS payload will fly aboard a smaller satellite to be manufactured by OHB AG of Bremen, Germany, under a contract with Astrium Services.

In 2009 ESA signed an agreement with the German Aerospace Center DLR to fly the Laser Communication Terminal on the Sentinel-1A spacecraft being developed under the European Global Monitoring for Environment and Security (GMES) program. The deal calls for DLR to provide an in-kind contribution of the lasercom payload to allow sending data via EDRS to the ground in near-real time for emergency and security services.

In addition, Tesat is contributing the Optical Communication Payload to the GMES Sentinel-2 mission. The instrument is designed to transmit vast data sets to the EDRS relay spacecraft.

The ocean-monitoring Sentinel-3 spacecraft will carry a lasercom payload, dubbed the Laser Retro-Reflector. The device, which uses an array of mirrors as a target for laser tracking measurements from the ground, will allow controllers to determine the satellite's position in orbit.

Tesat also is providing a 2-gbps optical LEO-to-GEO link to fly as a technology demonstration on Inmarsat's Alphasat 1-XL spacecraft slated for launch early next year. The technology will be verified in orbit aboard Europe's new Alphasat platform, jointly built by Astrium and Thales Alenia Space, as part of an experimental broadband data relay system transmitting a 300-mbps user data stream from Tandem-X, a German Earth-observation LEO satellite, to the ground.

In addition to optical LEO-to-GEO links, the laser communication terminal will also be used for optical bi-directional GEO-Alphasat links, optical aircraft-to-GEO links and optical Alphasat-to-ground links. ☼

French aerospace and defense companies saw a 17% rise in orders booked in 2011 for a total of €53.9 billion, driven in part by sales of the Airbus A320NEO.



Riding High

Despite defense cutbacks, 2011 was a banner year for French aerospace

AMY SVITAK/PARIS

In a generally difficult economic climate, France's aerospace and defense equipment industry is coming off an excellent year in 2011, with a healthy backlog and a particularly strong performance in global export markets. The growth more than compensates for declining French defense equipment budgets, having helped mitigate the negative impact of Europe's financial crisis on the country's economy, and augurs well for both prime contractors and suppliers in 2012.

Even in the defense equipment sector, which ended 2011 with a somewhat lackluster performance relative to French civil aviation, the rise of emerging markets is taking up the slack left by shrinking defense budgets in the West, with orders increasing at double-digit percentage rates in other parts of the world.

Competing for those same orders—both civil and defense-related—is the U.S., whose export sales rose by about 12% in 2011 following two consecutive years of declines. And civil exports, not military-related equipment and services, were responsible for most of that increase. Unlike France, U.S. aerospace companies are unlikely to offset the expected downturn in domestic defense spending through military-related sales to other countries.

Jean-Paul Herteman, CEO of aero-engine maker Safran Group, says even with the U.S. slipping from 55% to 45% of the global market, defense equipment revenue worldwide has been on the rise, more than offsetting declines

in France and the rest of Europe, and to some extent in the U.S. as well.

"This is the next phase of globalization," says Herteman, who serves as president of the industry advocacy organization Gifas, which represents close to 300 aeronautics and space companies in France.

While military revenues for French companies in this sector increased by just 2.6% last year, with orders dropping 26%, civil aerospace revenue, driven by the civil aviation market for both large and mid-sized aircraft, increased by 4.6% in 2011.

Overall, Gifas companies saw a 17% increase in orders booked in 2011 for a total of €53.9 billion (\$71 billion), driven by new programs including the next-generation Airbus A320NEO, the Leap engine and the ATR regional transport aircraft. As of Dec. 31, 2011, the French aerospace industry's backlog was equivalent to four years of production at current capacity rates.

"This volume of orders shows the continued strength of this industry," Herteman says. The new level of backlog, which is higher than revenues last year, is testimony to a durable improvement in the situation for equipment manufacturers, Herteman adds.

Even accounting for possible order cancellations, 2011 bookings showed that the civil aerospace industry in France is in excellent health.

"To continue to play this role as a pillar of the French economy, we will be leaning on a significant order backlog, and on our strategy of reinforcing

the competitiveness of the industry," says Herteman, who credits the sector's strong 2011 performance to long-term investments with an emphasis on research and development.

"The 2011 results confirm the sector's recovery that began in 2010," he says. "Turnover grew by 3.3%, at €38.5 billion, with still a very high share in the export sector at €23.5 billion, led by the civil sector that represents 72% of overall activity."

Olivier Zarrouati, president of Zo-

diac Aerospace, says the downside is that the four-year backlog for aircraft manufacturers is not expected to grow.

French equipment suppliers were the star performers of the aerospace sector in 2011 with revenue up 13.8% to €11.4 billion and a 20.5% increase in new orders to €14.3 billion. Of those, €6.3 billion were for exports, a sign of the health of this industry, which is vital to the performance of France's prime contractors. Of that €14.3 billion in orders, 87% was attributed to the civil market.

Other areas fared less well—notably space, which was flat at €4 billion, Herteman says, though commercial space accounted for 60% of sales last year.

Herteman emphasized the fact that the aerospace business leads France as one of its best-performing industries in terms of exports, generating a trade surplus of €17.7 billion last year, and 77% of total revenue among Gifas member companies was drawn from export orders in an industry that employs 70% of its workforce on French soil. ☐

Training Games

L-3 purchase of Thales simulation unit consolidates industry

GRAHAM WARWICK/WASHINGTON

Corporate raider Paul Bilzerian may have ended up in prison after his takeover and break-up of diversified manufacturer Singer in the late 1980s, but he set in motion a chain of events that shaped and reshaped the flight-simulation market—and which may only now be reaching their conclusion.

Always technology-driven and highly competitive, the simulation industry has been wracked by waves of consolidation that have seen the some players change hands several times.

In the latest development, military simulation market leader L-3 Communications is to acquire Thales's civil aviation training business, bringing together two entities that had their origins

Thales is building an Airbus A380 full-flight simulator for British Airways.

in the company formed by flight-simulator inventor Edwin Link and once part of Singer. The deal will bring the military and commercial flight simulation markets together under two major players: L-3 Link Simulation & Training and Canada's CAE.

The purchase price of £82 million (\$132 million) includes Thales's civil simulation business headquartered in Crawley, England, employing 400 people, as well as the Asian ATR Training Center in Bangkok. Pending regulatory approval, the deal is expected to close this summer, with Thales Training & Simulation becoming part of L-3 Link and expanding the Arlington, Texas-based company into the civil market.

Thales's U.K.-based military fixed-wing and France-based civil and military rotary-wing simulation and training businesses are not included in the deal. L-3 will continue to supply civil-simulator components required by Thales's military business, which includes providing the training system for Airbus A330-based Voyager aerial-refueling tankers operated for the Royal Air Force, the first of which entered service this month.

Thales is a distant second in terms of annual simulator sales to civil market leader CAE, which claims a 70% market share, selling 37 full-flight simulators in the financial year ended March 31. Thales has focused principally on Airbus aircraft, including

the A320, A380 and now A35, as well as the Boeing 787. Recent Thales sales include an A380 full-flight simulator to British Airways, for delivery in 2013. The Bangkok ATR center has been expanded with addition of an A320 simulator, and Thales is also the supplier of training devices for the Sukhoi Superjet 100.

Singer's Link Flight Simulation division was first acquired by CAE in 1988. In the same year, U.K.-based Rediffusion Simulation was bought by Hughes Aircraft, which went on to purchase Link from CAE in 1995. But in 1998, Hughes's defense electronics business was sold to Raytheon, which two years later sold the training and simulation business to L-3. Meanwhile, Paris-based Thomson-CSF acquired U.K.-based simulator manufacturer Link-Miles from the bankrupt remains of Singer in 1990. The French electronics giant acquired Rediffusion from Hughes in 1994, merging it with Link-Miles to form Thomson (later Thales) Training & Simulation.



THALES UK

While the established players in the commercial market have been consolidating, new competitors have emerged, including Montreal-based Mechtronix and Netherlands-based Sim-Industries, which was acquired by defense giant Lockheed Martin in November. FlightSafety International is a major manufacturer of commercial flight simulators, but only for its own use. Avionics maker Rockwell Collins bought into the market in 2003, but has seen little success in selling civil simulators.

Past convulsions in this industry were caused by military manufacturers seeking to diversify into commercial markets during defense downturns, only to find they were ill-suited to succeeding in the airline world. Only CAE has stuck to its knitting, focusing on the simulation business and expanding into training services as its rivals changed hands. Now another defense contraction is under way, but this time the civil market will be held by two players for whom simulation is their primary business. ☐

Tug Of War

Industry pushes for bigger role in Air Force sustainment, warns of 'train wreck'

BILL SWEETMAN/DALLAS

The simmering war between major primes, mid-sized contractors and government depots over the management and execution of military aviation support appears to be heating up.

A September 2011 report by a National Academy of Sciences (NAS) panel called for major changes in Air Force management of sustainment, including stronger management, consistent metrics (which are currently absent) and a total overhaul of its parts supply system. Some witnesses warned of a "sustainment train wreck" in the near future as an aging and diverse fleet puts steadily increasing demands on an inefficient system, at the same time as new and complex Joint Strike Fighters start to join the force in large numbers. Aviation Week's MRO Military conference, held here earlier this month, highlighted the urgency of the issue and the tensions among some of the players—even though all realize they will have to work together to resolve pressing problems.

Primes are touting their ability to provide efficient performance-based logistics (PBL) systems, analogous to the "power-by-the-hour" deals now standard in the commercial world, and believe that military and political opposition to PBLs has weakened. "The need for affordability means that PBLs are back in vogue," says Rod Skotty, president of Maritime Helicopter Support Co. (MHSCo.), a Lockheed Martin/Sikorsky joint venture that provides PBL services to the U.S. Navy's H-60 helicopter fleet.

Lockheed Martin has hired the co-leader of the NAS report team, Lt. Gen (ret.) Mike Zettler, to lead and promote the largest PBL in the military world, the F-35 Joint Strike Fighter's Automated Logistics Information System (ALIS).

ALIS is key to the JSF program's plans to bring down cost per flight-hour, which the latest Pentagon selected acquisition report estimates at 42% more



Industry thinks it can do a better job of getting parts to the line maintainers than the government does today.

than for the USAF's current F-16C/D—versus 20% less as advertised as recently as 2008. "We can deliver performance outcomes at less cost than legacy if we are allowed to execute our program of record," Zettler told the conference.

Issues in PBLs include whether contracts should be fixed-price or cost-plus. The former allows for more stable budgeting but the customer has to accept that the contractor may reap large profits by driving costs down. One executive at a prime recalls being told by a service contracting officer that profit constituted waste. "I said, 'Thank you, comrade,'" he told the meeting.

Examples can be found on both sides. Northrop Grumman provides support to the E-8C Joint Stars fleet through a 20-year cost-plus contract that started in 2000. The company's fee is based on performance, measured through custom-built software called Wiscrs (Web-Based Incentive Strategy Collection and Reporting System). Conversely, MHSCo is operating on five-year contracts with a firm, fixed price per flight-hour, and

Skotty calls such arrangements "essential" for PBL. MHSCo. reduced its cost per flight-hour by 17% in its second contract term, which started in December 2010, despite the fact that the incoming MH-60R/S versions are more costly than the aircraft they replace.

Another argument is over data rights and transparency. MHSCo. has been asked to report its costs when it negotiates its next contract, and has agreed to do so subject to a stipulation that the data not be used to cap or claw back profits as the basis for a renegotiation.

Primes and MRO contractors argue for long-term contracts that support investment in tooling and allow processes and the supply chain to be made more efficient year-over-year, although customers may worry that such contracts reduce competitive pressures on the prime.

Lower-tier suppliers fret that prime-led PBLs such as ALIS leave the prime with enormous power and incentives to generate competition at their level. "We see the platform guys squeezing costs, without regard to suppliers," comments Scott Gunnufson, Rockwell Collins vice president for service solutions.

Standard Aero's vice president for defense marketing, Dan Gonzales, notes a push to shorten contract terms. However, he says, "we have realized that the way to get costs out is a systems approach to whatever we are working on, optimizing the value chain and the entire facility." This takes time, but he claims that Standard's T56 engines last twice as long between removals as those of competitors.

At the same time, current law mandates that 50% of maintenance funding be provided to depots, although the exact metrics are not clear. Mid-level military MRO contractors are complaining, however, that government depots not only provide more job stability and greater benefits than they can afford, but pay higher salaries, too—a factor that further increases political pressure to sustain the depots.

Depots are also criticized for work practices, which are not standardized. "A lot of us have knots on our heads from banging our heads against the wall, challenging the use of new parts on engines that are 20 years old when there are alternatives available at a 70-80% discount," says Don Wetekam, AAR Corp. senior vice president of defense business development. ☐



Boeing is expected to unveil new 737 MAX wingtip and aft-fuselage details before the Farnborough air show.

Fine-Tuning

MAX design team considers wingtip options as new 737 design firms up

GUY NORRIS/LOS ANGELES

Boeing's goal with the newest version of the 737 has always been to keep change to a minimum; but as the company closes on the final design, it appears more substantial upgrades are in the works to meet performance targets.

The company says it will adopt an 8-in. nose-gear extension to provide adequate ground clearance for the CFM Leap-1B engine. The decision backs up earlier disclosures that Boeing and CFM are considering increasing the fan diameter to 69 in. when the 737 MAX's firm configuration is completed around mid-2013. The larger fan is close to the top end of the 65-70-in. range the companies sketched out when the project was announced last year (*AW&ST* April 2, p. 28).

MAX will be fitted with fly-by-wire spoilers, an option first studied for the 737 Next Generation Plus—a proposed interim step between the current model and a clean-sheet New Small Airplane—which was subsequently abandoned. Boeing says the fly-by-wire spoiler system, which dates to the 1980s on the 757/767, will be used primarily for weight savings. However, the newer system is less mechanically complex, so it is ex-

pected to reduce maintenance costs and provide potential load-alleviation benefits.

The aft-fuselage changes originally outlined by Boeing in August 2011 may also be more substantial than first suggested. The company says "the tail cone will be extended and the section above the elevator thickened to improve steadiness of airflow. This eliminates the need for vortex generators on the tail. These improvements will result in less drag, giving the airplane better performance."

The revision of the Section 47/48 tail cone to a lower-drag shape similar to the 787's is also expected to include the elimination of an aft-body join and changes to the aft pressure-relief port cavity to reduce drag. Boeing will not confirm these details but cautions that more changes will be visible when updated impressions of the MAX are released around the Farnborough air show in July. The current images "don't accurately reflect the full technical changes we've chosen for the airplane today," the company adds.

Regarding the latest updates, Beverly Wyse, 737 program vice president and

general manager, says: "We've made several design decisions that support the performance targets for the MAX and evolve the 737 NG's design within the scope of the 737 MAX program." Despite suggestions made by Airbus that Boeing's design falls short of the targets set for fuel burn, she insists that "the 737 MAX is on track to deliver substantial fuel savings to customers starting in 2017."

Boeing notes that the Leap engine will be integrated with the wing in a way that is similar to the aerodynamic lines of the 787. This adds to speculation that the MAX will incorporate a natural laminar-flow nacelle that mimics the low-drag shape of the 787's engines. To help with ground clearance, the engine will be hung on a redesigned strut with new fairings, and will incorporate a one-piece acoustic liner. Boeing's original concept drawings also indicate low-noise chevrons on the fan duct, though for now it is not believed the configuration includes chevrons on the primary duct.

Reiterating some system decisions revealed earlier this month by Boeing Commercial Airplanes' business strategist, Vice President Mike Bair, the company says the MAX also will feature an electronic bleed-air system. It will allow for "increased optimization of the cabin pressurization and ice-protection systems, resulting in better fuel burn."

Structural changes, described as "minor," involve strengthening the main landing gear, wing and fuselage (at Section 11), flaps, flap fairings and spoilers to accommodate an increase in loads from the larger engines. Boeing says it

will “continue to conduct aerodynamic, engine and airplane trade studies as the team works to optimize the design of the airplane by mid-2013.”

One major unknown remains the configuration of the MAX’s wingtips. They were originally sketched as strengthened versions of the blended winglet

design from Aviation Partners Boeing and were sized to match the 117-ft. 5-in. span of existing models. Boeing now says a “possible revision to the wingtips on the MAX also is being tested in the wind tunnel to see if this new technology could further benefit the airplane.” The company is not offering further details,

but says the option will be “more advanced” than the existing design or the raked-tip treatment of the P-8A Poseidon variant developed for the U.S. Navy.

The first aircraft is due to enter service with Southwest Airlines in 2017, though Boeing continues to hint that this may be moved up to 2016. ☐

Order Outlook

Boeing maintains its 2012 order and delivery edge over Airbus

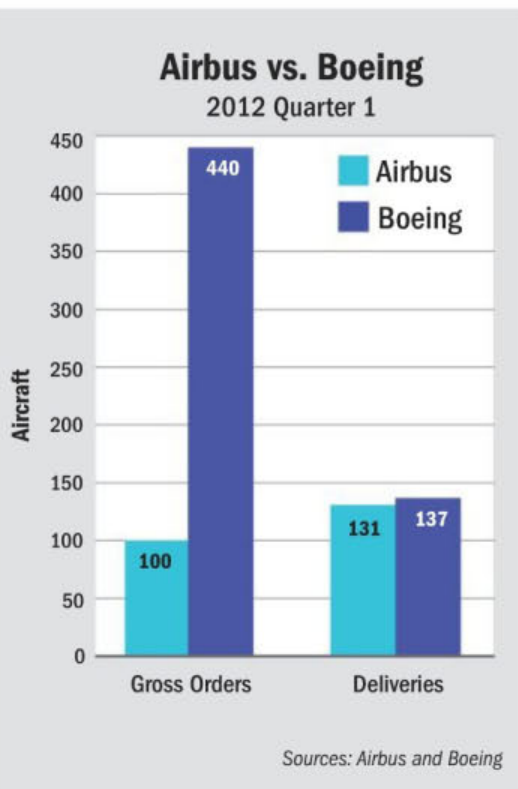
ROBERT WALL/LONDON

Airbus and Boeing face a common problem, with so much interest in their new narrowbodies, the A320NEO and 737 MAX—how to fill production gaps as existing products are replaced.

Analysts have warned that the transition period will be a challenge for the two manufacturers as they try to maintain a smooth production flow from the current product to the new one. The companies are playing down the significance of the issue. With the orders booked so far, the global airline market has a need for 1,000 more narrowbodies through 2016, says David Prevor, head of market research and forecasts at Airbus. The NEO will not be fielded until 2015 if the current schedule holds, and the MAX comes later—so that outstanding demand could represent additional orders of the existing configurations.

In the meantime, Airbus and Boeing are on track to garner strong intakes this year, ensuring that new orders outpace deliveries. With Airbus coming off a record 2011, Boeing is maintaining its momentum to outsell its rival in 2012.

Last month, Airbus reported four cancellations that bring first-quarter activity to 100 gross orders through March 31 and 90 net orders. Although orders have slowed from the final months of 2011, Airbus remains ahead in new bookings compared with last year, when it set an order record for the full year.



In contrast, Boeing booked 440 gross orders, with 28 cancellations, bringing its total intake to 412 units.

Last month’s cancellation activity at Airbus was dominated by four A330-200Fs from Intrepid Aviation. The U.S. lessor still has 15 aircraft on the books and also added a passenger A330-200 and -300, offsetting some of the -200F cancellations.

The order withdrawals include one A318 Elite private jet, but Airbus also booked a new Elite request, keeping the total orderbook at 80 units with 76 delivered.

New orders last month included an A330-200 and -300 from Air Lease Corp. The aircraft maker also received a boost last week when Garuda Indonesia placed a top-up order for A330-300s, adding 11 aircraft to its orderbook. The airline now has three A330-200 and 18 -300 deliveries still outstanding; the aircraft are slated to be delivered through 2017. Garuda also plans to order A330-200Fs.

Boeing holds an edge in deliveries over Airbus, although the U.S. manufacturer is slightly behind the expected pace for the year, in part because the first 747-8I for Lufthansa is still caught up in handover negotiations with the German airline.

Airbus deliveries in the first quarter reached 131 aircraft, ahead of 119 last year; Boeing completed 137 in the first three months.

Delivery consistency remains an issue for both companies. The road map appears tentative, particularly when it comes to their flagship programs, the A380 and 787. The situation has left British Airways, which is due to receive the first of each aircraft next year, uncertain which will come first. Similarly, BA officials say they do not know how many of each aircraft will be handed over in 2013.

Even so, British Airways still expects to field all 12 A380s on order between 2013 and 2015.

One issue for Airbus remains how it deals with fixing problems with a wing component that cracks under fatigue because of a production flaw. While temporary solutions have been identified for in-service aircraft, still unclear is how aircraft will be handled for which the wing has been assembled but that have not yet been delivered. The company says it is “in discussion with our individual customers on the best ways to manage the A380 fleets prior to availability of the final fix.”

For now, however, Airbus is sticking by its target of delivering at least 30 A380s this year. ☐

No Rush

Embraer studies engine options for upgraded E-Jets but may not decide until next year

JOSEPH C. ANSELMO/WASHINGTON and GUY NORRIS/LOS ANGELES

Embraer may wait until 2013 to select a new engine for its family of E-Jets as it talks with airlines about what upgrades are needed to keep the aircraft competitive.

President and CEO Frederico Fleury Curado says the Brazilian airframer is studying a range of options for the E-170/175 and E-190/195 jets, including a next-generation engine, whether to offer three or four variants, and what improvements should be made beyond the new engines. But he says the company is "some time away from having a frozen configuration."

Among the changes being looked at are an all-new wing and extended landing gear that would provide room for larger, higher-bypass turbofans aimed at providing fuel-burn improvements of 10% over current models. Other potential enhancements include blended winglets and an electric taxiing system.

"My guess is, the bulk of what is going to be the next generation of E-Jets would be [decided] more toward next year than this year," Curado said in a meeting with journalists in Washington. The existing E-Jets—which are designed to serve the 70-120-seat airline market—are selling well and have solid backlogs, he adds, noting that "the 190 was certified just six years ago."

Whatever upgrades are made will be tailored to meet the needs of Embraer's customers, Curado declares. "It's identifying exactly what the customers want," he says. "Those things are not as clear as one might think. You have to compute and translate that into airplane specs."

The biggest change clearly will be to outfit the E-Jets with next-generation engines. Embraer has a long-standing relationship with General Electric (GE), which provides the CF34-8 for the E-170/175 and CF34-10 for the E-190/195 and is developing a new centerline regional jet engine dubbed NG34. But Pratt & Whitney says it could offer almost a two-year time advantage to Embraer if the airframer selects a variant of the PW1000G geared turbofan, versions of which are being offered on the Airbus A320NEO, Bombardier CSeries, Mitsubishi Regional Jet (MRJ) and Irkut MS-21. Rolls-Royce is also interested in offering an E-Jet powerplant.

"The competition is tough," says Bob Saia, vice president for Pratt & Whitney's Next Generation Product Family. "But GE has got a long way to go to get a product installed, and we've shortened the envelope. We are in test and have the benefit of being able to make enhancements."

Asked what it would take for Embraer to leave GE, Curado stresses that the company is seeking not only more efficient fuel consumption but also reduced maintenance costs and solid reliability. "GE is a great partner, [but] we have to be open-minded about what is the best engine for the aircraft," he says. "It's the core feature of the aircraft."

Saia says Embraer's timing is optimal because Pratt will be done with the engines for the MRJ and CSeries and well into testing on the powerplants for the MRJ and MS-21. But he cautions that Pratt will not attempt to underbid to secure the E-Jets as a platform. "We are going to be good stewards of the business and not just buying market share," he says.

The new family of E-Jets will not push up into the market segment long dominated by the Boeing 737 and Airbus A320 families. The Brazilian airframer had considered launching a new family of jets to enter that space, but abandoned the idea last November in favor of developing a second generation of E-Jets. "That was a difficult decision for us," Curado acknowledges. "I think it was the first time that I decided not to do something. . . . But we really do not see a business case for us, or for that sake anybody else."

"Down the road everything is possible," he adds. "Technology changes, the competitive landscape changes. But I don't see that in the short term." ☐

Embraer says customers, not engineers, will drive requirements for upgrades on its E-Jets.





EgyptAir has six 777-300ERS and is now working to phase out its three Airbus A340-200s and four 777-200s.

EGYPTAIR

Bounce Back

EgyptAir is rebuilding its business following last year's political turmoil

LEITHEN FRANCIS/TAIPEI, TAIWAN

For EgyptAir, it will be crucial that the country's June presidential elections bring greater political stability if the airline is to have any hope of seeing passenger traffic returning to normal.

The Star Alliance carrier has been through a tumultuous 14 months following the civil unrest and violence that toppled the nearly 30-year regime of President Hosni Mubarak. Then in August, Libyan leader Moammar Gadhafi was toppled from power.

During three weeks in March last year, EgyptAir mounted more than 200 flights to Libya in which it evacuated 85,000 people, says Corporate Communications Director Mohamed Rahma. The busiest day, March 28, saw 45 flights, he adds.

It normally takes about 2 hr. to fly from Cairo to Tripoli, but during this period it took twice as long because the NATO-imposed no-fly zone left only a few air corridors for commercial aircraft, says Rahma. These corridors went from the north, near Greek airspace, to Libya's capital. There was no airspace open between Egypt and Libya, he says.

Some of the evacuation flights used EgyptAir's four Boeing 777-200s, a type the carrier wants to phase out as soon as possible, says Rahma. Two have already

been grounded and the other two are on standby for charters, he says. The airline no longer needs the -200s because, from March 2010 to April 2011, it received six -300ERS on lease from GE Capital Aviation Services. Since August 2010 it also added four Airbus A330-300s to its fleet.

EgyptAir's three A340-200s, meanwhile, are also being phased out, says CEO Hossam Kamal, who spoke to Aviation Week on the sidelines of a Star Alliance event in Taipei late last month to welcome EVA Air's future membership. Kamal, who has been with the carrier for 29 years, was promoted to CEO from deputy in December, just weeks after the country's free parliamentary elections. Under Mubarak, the CEO position at the national carrier was reserved for the military. Mubarak is a former air chief marshal. Hussein Massoud, the previous CEO and chairman of EgyptAir, was in the air force for 22 years. Kamal, meanwhile, is a former commercial pilot who still flies a 777 once a month to keep his type-rating.

Kamal says EgyptAir's passenger load factor, prior to last year's political uprising, was 72-75% and now it is 67-69%. EgyptAir had 10.2 million passengers in 2010, but last year it fell to 8.5 million, says Kamal. This year the target

is 12 million passengers, he adds. "We hope that after the presidential elections in June and by the end of this year, traffic will be back to normal," he says. EgyptAir remains in the black, but profits are down 75% year-on-year, he adds.

EgyptAir was planning to launch services to Toronto and Washington in June, but has delayed this to June 2013. In the near term at least, the carrier appears to be focusing its route expansion on Africa. It launched a service in August 2010 to Juba, South Sudan, a nation that only came into being last July. Passenger loads have been so strong that service was recently increased to daily, says Rahma. EgyptAir serves 17 airports in Africa and another 10 through codeshares. It is considering also serving Abidjan, the former capital of Ivory Coast, and Kigali, Rwanda's capital, he says.

EgyptAir, meanwhile, is in negotiations with Ethiopian Airlines about establishing a hub or joint venture in the West African city of Accra, Ghana, says Kamal. EgyptAir has said this before, but Kamal asserts: "Negotiations got serious in February. The chairman of each airline is due to meet in April for further [talks] and then after that we can announce something."

As for its fleet, the airline is also working to revive the renewal program that was put on hold because of regional unrest. Kamal says executives are evaluating Airbus A350s and Boeing 787s, but he adds that EgyptAir is in no hurry to decide because the average age of its fleet is 5-7 years. However, he concedes that the airline will need to replace its 777-300ERS and A330s in the 2020-25 period. It still has one A330-300 on order for delivery in 2014. There are also two Boeing 737-800s on order for delivery in July and August.

Some of the carrier's oldest aircraft include a batch of eight A320s it received in the early 1990s. Airbus is due to present a proposal in April on replacements for these, says Kamal, adding that EgyptAir plans to acquire 13-15. There is a batch of A320s it received nine years ago, but EgyptAir wants to retain these, he adds.

The CEO also is interested in Boeing's efforts to develop the 777-8X and -9X. He says he would like the new 777 to have more passenger capacity and lower fuel-burn and carbon emissions. Boeing is promising the -9X will be a long-range aircraft with passenger capacity of 420, he notes. ☉

Settling Slowly

Commercial, business aircraft makers await North African recovery

ROBERT WALL/MARRAKECH, MOROCCO

When pictures emerged last year showing Afriqiyah Airways aircraft destroyed in fighting in Libya, it was emblematic of the enormous toll that the war exacted on the region's air transport sector.

A year later, industry officials at the Marrakech air show tell Aviation Week that they are starting to see signs of the market settling and the groundwork being laid for new orders. Deals themselves may still be months off, but the relatively quick turnaround is nonetheless striking even as carriers are also struggling with high fuel prices.

"We are reasonably optimistic," declares Mathieu Duquesnoy, Embraer vice president for the Middle East and African airline market. That view is echoed by the company's Canadian rival. "We are seeing more movement in North Africa," says Raphael Haddad, vice president for Middle East and Africa sales for Bombardier Commercial Aircraft.

"Everyone is looking at Libya," says one Western aircraft salesman. However, continued turmoil there still needs to be sorted out for investors to regain confidence and the tourism sector to flourish.

But Libya also mirrors the difficulties faced by other nations in the region. Even as carriers try to return to normal, they must deal with a weakened infrastructure, including at a political level. Now Libyan airlines are banned from flying to European Union points.

The Libyan government imposed

the ban to avoid being formally placed on the EU aviation blacklist; doing so may make it easier to restore traffic. The EU, which recently issued its latest blacklist, says "serious concerns were identified regarding the safety oversight of air carriers licensed in Libya." A review of the status is due later this year, but for now the ban is in effect at least until Nov. 22.

Still, in the long term, Libya is seen as an attractive market. Airbus even considers it one of the North African countries where it believes it can place A380s; Egypt offers another opportunity, once its airline industry recovers (see p. 38).

Another sign that airlines are starting to focus on the future again is Royal Air Maroc's decision to launch a new strategic review to spell out its development goals once the current plan ends in 2016. The overview is to look at fleet requirements and network plans through 2025.

The airline was among those that was forced into structural changes as a result of declining tourist numbers owing to recent events. It phased out its Boeing 737-400/500s and decided to focus on three models: its 737NGs, ATR 72-600s, and 767s (to be replaced by 787s). The airline currently has 34 737NGs and will receive seven more through 2015; two ATR 72-600s are fielded, and two more are slated to arrive in June to replace the -200s, with two more to come later. The company is guarded about a new

fielding date for four 787s (it also has an option), but they are to arrive once the 767 leases expire.

However, in many cases, some restructuring still needs to be completed by airlines before they go back to ordering aircraft, says Fouad Attar, Airbus deputy president for the Middle East. The company's market projection for the region nonetheless still sees demand for 575 new passenger aircraft and 12 new freighters through 2030—the bulk, 439, in the single-aisle segment. The foundations of the recovery are there, with traffic growing and airlines feeling confident enough to again add capacity, suggests David Prevor, head of Airbus market forecast and research.

In anticipation of an upturn, Embraer this year is poised to begin building up its regional support center for the 170/190 regional jet family, according to Duquesnoy.

On the business aviation side, the so-called Arab Spring "put everything on hold," says Jim Evans, chairman and CEO of Cessna distributor Africair. But, he adds, there is "pent-up demand," although in many places such as Libya "the change process is not yet completed." The company made no deliveries in 2011, and while no deposits have been taken this year, Evans is encouraged by the fact that there are several deals close to completion.

For business aircraft manufacturers, the biggest hit occurred in Egypt, a major market. When an uptick will occur is not yet clear, but Gilles Goutier, Dassault vice president for international sales, asserts that it will likely gather steam quickly once it does emerge. ☉



Afriqiyah Airways is seen as a potential driver of North African growth, although the aftermath of the Libyan war and concerns with the country's air safety are near-term barriers.

ARBUS

Changing Game

Commercial cargo and crew developments are starting to affect larger launch market

FRANK MORRING, JR./WASHINGTON

It's still a "Field of Dreams" proposition—"if you build it, they will come." Even so, NASA's as-yet-unrealized efforts to offload routine human space access onto the private sector is beginning to ripple across the U.S. launch industry in ways that could go well beyond transporting people and their stuff into space.

Brash entrepreneurs like Elon Musk, who openly declares his intention to take over the worldwide launch industry with lower-cost launchers than the competition's, are exerting downward price pressure on traditional launch-vehicle manufacturers. And the possibility of an off-planet economy in low Earth orbit (LEO) has triggered a new round of innovative launcher designs, not all of them "paper rockets" and some of them quite different from traditional vehicles.

"We've selected the Atlas V for our test flights through the Commercial Crew Program," says John Mulholland, vice president and manager of Commercial Programs for Boeing Space Exploration. "But we will continue to maintain our design to be compatible with multiple launch vehicles so that we can competitively procure launch vehicles in the future, which is important for us to maintain best value, obviously. The launch vehicle is such a huge portion of our offer."

Mulholland's group has just completed the preliminary design review on the CST-100, Boeing's entry into the NASA-run commercial crew development competition. Two other teams have baselined the Atlas V to launch their space taxis, but Atlas-builder United Launch Alliance (ULA) is not resting on its laurels. The Boeing/Lockheed Martin joint venture is scrambling to cut costs of its Atlas V and Delta IV launcher lines to meet the anticipated competition from Musk and other startups, while stressing the demonstrated reliability of their products and working to improve them (see p. 44).

And as ULA goes after the nascent human space-flight market with the Atlas V it uses to launch big government satellites and space probes, new entrants in the commercial cargo and crew game are not pinning their hopes on the human market alone. If a launcher is reliable enough to send astronauts



Atlas V lifts off with the first Mobile User Objective System, a military communications satellite. Ultimately, Atlas will face competition from new players.

UNITED LAUNCH ALLIANCE

aloft, the argument goes, it certainly is reliable enough to handle high-value satellites and other spacecraft, and perhaps open up new space businesses such as satellite servicing and orbital tourism.

If it all works out—and that remains a pretty large “if”—NASA’s commercial approach to carrying astronauts to low Earth orbit could lower the cost of space access to the point that the business cases for new LEO applications can close.

Beginning with the Commercial Orbital Transportation Services (COTS) program initiated by then-Administrator Michael Griffin, NASA has invested about \$925 million of taxpayer seed money to help create a private human spaceflight industry. That money has attracted significant private investment, and the agency is optimistic that this can generate one or more new ways to get humans and cargo to the International Space Station (ISS) for less money than traditional government procurements.

The COTS program could start to pay off as early as next month, provided Musk’s Space Exploration Technologies Inc. (SpaceX) succeeds in getting its next Dragon capsule off the ground with its Falcon 9 rocket and berthed at the ISS for the first time, carrying 1,000 lb. of food and other relatively low-value cargo. Orbital Sciences Corp., NASA’s other COTS partner, also hopes to reach the station this year with its Cygnus cargo vehicle riding the company’s new Antares liquid-fueled launcher.

That could be just the beginning. With the space shuttle fleet retired, NASA is paying Russia more than \$60 million a seat to train and fly astronauts to the ISS in Soyuz capsules. Starting with \$50 million in federal economic stimulus package funding in fiscal 2009, NASA has been seeding development of commercial space taxis under its Commercial Crew Development (CCDev) and Commercial Crew Integrated Capability (CCiCap) initiatives.

The latter has attracted several different proposals for full-scale systems that would ferry ISS crews to orbit beginning as early as 2017. Funding commercial crew is contentious in Washington, and the first human flights already have been delayed a year because Congress does not want NASA to put all of its eggs in the commercial crew basket (*AW&ST* Dec. 19, 2011, p. 20).

At the heart of the commercial crew thrust is a change in the basic approach to spaceflight safety. Instead of costly efforts to install launch system redun-

dancy for fail-safe reliability, the new commercial crew vehicles will rely on sophisticated escape systems to safely get away from a failing rocket.

That requires quick-response health-monitoring software in the rocket to trigger an abort. And it is driving development of cost-saving escape-propulsion systems that—unlike the escape towers NASA used in the 1960s—retain their propellant after a successful launch for orbital maneuvering. ULA won \$6.7 million in the first round of CCDev awards to start developing an emergency detection system (EDS) for the Atlas V. And the company has continued testing and qualification on its own dime, in partner-

ship with NASA, via an unfunded Space Act agreement.

“There will be a certain category of failures where you’re not going to want to have any men in the loop at all,” says George Sowers, ULA’s vice president of business development and advanced programs. “Failure is so imminent and the consequences are so fast that you just want the computer to make the decision and pop it off. Some warning light will come on and the astronauts will have time to clench their guts and away they go.”

Other failures may develop more slowly, giving range safety officers, the ULA launch control room and even the



Boeing began drop-testing the parachute-recovery system for its CST-100 this month, and believes it can close its business case on the battery-powered capsule with NASA-purchased crew flights to the ISS alone.



LAUNCH VEHICLES

crew itself time to decide whether to abort, based on information they will be receiving from the EDS. Essentially a software package, the system will draw on data from about 80 instruments already flying on the Atlas V—from engine rpms to tank pressure to acceleration rates and directions.

Even without the added layer of safety for crews that the EDS provides, reliability played a big role in the choice of Atlas V as a crew-launch vehicle by Blue Origin, Boeing and Sierra Nevada Corp. “They’ve had 29 launches on this version

funding is completed. NASA astronauts have been spending a lot of time in the company’s Hawthorne, Calif., plant familiarizing themselves with the Dragon capsule’s systems, which Musk expects their colleagues to be operating in space as early as next month. Company engineers have been working overtime to meet NASA’s stringent requirements for getting close enough to the ISS for the station crew to grapple the Dragon with a robotic arm, berth it and open it to the station environment (*AW&ST* Feb. 13, p. 27). The first flight will com-

(FAR) oversight when it comes to gaining NASA’s approval to fly humans.

“Eventually we will begin a certification effort that will look fairly conventional in terms of what NASA will do to ensure that we have a level of safety and mission assurance needed to fly to ISS,” says Brent Jett, a two-time shuttle commander who serves as deputy manager of NASA’s Commercial Crew Program.

That approach will extend to any improvements in crew vehicle designs or launch vehicle changes. SpaceX plans to change engines after its first three commercial cargo flights, and Musk has high hopes for lowering his costs and customer prices with first- and second-stage upgrades by the time he intends to begin flying crews.

SpaceX plans to use its Falcon 9 to deliver the first Dragon cargo capsule to ISS as early as next month, and hopes to send one or two more Dragons on full-up Commercial Resupply Service missions this year.

“We are aware that SpaceX does have an upgrade coming to the Falcon 9 that they intend to use for crew,” Jett says. “[I]f they win CCiCap, we would see in their certification plan . . . [just] how they would get comfortable certifying that vehicle. They’re going to tell us how they would certify it, and then we’ll balance that against how we would certify it, and be able to understand that delta of what we would be able to do under that certification contract [which is] going to come sometime in the future.”

This is an approach that will extend to all potential commercial crew transport providers. NASA is evaluating proposals it received last month under the CCiCap phase of the program, in which potential suppliers describe their overall systems, including launch vehicles, and tell NASA how they plan to meet its human-rating requirements. The agency hopes to award at least two Space Act agreements late in the summer, with a 21-month base period to push system design toward—if not past—critical design review, and to include “serious risk reduction,” with no promises after that.

“The whole idea there is we have a base period and then we have an optional period,” says Ed Mango, the Commercial Crew Program manager. “NASA will then decide if we want to continue on with the partners in that optional period, and that is at our discretion based on how they are performing during the base period, and also how we are doing



of the Atlas V, a 100% success rate, so for a crew transportation launch vehicle that was a clear choice for now,” says Boeing’s Mulholland.

Sowers says the EDS will improve Atlas V reliability for all of its payloads—manned and unmanned—because of the added insight into the rocket’s performance that it affords even without hardware upgrades. As part of its unfunded commercial crew work, ULA assessed how well Atlas V stacked up against NASA’s human-rating requirements.

“We’ve completed that, and we don’t believe there are any design modifications we have to do to the Atlas rocket to meet those requirements,” he says. “We’re not certified yet, and complete certification won’t come until the next phase of the commercial crew program, but we did that hand-in-hand with NASA, and we feel really good about the ability of the Atlas rocket—with the addition of the emergency detection system—to meet the NASA requirements.”

At SpaceX, Musk says, the company’s Falcon 9 rocket was built from the ground up to meet NASA’s human-rating requirements, and will be ready to carry crew to the ISS as soon as Dragon’s pusher-type abort system the company is developing with CCDev-2

bine two milestone missions to close out the company’s COTS work, and Musk says he hopes to fly at least two Commercial Resupply Services (CRS) missions before the end of this year if NASA needs the supplies they can carry.

The Dragon capsule is designed to take 6,000 kg (13,200 lb.) to the ISS and return 3,000 kg to Earth. Musk is quick to point out that the down-mass capability is not shared by its COTS competitor, Orbital Sciences. “Orbital gets almost twice as much as we do per flight, but they don’t bring anything back,” he says. “It’s about twice the value for half the money.”

Under its initial CRS contract, SpaceX will be paid \$1.6 billion for 12 cargo flights to the ISS, and Orbital \$1.9 billion for eight flights. The fixed-price, indefinite-delivery, indefinite-quantity contracts each have a maximum potential value of \$3.1 billion, although based on “known requirements,” NASA expects to spend a total of \$3.5 billion on the commercial cargo missions combined.

Ultimately, the Dragon capsule and its Falcon 9 launcher are intended to be human-rated. While the company is working under a Space Act agreement with its cargo variant, it will go to the more rigorous Federal Acquisition Regulations

at that point to deal with certification of a vehicle toward our requirements.”

Also in the mix with the SpaceX Dragon/Falcon 9 are the Atlas-launched vehicles under development by Boeing and Blue Origin, and a lifting body in development by Sierra Nevada. Blue Origins, a secretive operation bankrolled by Amazon.com founder Jeff Bezos, builds on hydrogen-fueled vertical-takeoff-and-landing technology that NASA studied in the 1990s.

The Sierra Nevada Dream Chaser is based on NASA's old HL-20 lifting-body test vehicle, and adds a pair of hybrid rocket motors burning nitrous oxide and hydroxyl-terminated polybutadiene (HTPB) fuel—basically a kind of rubber—for abort or in-space operations. Either way, it returns to a runway landing, and that makes it reusable even with the expendable Atlas V as its lift to space, according to Mark Sirangelo, Sierra Nevada's space systems chief.

“We expect to be less expensive than the cost of the Russians right now, per seat,” he says. “The other benefit in the Atlas is that if the two choices . . . made here are both Atlases, [the more Atlases produced], the lower . . . the cost.”

Particularly when combined with U.S. Air Force use of the Atlas V, the commercial crew business could lower the cost of access to LEO for all comers. But Mango stresses that competition is key, particularly early on. And that will be difficult, as Congress questions the expense of keeping at least potential operators in the running while NASA slows its internal SLS development (AW&ST March 12, p. 36).

“Our overall program approach is that we are going to need more than one company in this next phase, because we are not meeting, and I quote, ‘NASA's requirements,’ per se, so how do you get industry to try to get close,” says Mango. “You do that by having a competition. And that competition not only keeps the price down, but it also says ‘hey, the other competitor is willing to meet or try to meet more of their customer needs.’”

The same would hold true during the safety certification phase, and in the actual contracting for services,” Mango adds. “That will be another FAR contract kind of acquisition approach.

Despite delays in readying the ground facilities, Orbital Sciences hopes to use its kerosene-fueled Antares launcher—here in concept on its Wallops Island (Va.) pad—to deliver the first Cygnus cargo vehicle to the ISS this year.

It is similar to something like what the launch services program uses” [for unmanned NASA launches].

Even if NASA winds up with only one commercial crew contractor, it could still gain competitive prices in launch services for its robotic space probes and Earth-observation satellites. With the Delta II out of production, Orbital Sciences, SpaceX and perhaps some of the other new launch systems in the works may go head-to-head for launch contracts on that class of vehicle.

Orbital decided not to compete in the commercial crew arena after losing out in its bid for CCDev-2 funding, but it hopes to gain the same economies of scale for unmanned launches with its Antares rocket—a kerosene-fueled vehicle that can deliver 6,120 kg to LEO from its new launch facility on Wallops Island, Va. (AW&ST Feb. 27, p. 35).

For its part, NASA is seeking \$830 million in fiscal 2013 to invest in commercial crew. That is comparable to the \$850 million it requested for the current fiscal year. When Congress whittled that figure down to \$406 million, the agency was forced to delay its estimated start of commercial flights to the ISS to 2017 from 2016.

So far, it remains to be seen if the commercial approach actually will hold down costs once NASA begins buying crew flights. Boeing says its business case closes on the NASA missions alone—essentially two flights a year. But company officials also concede that the price per seat of a ride in the CST-100 would only be “competitive” with Soyuz seats, and not a dramatic drop.

Boeing also has partnerships with Space Adventures, which brokers Soyuz

rides to the ISS at a reported \$30 million a trip, and with Bigelow Aerospace. Bigelow already has flown prototypes of its planned inflatable space habitats to orbit, and is marking time to see what happens with the NASA effort before it begins seriously marketing its capabilities. Potential customers are industrial users and sovereign nations that lack the wherewithal to develop their own space laboratories.

Sierra Nevada's Dream Chaser will not only be reusable, but also reconfigurable for different types of missions, according to Sirangelo. These could include satellite-servicing flights with space-suited astronauts, a capability pioneered on the Hubble Space Telescope and lost with the shuttle's retirement. Like the SpaceX Dragon, the Dream Chaser will be designed to return scientific samples and other cargo from orbit—another potential market. Both vehicles also would have the capability to operate autonomously as unmanned or man-tended commercial laboratories.

But at this stage of the transition to the post-shuttle era, those sorts of commercial activities remain in the “Field of Dreams” realm, and the Dream Chaser and its on-orbit competitors have a long way to go before the customers will come.

Still, even without having flown, the NASA-backed commercial crew vehicles have created a space-launch market that did not exist before.

“Our position is, as these other emerging launch vehicles actually get to demonstrated reliability, necessary to ensure crew safely, we would absolutely consider using them,” says Boeing's Mulholland. ☛



Setting the Stage

Air Force recasts launch contract to contain costs, eyes long-term market competition



United Launch Alliance Delta IV and Atlas V boosters are being loaded onto a barge for shipping.

AMY BUTLER/WASHINGTON

More than a decade after the bottom dropped out of the prospective U.S. commercial launch market, the U.S. Air Force is struggling to deal with the continued financial ramifications of that unrealized opportunity. Those challenges are compounded by NASA's decision to rely on Russian rockets for its cargo missions in the near future, so the burden of shepherding the bloated U.S. launch infrastructure has now fallen into the lap of the Air Force.

The service is pursuing a multi-pronged strategy to contain costs. In the near term, the service has renegotiated a major contract with the current rocket provider, the United Launch Alliance (ULA), in an effort to control costs. Farther out, the service is hoping that the reintroduction of competition into the market will curb additional cost growth and—hopefully—save money. What remains to be seen is if and how quickly Space Exploration Technologies (SpaceX) can become certified for government missions and compete with ULA, and whether the U.S. market will be large enough to sustain two domestic launch providers.

ULA, which manages the Delta IV and Atlas V vehicle families, has “enormous contracts and enormous contract challenges,” says Maj. Gen. John Hyten, director of space programs for the Air Force's procurement secretary. In an attempt to cut costs, the Pentagon renegotiated the launch “capabilities” contract with ULA last June; this deal pays for the personnel and infrastructure needed to support launch activities. A separate launch services contract is a fixed-price structure that pays for the actual boosters.

The new launch capabilities contract will—like other Pentagon contracts such as for the F-35 Joint Strike Fighter—force the contractor to step out of a more fiscally advantageous cost-plus award fee deal. The revised agreement will maintain the cost-plus structure, but shift to an incentive fee schedule, says Scott Correll, the Air Force's program executive officer for launch.

“My view on award fee is they are going to do everything they can and hire as many people as they can to make us happy. And, we pay for that so they can earn their award fee,” Correll says. “A cost-plus, incentive-fee contract fundamentally changes the behavior of the company because now they are looking at how to become more efficient to earn their fee.”

And, he says, the new contract structure is already making an impact. ULA has one team supporting launches on

both the East and West coasts; previously, there were multiple teams. Now, the company is working to standardize processes for the Delta IV and Atlas V vehicles, “which should allow them to be much more efficient,” Correll says. ULA CEO Michael Gass says that the company is also consolidating and improving its information technology support work, a lengthy process that should eventually produce efficiencies.

Based on the findings of a deep dive into the cost of the two Evolved Expendable Launch Vehicles (EELV), Correll says there has been both a dramatic spike in the cost of the launchers as a result of NASA's temporary exit from the market as well as a shift of overhead costs to the Air Force.

“The main driver for cost is at one point NASA had a very aggressive business base. So, companies like Pratt & Whitney and ATK and Aerojet and others had a lot of work coming from NASA. We were only picking up maybe 9-20% . . . of the overhead structure” for those companies, Correll says. “But as NASA's business case went away, we are now up in the 75-80% range of paying for that overhead structure.”

Gass acknowledges that the propulsion infrastructure is “absolutely” too large. But, he notes that shrinking infrastructure will not happen quickly. “In the short term it costs money to save money,” he adds, since new, standardized or modernized facilities require time to be qualified for work.

Engine cost is a primary driver for the cost of the launch vehicles. The government has opted to keep oversight of the RS-68 and the RL10 under the purview of ULA for now; officials had studied whether the government should directly manage those contracts and provide the propulsion systems to ULA as government-furnished equipment. Hyten says that is “part of the price for launching.” Ultimately, however, Correll says studies have provided a better understanding on what is driving the cost of the propulsion systems and where savings may be possible.

However, the Atlas main engine, the RD-180, is built by NPO Energomash of Russia, so the Air Force has little insight into its cost structure. Some “comparisons and judgments” are possible based on the data gleaned from the RL10 and RS-68 work, Hyten says.

Another cost driver lies squarely on the shoulders of the Air Force itself, Correll says. The service is largely requiring ULA to adhere to the same rigorous processes for each launch as it did years ago, despite a flawless launch record.

"It appears to me that we are driving some cost to ULA through all of these processes . . . and I'm not sure we need to," he says. Rigorous pre-launch processes are especially needed when launching a first-of-a-kind satellite, as has been the case in recent years with the launch of the Advanced Extremely High Frequency (AEHF), Space-Based Infrared System (Sbirs) and Mobile User Objective System spacecraft. Clones of these, however, are on the manifest. And, some savings can be garnered by shortening the certification process. "Mission assurance is vitally important, but equally important is going to be [the] price for taxpayers," Correll says, noting a shift in culture. Previously, mission assurance was sought at virtually any cost.

Correll says the service never again intends to buy rockets one at a time, as it has done in the past. Now, the Air Force has asked ULA for a pricing matrix to address costs for various numbers of rockets annually; this should provide some certainty and predictability for the industrial base and payback in the form of cost avoidance. Already, the Air Force has issued a "bridge" contract for nine boosters to ULA to account for launches before an entirely new contracting arrangement is negotiated in fiscal 2013. Though not final at the moment, this contract at least takes advantage of some administrative efficiencies, Correll says, because it combines numerous statements of work into one, reducing the amount of proposal work and documentation needed.

Though launch costs have become alarming to some in government, demand for launches shows no sign of waning. The government is launching roughly one EELV per month,

a faster pace than ever for the program. And, the manifest is still not being fully served, Hyten says.

"In the next two years, we are going to be storing GPS satellites, AEHF satellites and Sbirs GEO 2. It really is remarkable that Sbirs GEO 2—Sbirs GEO 2—is going into storage because we don't have a launch slot and a booster ready to have it go on," Hyten says. "So, there is clearly demand that we don't have the ability to respond to."

Though ULA will be guaranteed roughly 11-12 launches per year, the service has crafted criteria to allow for new companies to enter the market. The first to submit a statement of intent to become certified for government launches is SpaceX. Company officials declined to say how long SpaceX thinks it will take to become certified with its burgeoning Falcon vehicle family.

Also eyeing the opportunity is ATK/EADS with its Liberty launch vehicle concept and Lockheed Martin with the Athena. SpaceX, however, is likely to be the first certified to take on ULA in direct competition.

"The biggest challenge is going to be that they have to fly. When it comes right down to it, the only way to certification is through flight," Hyten says. A request for proposals for two forthcoming launches—open only to new entrants—is expected to be released soon, Correll says. Two launches up for grabs are for the Orbital/Suborbital-3 and NASA's Deep Space Climate Observatory (DSCOVR) satellite. A source selection is expected by year-end.

The goal with these launches is to allow new entrants such as SpaceX to prove their abilities. While the government will pay for the launch, it will not pay for any extra telem-

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etry or data collection needed for the certification process.

But this is a key opportunity for SpaceX. Though it is slated to perform cargo delivery missions for NASA to the International Space Station, Correll and Hyten emphasize that these missions alone are not a sufficient path for certification.

"If you look at the NASA [commercial off-the-shelf] mission that they have for cargo, there are certain things we can use those missions for in the certification process—the engines, the stacks, the loads analysis, the avionics. [But] they don't have a fairing. They are not putting a satellite in a specific orbit. And, therefore they are going to have to fly in a like configuration at a certain point."

The pace of certification depends on each would-be competitor's business plan and how quickly they intend to invest in these types of capabilities, Hyten says.

Ultimately, Hyten notes that to garner savings through the pressures of competition, a new entrant needs "not just the capability to launch one rocket, it is the capability to launch the manifest."

Significant hurdles remain for SpaceX, including actual launches and the ramp-up of a high-capacity production facility in Hawthorne, Calif. "What is it going to take for that plant in Hawthorne to build up from where they are today to 15 rockets per year?" Hyten asks. "That is a long time ahead."

Meanwhile, the service is laying groundwork for some specific missions for which SpaceX and ULA can compete. Lockheed Martin is now developing the GPS III satellite, with launches slated to begin in 2014. The Air Force has contracted with both ULA and SpaceX to consider how to "dual-launch" two GPS satellites off of one booster in an effort to save money. ☐

Atlas V boosters (shown) are now assembled at the United Launch Alliance's Decatur, Ala., facility alongside the Delta IVs, part of a consolidation aimed at reducing costs.



Exit Strategy

Europe's next-gen launcher may rely less on commercial market

AMY SVITAK/PARIS and KOUROU, FRENCH GUIANA

The future of Europe's launcher sector—and by implication the global commercial launch market—will be decided this year when European Space Agency (ESA) governments opt to either add more muscle to the current Ariane 5 rocket or supplant it with a completely new launcher designed to rely less on commercial business.

Even now, ESA's two largest financial contributors, France and Germany, are haggling over the merits of an upgrade to the Ariane 5—known as the midlife evolution or Ariane 5 ME—or getting started right away on a successor, next-generation launcher that many in France have dubbed Ariane 6.

The two sides are expected to hash out a common vision by June 30, ahead of a November summit at which ESA's ministerial council will set the agency's next multiyear spending plan.

During ESA's last round of budget negotiations in 2008, an initial tranche of €355 million (\$464 million) was approved to begin work on the Ariane 5 ME, a development approved with Franco-German support. Another €1.5 billion would be needed starting next year to complete work on the upgrade, which would equip the Ariane 5 with the Vinci restartable cryogenic upper-stage engine and keep prime contractor EADS-Astrium's German engineering teams busy until Europe decides on a successor rocket.

"Ariane 5 ME will be a very competitive product to be put on the market in 2016 or 2017," Astrium Space Transportation CEO Alain Charneau says, adding that the upgrade would equate to a 20% performance boost for the same price of an Ariane 5 launch today.

France, on the other hand, now appears ready to scrap the ME and start work on Ariane 6, a next-generation rocket that would feature a modular design less reliant on commercial launches than Ariane 5.

Designed to appeal to the global commercial market, Ariane launch vehicles have been the "go-to" rockets for satellite fleet operators worldwide for the past 20 years. With the March 23 liftoff of ESA's third Automated Transfer Vehicle (ATV-3), Europe's commercial launch consortium, Arianespace, boasts 47 consecutive Ariane 5 missions without a failure while comprising almost half of the global commercial market.

Despite this track record of reliability, the likelihood of the U.S. dollar remaining sharply lower than the euro in the coming years, coupled with emerging competition from the U.S. Falcon 9, Chinese Long March and new Indian rockets has led French government officials and some outside analysts to conclude that the relatively high cost of Ariane 5 launches can no longer be sustained.

Arianespace is already lowering operating costs by 15-20% through an uptick in launch tempo with the addition of new capabilities, including a European variant of the medium-lift Russian Soyuz rocket and a brand-new Italian-built light-launcher dubbed Vega. Ariane 5 ME could further lower costs, EADS-Astrium argues, by boosting performance with co-manifested launches weighing a combined 12,000



kg (26,455 lb.) to geostationary transfer orbit (GTO) for the same price as an Ariane 5 launch today.

The argument for Ariane 5 ME assumes the commercial market is trending toward larger, heavier satellites that can be launched two at a time. But, as Arianespace has learned, orchestrating such dual launches of commercial and sometimes government payloads is tricky, and achieving optimum payload capacity is not always possible.

Unlike the Ariane 5, which has required Arianespace to capture up to 50% of the commercial market just to break even, the Ariane 6 could get by solely on anticipated European government demand—roughly two or three launches annually—making the next-generation launcher less reliant on the commercial market than Ariane 5 or its planned upgrade. While the Ariane 6 would maintain the same launch rhythm—between five and seven annually—as its predecessor, it would do so at a much lower cost. And while Arianespace currently struggles to fill the Ariane 5's massive dual-payload capacity—currently more than 9,000 kg and up to 12,000 kg with the new upper stage—the modular Ariane 6 could accommodate launches of single spacecraft weighing 3,000-8,000 kg at a price tailored to fit customer needs. In contrast to the situation today, Arianespace would never have to worry about losing money on a launch for which it is unable to fill the rocket to capacity.

Such a business model, France argues, would mean Arianespace would no longer have to slug it out in the commercial market in order to survive. The consortium could be viable with only two or three European military or civil launches per year, with a few commercial missions to fill out the 5-7 needed to sustain the Ariane 5. Ariane 6's net effect on commercial launch prices would depend on how much of a splash

Engineered with performance—rather than costs—in mind, the Ariane 5 faces challenges in serving the commercial market on which it now relies.

new entrants to the market ultimately make. Although a less commercially reliant Ariane 6 could put upward pressure on prices, the emergence of new launchers in the U.S., China, India and Brazil would tend to drive prices down.

Over the past several months ESA has queried its largest European customers—SES, Eutelsat, Hispasat and European militaries—as to their requirements for a future launcher. SES President Romain Bausch says his company—the world's second-largest commercial satellite operator in terms of revenue—favors Ariane 6 over Ariane 5 ME.

"We see the market splitting into two groups of satellites, one 3 to 3.5 tonnes, the other 6 to 6.5 tonnes," Bausch said on the sidelines of the Satellite 2012 conference in Washington March 12. "ESA has asked us our thoughts about the market and we have told them what we thought. It is certainly along the lines of what has been called Ariane 6, a modular vehicle capable of launching one satellite at a time, covering the two weight classes into GTO."

ESA Director General Jean-Jacques Dordain is expected to seek design proposals from industry this month for building a next-generation launcher under a procurement strategy that would alter the 19-nation agency's acquisition approach to facilitate more competition among companies in an effort to lower development costs.

Traditionally, ESA has relied on member states to ante up funding every three years for specific development programs, leaving the agency to build the project while adhering to a geographic return policy, guaranteeing a 90% return on

investment for participating countries in the form of industrial work shares.

Last year, an outside audit of Ariane 5 manufacturers found that unless European governments agreed to bend ESA's geographic return policy, the agency would be hard-pressed to find savings in the Ariane 5 program, including Ariane 5 ME.

Dordain, who hopes to have the industry proposals in hand by the November ministerial, believes the shift in acquisition approach would indeed lower the cost to develop a new launcher, a figure that France and Germany say is expected to be €3-5 billion. At a minimum, he expects ESA ministers to make a decision on the first phase of a next-generation launcher at the November meeting.

"I wish to know by at least the end of the year the architecture of the next-generation launch vehicle and the industrial team," he says.

But while Dordain's cost-saving approach is sure to put

pressure on existing suppliers to lower prices, tampering with ESA's current industrial return rules could alienate some of its key financial backers.

"If you change it so that development occurs in one location, it would be cheaper, but then it would not be European," says Johann-Dietrich Woerner, head of the German Aerospace Center DLR. "We still think a European solution is the right solution. We should put all arguments on the table, including costs, including perspectives, and then decide."

Charmeau says although Ariane 6 could serve as a pilot program for a new industrial arrangement among ESA stakeholders, pulling it together could take time.

"It could be very good for us to start working on technologies for Ariane 6 in parallel with [Ariane 5 ME], and it could very well lead to a decision for Ariane 6 in 2015," when ESA is expected once again to meet at the ministerial level to set its multiyear spending plan.

But France has already put close to €200 million toward

studies of a next-generation launch vehicle design in preparation for the November meeting. Emmanuel Terrasse, space policy adviser to the French higher education and research minister, Laurent Wauquiez, says the decision to continue with the Ariane 5 ME or to initiate development of a new launcher cannot be delayed.

"The key point is really the content and the type of launcher we want to have," Terrasse said in March. "This decision cannot wait, it needs to be taken now, given the development times. It cannot be postponed until 2015," he said, a position Wauquiez confirmed recently.

"These studies will permit Europe to be im-

Along with Ariane 5 and the new Vega light launcher, Russia's medium-lift Soyuz rounds out Europe's launch vehicle offerings at the Guiana Space Center in Kourou.

mediately operational when it takes the decision, next November, to begin development of whatever launcher is decided," Wauquiez said in remarks accompanying the release of France's updated space strategy, a document that asserts that the current Ariane 5 system is unsustainable. "On this point, my position is clear: We must make the decision in an analytical way based on two objective criteria—the combined demand of government and commercial customers, and the reduction of cost," Wauquiez said.

However, Charmeau says ESA's forthcoming decision does not have to pit Ariane 5 ME against a next-generation launcher.

"It's not one against the other: For the moment it is Ariane 5, then we go on with Ariane 5 ME, and we will be very glad if we can prepare for Ariane 6 with technology demonstrators," Charmeau says.

But given that many European nations are still grappling with sovereign-debt crises or new governments, it is unlikely that ESA member states can afford to do both. ☐



The end of the shuttle era has triggered development of several new launchers, including the Stratolaunch system financed by Microsoft co-founder Paul Allen.

What Next?

Deep pockets, international entries add content to launcher concepts

FRANK MORRING, JR./WASHINGTON

In Mojave, Calif., workers are cannibalizing a pair of surplus United Airlines Boeing 747-400 airliners for parts to build a flying launch pad.

In January their employer, Stratolaunch Systems, broke ground on an 88,000-sq.-ft. wing-fabrication facility that will be finished late this year. By mid-2013 it will be joined by a 92,640-sq.-ft. hangar to accommodate the largest aircraft ever built.

Funded by the deep pockets of Microsoft co-founder Paul Allen, Stratolaunch paid about \$22 million apiece for the two aircraft, part of an estimated \$200 million down payment on the innovative launch concept. The company is negotiating with Space Exploration Technologies Inc. (SpaceX) for a scaled-down version of its Falcon 9.

"We're looking at the performance of a Falcon 5 versus a Falcon 7 right now," says Gary L. Wentz, Jr., CEO and chairman of the startup "project" Allen kicked off late last year (*AW&ST* Dec. 19, 2011, p. 26). "A lot of it has to do with the payload and the loads we're expecting to see. We'll probably make that decision within the next two months."

Stratolaunch's concept is one of several taking shape as the international launch industry adjusts to a world without space shuttles and a U.S. administration seeking private companies to deliver humans and their cargo to low Earth orbit.

Based in Huntsville, Ala., where NASA is managing in-house develop-

ment of the congressionally mandated heavy-lift Space Launch System (SLS), Stratolaunch hopes to begin flying its launch-carrier aircraft—a 1.2-million-lb. behemoth with a 385-ft. wingspan—in the second half of 2015. The first test-firing of an air-dropped Falcon rocket should come by the end of 2016, Wentz says. The company's initial goal is to demonstrate that the concept—essentially an upsized version of the Allen-sponsored vehicles that won the Ansari X Prize—will work.

"We haven't done any real sales or marketing at Stratolaunch," Wentz says. "Paul's philosophy is to basically prove the capability, and then go after payload customers. We'll probably initiate some of that within the next two years. We're focused primarily on developing the system, developing the components and integrating the system."

Presently Stratolaunch has a staff of nine—typical, Wentz says, for an Allen startup at its present stage of activity. Scaled Composites, which built SpaceShipOne, will work with BAE to build and outfit the carrier aircraft that will take the Falcon to its 30,000-35,000-ft. drop altitude. Also on the team is Dynetics, which is providing engineering support.

The Falcon that Stratolaunch selects will carry either five or seven of the new SpaceX Merlin 1D engines now in development test. Designed to generate 155,000 lb. vacuum thrust, with a 310-sec. specific impulse and a thrust-to-weight ratio of 160:1, the engine will power the Falcon 9s the company plans to use to fly cargo and crew to the

International Space Station after the first three cargo flights, according to SpaceX founder Elon Musk.

Beyond the engine itself, the company is looking for cost-saving upgrades that may include a flyback capability in at least the first stage, says Musk, offering the sort of vision that often leaves engineers from outside the company shaking their heads with skepticism (*AW&ST* March 12, p. 49).

"In some cases it will be a flyback to a land landing," Musk says, explaining how cold-gas thrusters would turn the thrusting stage back toward its recovery area. That could be in the ocean, depending on the size of the payload, Musk says, but the idea is to cut costs even more than the low figures—averaging \$55 million to put a 4.5-ton payload in orbit—on the company's website.

"None of our prices assume reusability," he says. "We don't know when reusability will work, [or] which customers will sign up."

Instead, the new version of the Falcon 9—which will include pressure-stabilized propellant tanks and a common bulkhead, made of friction stir-welded aluminum lithium for weight saving—will be 60% more capable than the current version with costs that are "more or less consistent" with it, Musk says.

Ultimately, he says, recovering the first and second stages with flyback could cut the company's prices by 20% to as much as 50% "if we start getting really high volume."

"I think we'll end up pretty much tak-

LAUNCH VEHICLES

ing over the whole launch industry, unless somebody comes along and offers [something better]," Musk says. "We're punching above the belt. We're not doing anything unfair or unreasonable. We are competing pretty hard."

Musk's competitors are quick to point out that he hasn't flown to space since December 2010. But that was a landmark flight that made SpaceX the first private company to orbit and recover an intact spacecraft (*AW&ST* Dec. 13, 2010, p. 22). The company's upcoming cargo flight to the ISS will go a long way to quiet critics and reassure NASA and other customers—if it is successful. The history of space launch is littered with paper rockets, concept vehicles that never got off the ground or never reached full-up operations. Conestoga, Aquila, Roton, K-1

ter the fray, sometimes with interesting ideas that at least hold the promise of moving beyond the paper stage.

One such idea is the Liberty rocket, a collaboration between ATK and Astrium that marries the solid-fuel first stage ATK developed for NASA's defunct Ares I crew launch vehicle with the Ariane 5 first stage, modified so its Vulcain 2 main engine can start at altitude.

The project didn't win any NASA seed money, but continued under an unfunded Space Act agreement. It remains a possible launch vehicle for Boeing's CST-100 commercial crew vehicle, and perhaps for other crew vehicles as well (see p. 40).

In the U.S., NASA is hard at work adapting 50 years worth of launch ground infrastructure for the new era. Instead of single-vehicle operations,

ment and Operations Program at KSC.

Work on Pad 39B got underway as the final shuttle missions lifted off from Pad 39A, with modifications initially put in place to accommodate the Ares I. Since then Colloredo and his colleagues have been looking for ways to accommodate as many potential vehicles as possible.

That sort of flexibility poses a number of issues, since some launch vehicles are designed to stack vertically, and others to be assembled in the horizontal position. Planning work extends beyond the pads to the processing facilities and the huge Vehicle Assembly Building where Saturns and shuttles were stacked.

"We're looking at everything from spacecraft to horizontal launchers to medium to heavy-class vehicles, you name it," says Colloredo. "We're trying to make sure that when we put them all together they're all able to function, and as much as possible function autonomously, where each one can get their mission done, and they're not compromising the mission of the other."

Changes in the way humans and payloads get to orbit aren't limited to the U.S. As Europe ponders its next step in space launch (see p. 46), other international launch-vehicle work also could impact the changing launch-services industry worldwide, provided such thorny political issues as export control and non-proliferation can be resolved.

India's long-awaited all-domestic Geostationary Launch Vehicle (GSLV Mk. III) is slated for its first flight this year, which would allow the Indian Space Research Organization to launch its own heavy communications satellites, and perhaps sell launches to commercial customers as well (*AW&ST* April 2, p. 18).

China—only the third nation to orbit humans—is making steady progress on its Long March line of launchers with a new class built around the 260,000-lb.-thrust YF-100 kerosene-fueled rocket engines. Late next year the Long March 7, China's newest—and most capable—medium-class launch vehicle, should begin operations. Also in the works for launch late next year or early in 2014 is the smaller Long March 6.

Later in 2014 China hopes to send its first Long March 5 into space. Able to lift as much as 25 tons to low Earth orbit in its largest configuration, the Long March 5 will lift off with 10 engines firing at once—eight YF-100s in four strap-on boosters, and two gas-generator-cycle main-stage engines fueled by liquid hydrogen (*AW&ST* March 12, p. 32). ☉



New launchers will require modifications to ground infrastructure at Cape Canaveral and elsewhere. Shown is a concept of Sierra Nevada's Dream Chaser with its on-pad crew access system in place.

and Gryphon are among the also-rans of commercial spaceflight. Usually there wasn't enough money to keep them going long enough to iron out the inevitable technical problems and turn a profit.

That old equation has changed with the arrival of billionaires like Allen, Musk and Amazon.com founder Jeff Bezos, who is using some of his dot-com money to endow the secretive Blue Origin vertical-takeoff-and-landing space launch vehicles. The addition of serious U.S. government funding for commercial access to the ISS also has spurred companies that must answer to shareholders to en-

Launch Complex 39 is being readied to handle everything from the government's Saturn V-class SLS to the whole range of new commercial vehicles.

Boeing already has a deal to use one of the Orbiter Processing Facilities at Kennedy Space Center for the CST-100 (*AW&ST* Nov. 7, 2011, p. 34), and the Liberty vehicle is another likely candidate to use surplus space shuttle facilities at KSC that were recycled from Apollo days.

"The way the pad is being designed is to be as standard and generic as possible," says Scott Colloredo, chief architect in the Ground Systems Develop-

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April 27—Rotary International Award for Space Achievement. Hyatt Regency Hotel, Houston. Call +1 (281) 488-2733 or see www.rnasa.org

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See www.setp.org/workshop/2012-flight-test-safety-workshop-information

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May 14-16—European Business Aviation Convention and Exhibition 2012. Palexpo, Geneva. See www.epace.aero/2012

May 14-16—International Air Transport Association/International Civil Aviation Organization's Global Runway Symposium. Intercontinental Hotel, Amman, Jordan. See www.iata.org/events

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Many to Blame in LightSquared Mess

If ever there were a story without heroes, it is the saga of LightSquared, the New York company that wants to build a network using satellites and terrestrial transmitters to offer wholesale 4G-LTE wireless broadband services in the U.S.

LightSquared, backed by Harbinger Capital Partners and its billionaire CEO, Philip Falcone, had plans to invest upwards of \$10 billion and stood to become a major player in the broadband telecom market. Those plans fit neatly with the Obama administration's goal of advancing affordable broadband Internet. First, it would add third-party muscle in the mobile arena dominated by AT&T and Verizon. And the use of satellites offers an effective way to reach users in areas too sparsely populated to support terrestrial infrastructure profitably.

The Federal Communications Commission (FCC) fast-tracked approval of LightSquared's proposal to use spectrum designated for mobile satellite services (MSS) not just for satcom, but also for the transmitters it planned to build on the ground. That portion of L-band spectrum sits adjacent to spectrum used by GPS satellites to transmit their timing/navigation signals to myriad devices in the hands of millions of users, including some critical to aviation and national defense.

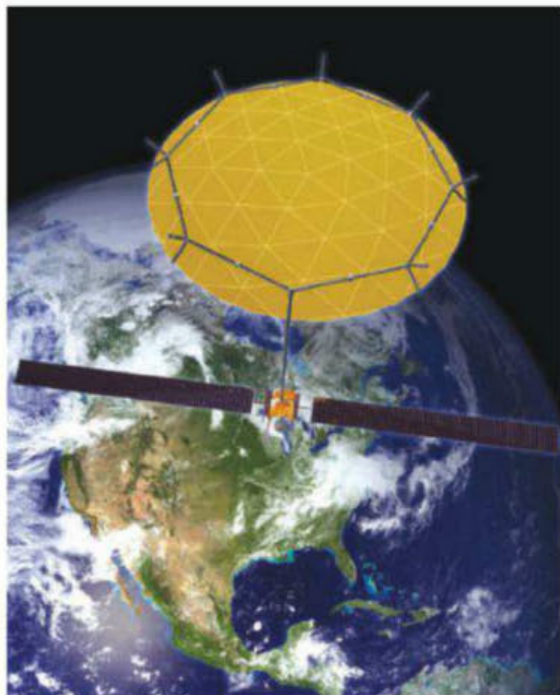
GPS signals are necessarily faint, and because intermodulation ripples into part of the MSS spectrum, GPS receivers can take advantage of what has been a "quiet neighborhood" and listen there, too. Concerns began to grow about the potential for LightSquared's ground transmitters to interfere with reception of the GPS signal. Worries escalated after the FCC approved a change in LightSquared's plan designed to enable its network to be used in terrestrial-only modes as well as satellite-only or dual-mode.

Nor surprisingly with so much at stake, the rhetoric on both sides grew overheated. Hyperbolic accusations of "GPS-jamming" and "spectrum-squatting" drowned out sober discussions of complicated technical issues. Most recently, the FCC backtracked, revoking its conditional approval of LightSquared's plans, and Falcone has indicated the startup may be headed for bankruptcy.

Depending on one's point of view, the FCC either succumbed to massive political pressure by entrenched GPS users or corrected an earlier transgression of a similar nature. Falcone is a generous contributor to political campaigns and FCC Chairman Julius Genachowski had been a key Obama fund-raiser. Either way, the FCC has egg on its face. Having now been on both sides of the issue, the FCC certainly cannot be said to have judiciously weighed technical issues and public benefits. Nor is the FCC the only part of the U.S. government that seems to have failed. Congress has certainly meddled in the matter, too (see p. 17).

The roots of all this go back well before Harbinger bought SkyTerra in 2010. LightSquared and its predecessors did not make a secret of their plans for the satellite spectrum they own. Nor is it unusual for spectrum to be acquired with one application in mind and for another one to be approved later.

The FCC skipped a typical regulatory step when it tentatively approved the change in the use of spectrum without issuing an notice of what it proposed to allow and asking for public comment and a technical assessment. Instead, we ended up with rushed testing,



BOEING CONCEPT

“ Having been on both sides of the issue, the FCC cannot be said to have judiciously weighed the technical issues and public benefits. ”

government waste and massive industry lobbying campaigns.

For its part, the GPS community dropped the ball when it did not realize what those plans would mean for GPS before early last year. Then, the hard line the GPS community took did nothing to allow exploration of a compromise.

LightSquared is largely correct in arguing that GPS receivers should be designed to be less susceptible to interference—aviation receivers are, because the FAA and International Civil Aviation Organization say they must be—but that was a decision made at the dawn of satellite navigation and no one revisited it, so everyone is allowed to build unregulated receivers with wide-open front ends. That will likely have to change, as GPS interference is becoming an issue beyond LightSquared. But it will take decades.

LightSquared may not be able to coexist with GPS, but it is wrong to assume that once any radio receiver has begun to use a portion of spectrum, users have a right to it forever. Nor is it correct to assume technical or financial hurdles to making smooth and equitable transitions are insurmountable. The FCC has been managing well a transition in the use of another band with millions of installed users—VHF television—by doing it systematically over decades. What is sad in the case of MSS and GPS frequencies is both how little was done to consider those possibilities and how badly the process of protecting GPS has been managed. ☐

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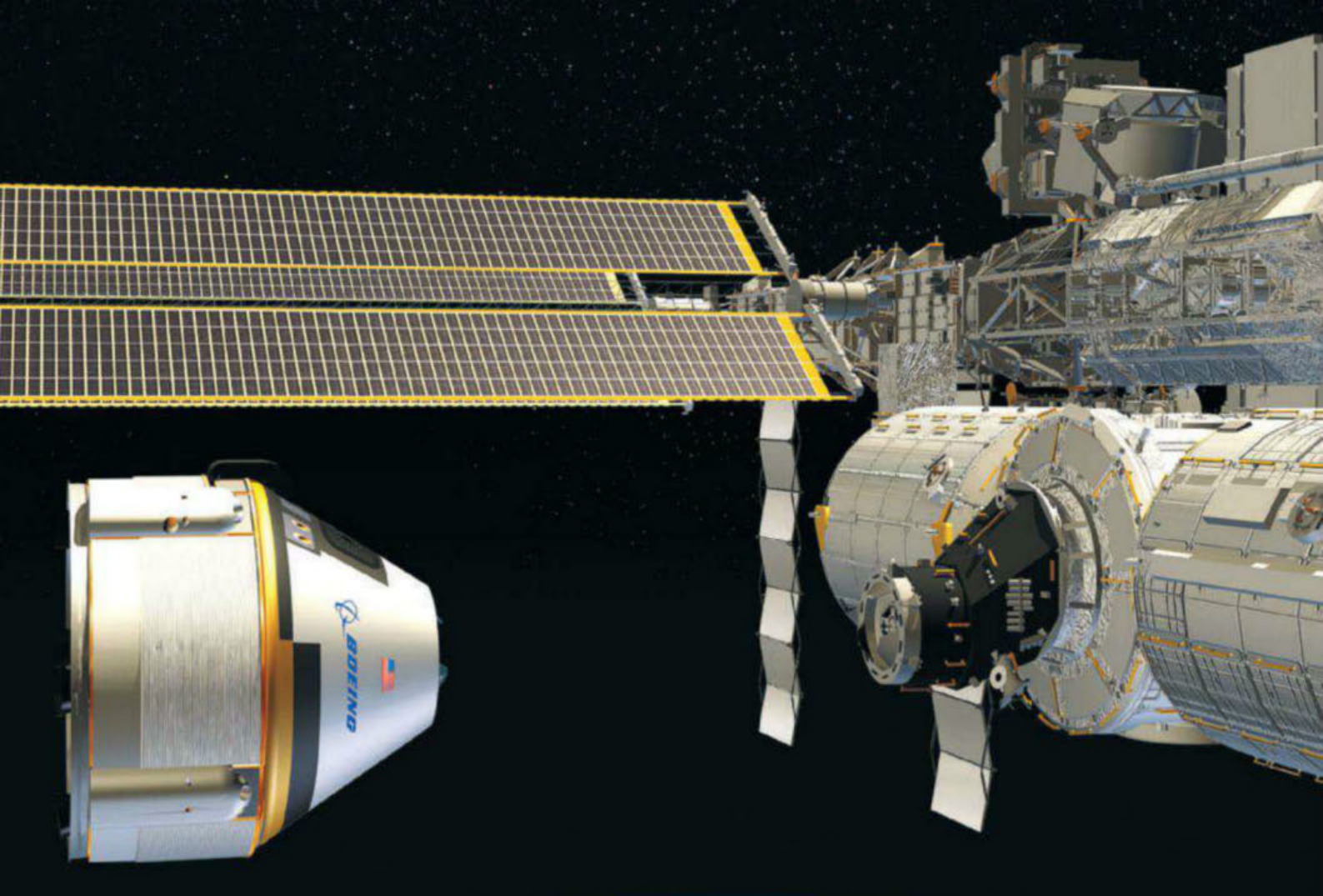


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