

Cabin electronics and connectivity

by James Wynbrandt

The relentless pursuit of the connected cabin accelerated over the past year, as new high-speed Ka-band satellite constellations and next-gen terrestrial networks prepared to come online, and passenger expectations for a home- or office-like cabin experience continued rising. The developments come fast and furious, as seen through the sphere's three foundational elements: the networks that carry the digital traffic; the hardware, products and apps that underpin and manage it; and the access services that unlock the channels to and from the aircraft. Here are highlights of the news, changes and progress of the past year. For exclusive content, visit www.ainonline.com/cabin-electronics-and-connectivity.



Networks

Major satellite and air-to-ground (ATG) networks, which provide the backbone for airborne connectivity services, are bringing new data pipes online, promising faster speeds and lower costs. Several distinctions separate ATG from satellite networks, of course, among the reasons many aircraft are equipped for more than one airborne connectivity access service. Within its service areas, Gogo Business Aviation's ATG offering (currently the sole ATG system operating) is available consistently only at altitudes of 10,000 feet and above, whereas satellite coverage is available both on the ground and at any altitude.

Additionally, Gogo's ATG service and the upcoming ATG system from SmartSky are largely confined to North America, while satellite networks that support business aviation can be accessed from almost any spot on earth. ATG networks are heading toward faster data speeds for business aviation and offer cheaper access rates than satellite networks, though the advent of Ka-band connectivity is already bringing terrestrial broadband speeds to bizav satcom.

Inmarsat

The recent inauguration of Inmarsat's Jet Connex (JX) Ka-band satcom service, the first global (polar regions excluded) high-speed airborne connectivity service, has been the connectivity story of the year. JX and other Inmarsat services are sold through distribution partners and value added resellers (VARs) such as Cobham, Gogo, Honeywell, Rockwell Collins, Satcom Direct, AirSatOne and others. Honeywell has a five-year exclusive license to furnish the JetWave hardware that provides



CONNECTIVITY UPGRADE ADVICE

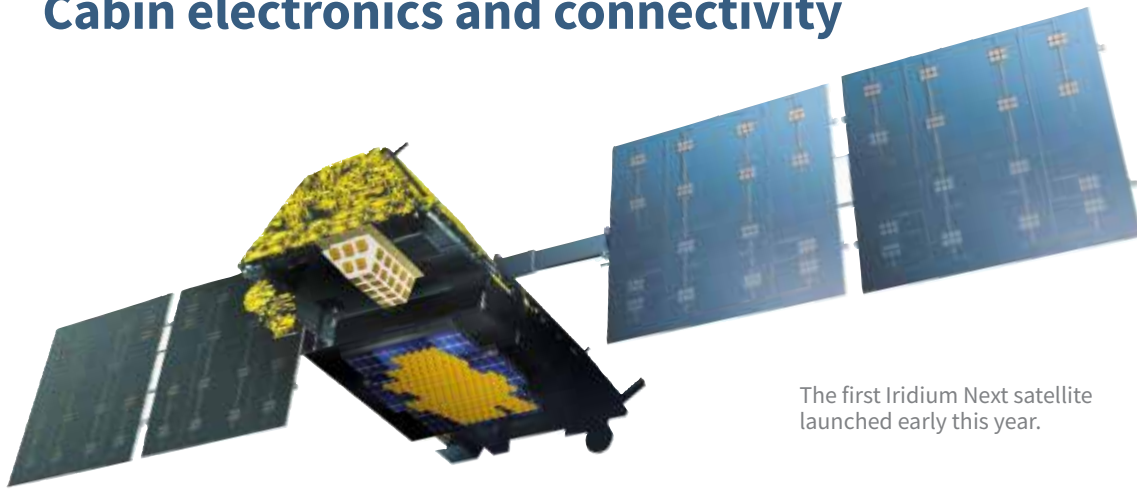
With the growing choice in networks, service plans and equipment, how can a consumer make sense of the choices, and how can a provider help a customer make the right choice?

"When we visit a customer, the first thing we ask is 'what is their mission? What do they need to do?'" said Curt Gray, Honeywell senior director of connectivity support. The answer will point to the networks, onboard platforms and service providers that bear consideration.

"It depends on the installation they already have, and the aircraft replacement strategy," said Michael Christensen, managing director of Europe, Middle East and Africa for Satcom Direct. He noted that providers can increase the capacity and speed of some services, and simply upping the data plan may provide sufficient bandwidth for immediate needs, particularly if the aircraft isn't large enough to support the Ka-band antenna required for high-speed broadband.

Advises Taylor Prosba, director of business jet cabin solutions at Rockwell Collins, "Make sure the customer has a realistic expectation of what they can do for their budget." News about high-speed broadband service may create misunderstandings about the level of connectivity available on smaller aircraft, or about bandwidth limitations that can affect user experience on aircraft equipped for current high-speed service. ■

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The first Iridium Next satellite launched early this year.

onboard access to the JX Ka-band satellite constellation. The speed of JX hasn't been officially disclosed, but in a typical business jet application could range up to around 15 Mbps. "The capacity is many, many times the capacity we have in the industry today," said Michael Christensen, managing director of Europe, Middle East and Africa for VAR Satcom Direct.

Bombardier, Gulfstream and Embraer are offering factory installation of JX, and STCs for 30 aircraft representing all major platforms that can accommodate a tail-mounted antenna are in hand, with more approvals under way.

The required tail-mounted antenna means JX is available generally aboard large-cabin business jets and executive-configured airliners, although there are signs that some super-mid-size jets may be able to accommodate antennas for Ka-band service. For the rest of the fleet, Inmarsat offers its legacy Swift 64 and SwiftBroadband (SBB) Ku-band services, which have seen service enhancements from some VARs. SBB delivers uncompressed speeds of up to 200 kbps and enhanced service speeds up to 432 kbps, and supports simultaneous high-speed data and voice service. Swift 64, operating on the L-band spectrum, provides up to 64 kbps per channel, and up to four channels can be combined for a throughput increase to 256 kbps. Cobham's Aviator 200 SBB is priced at \$65,000.

For lower-cost connectivity options, Honeywell's

BendixKing division manufactures the AeroWave 100 Inmarsat satcom, with a flat-rate, pay-by-the-hour airtime. AeroWave service runs at speeds of up to 200 Kbps on Inmarsat's Class 15 satcom network, allowing texting and light emailing. Operators pay for service up-front, \$1,999 for 50 hours, which averages to \$40 per hour, but this pre-paid package is limited to 104 Kbps. "Other plans are available with the higher speed," according to BendixKing. The system costs \$24,995 with a standard Arinc 600 tray; adding a cooling fan takes the price to \$27,499. Total system weight is about 12 pounds. Installations have been done on airplanes as small as the Cessna 421, but most have been in turboprops and jets. Two Wi-Fi routers are now available: a data-only unit for \$3,900 and data and voice for \$5,900.

Iridium

Iridium's low-earth-orbit (LEO) satellite network supports phone and fax connectivity, and limited data services such as sending/receiving email (without attachments) and SMS (text) messages, and datalink connectivity, using Short Burst Data protocol. Sold through distribution partners Gogo Business Aviation, Honeywell, Rockwell Collins, Satcom Direct and many other companies, Iridium service is available worldwide, even in the polar regions, as its satellites orbit the earth in a north-south plane.

Iridium's Go! provides voice and text messaging for iOS and

Android personal smartphones and tablets. France-based Wabnet offers the low-cost Aviator Wifi Iridium transceiver, and other manufacturers of low-cost Iridium systems for smaller aircraft include Send Solutions (Airtex), Garmin and Bizjet Mobile (Chiimp). Thales' Live-Aero hardware enables Iridium's OpenPort broadband service for tablets and laptops, offering Internet access worldwide. Iridium Certus, its next-generation data transmission platform, powered by the second-generation Next constellation, will offer speeds up to 1.4 Mbps. So far this year Iridium has placed 20 (in two launches) of a total of 81 Next satellites that will comprise the constellation in LEO.

ViaSat

ViaSat, which already has deployed a Ka-band high-speed satellite operator, expanded capacity with the June launch of ViaSat-2. Scheduled to begin



The ViaSat Global Aero Terminal with Ka-band access will be available early next year.

service next year, ViaSat-2 offers seven times more coverage than its predecessor—ViaSat-1—concentrated over North America, the North Atlantic, Europe, Central America, the Caribbean and portions of South America. Those areas encompass "80 percent of the business aviation flight routes," said

James Person, director of business development and strategy for ViaSat's business aviation division.

Aircraft equipped with a ViaSat Ku-band antenna in the tail can add a Ka-band system, providing a top speed of 16 Mbps, "and have a great backup system with the Ku," Person said. But there's "a bit of a waiting list for Ka" for ViaSat customers, said Person, as all available bandwidth for the year has been allocated.

The company's **Global Aero Terminal 5510** shipset (Ka-band antenna and modem), supporting access to the ViaSat's Ka-band satellites with service speeds of up to 16 Mbps, has been successfully demonstrated and certified units will be available for early access partners and customers in this year's second half. Volume production units will be available early next year, and STCs for installations on airframes of three OEMs, which Person declined to name, are expected next year as well.

Meanwhile, ViaSat announced at EBACE the doubling of the speed available from its Ku-band global data network, from 2 to 4 Mbps, providing a better quality of service for streaming content in high definition compared to standard definition. STCs for installations of the enabling antenna are expected early next year. ViaSat has also rebranded its Yonder and Exede in the Air services as ViaSat Ku-band and ViaSat Ka-band services, respectively. Both support streaming, video conferencing and high-quality Voice over Internet Protocol (VoIP) telephony. Data pricing plans are the same for both. All ViaSat data plans are a fixed monthly fee, which the company says gives customers greater cost savings and predictability over traditional "per megabyte" plans.

The company also makes onboard hardware and sells service plans for its satellite network.

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Panasonic Avionics

Panasonic Avionics' Global Communications Services, an aero-only Ku-band network, currently provides broadband connectivity for some 1,300 aircraft, most of them airliners, but Panasonic aims to sell its satcom service to business aviation, targeting the super-mid-size jet market. Satcom Direct has signed on as the first VAR. The Astronics AeroSat tail-mount shipset providing the onboard link received its first STC late last year for installation on a Gulfstream IV-SP.

The current service delivers speeds up to 6 Mbps via

high-throughput satellites (HTS), and Panasonic is adding capacity for full utilization of a worldwide network this year, with plans to add extreme throughput satellites (XTS) in the future.

SmartSky

SmartSky's 4G LTE (Long Term Evolution) ATG network, offering optimized bidirectional high bandwidth data transfers, is on the cusp of coming online, with "the vast majority of sites expected to be operational by this fall," according to the Charlotte, N.C.-based company. The

FCC certified its patented 4G radio system last September. Proprietary beamforming that makes use of the unlicensed 2.4-GHz spectrum band underlies the multi-megabit service offering. SmartSky has begun obtaining STCs for customers that signed for the early bird waiting list program, and is promoting the service to fleet operators as a branded offering that can differentiate service providers. Avidyne, manufacturer of glass-panel avionics for light aircraft, has partnered with SmartSky to develop connectivity products for its segment of the market.

While some suggest Ka-

band high-speed connectivity could supplant ATG networks, SmartSky chairman and CEO Haynes Griffin suggests that having both satellite and ATG provides optimal service and substantially reduces connectivity operating costs. SmartSky cites unit prices per megabyte and equipment cost differentials that can deliver a net savings to customers "upwards of \$1 million in expenses through least-cost routing over a 10-year period for the typical heavy business jet." Monthly service plans range from 5 GB Basic (about 10 hours of downloading content) for \$2,500, to Enterprise (25 GB) for \$4,500.

Hardware and Service Providers

Manufacturers of cabin management and connectivity equipment, and the service plan companies that provide the network access that equipment supports, used to be more clearly delineated. But Rockwell Collins's purchase of service provider Arinc Direct in 2013, Satcom Direct's purchase last year of True North, which manufactured the satcom company's premier hardware product (an onboard router) and Honeywell's purchase of Satcom1 (in 2015) and its new GoDirect products introduced this year mark a trend toward more integration. Providers are seeking to create what some call an "ecosystem" of products and services that can be tailored to the needs of individual customers. Some providers have already integrated vertically, and now more are bundling products and services. Here are some of the providers' developments during the last year.

Gogo Business Aviation

Gogo Business Aviation's Gogo Biz 4G ATG system launched

for business aviation last September but is already in widespread service on airliners. Aircraft that upgrade to the 4G system will be upgradeable later to Gogo's high-speed next generation network, which will use unlicensed spectrum, a proprietary modem and a new beam-forming antenna to produce peak network speeds of 100 Mbps, employing LTE technology and Gogo's existing North American network and infrastructure of 250 towers. The next generation system will deploy as a limited network for internal flight-testing this

year and go live in the second half of next year, said Sergio Aguirre, senior v-p and general manager of Gogo Business Aviation. The Gogo Vision inflight entertainment system (IFE) is included with the 4G system, and also available are a flight tracker with real-time weather reports and Gogo Text & Talk, which allows users to make voice calls and use text messaging with their own smartphones and phone numbers. (These features can be added to other existing Gogo systems.)

Half a dozen MROs are developing STCs for the installations of 4G ATG on models from every major business aircraft manufacturer, and charter operators Delta Private Jets and XOJet will equip fleet aircraft for the 4G service,

according to Gogo. The company is also offering "aggressive incentives to all existing customers" that want to upgrade, Aguirre said. Gogo Business Aviation believes it could land some 1,000 4G ATG customers in the near term.

At the EBACE trade show in Geneva in May, Gogo introduced Smart Cabin Systems—SCS Elite and SCS Media—voice and IFE services that can be personalized to passenger needs flight-by-flight, integrating passengers' own mix of technologies. "We created it to be a simple, powerful way to integrate all the necessary technology onboard for an enjoyable passenger experience," said Aguirre.

The light and compact SCS Elite router can be installed on virtually any size business aircraft, and works across ATG and satellite systems. It supports and manages multiple data bearers, voice bearers and cabin management systems (CMS), and offers a single interface for easier control of the cabin environment. SCS Media, also compact and lightweight, is a wireless infotainment system geared to light jet and turboprop operators, providing



Gogo Biz 4G allows streaming video and audio, email with attachments, web browsing, voice calling and VPN support.

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affordable stand-alone inflight maps and entertainment. An automated content delivery service for SCS Media is available through Gogo Cloud, providing access to refreshed news and entertainment selections.

Gogo also operates its own 2Ku system using satellite transponder capacity purchased on Intelsat and SES satellite systems, and employing proprietary antenna technology. Ku providers can “significantly increase throughput” by upgrading to 2Ku service, which Gogo is bringing to the VIP transport market, having announced in May entry into service of the first head-of-state ACJ319 equipped for 2Ku.

Meanwhile, Gogo is enabling other services and apps domestically through its ATG network. Aircraft equipped with Gogo hardware and service can now, for example, activate Rockwell Collins’s popular Airshow moving map on iPads through a Rockwell Collins app.

Satcom Direct

Satcom Direct holds distribution agreements with satellite system operators Inmarsat, Iridium, ViaSat and Panasonic. It also offers enhanced connectivity services through its private network and connectivity service apps. “The closer we come to the [network] vendor, the more enhanced services we can provide our customers through the network,” said Chris Moore, the company’s chief commercial officer.

But since moving into hardware with the launch of its SD Router (SDR) in 2013, the Florida-based company has made a name for its satcom products as well as services.

It has incorporated next-generation acceleration and compression technologies into SDR, enabling the unit to raise data speeds by inspecting traffic and selecting which portions are compressible, and also using bit-level caching to maximize



The Rockwell Collins Venue CMS can be integrated with ArincDirect’s airborne connectivity.



Honeywell’s Ovation touchscreen CMS lets passengers control cabin environmental conditions such as lighting, seats, temperature, galley at their seat or from a mobile electronic device.

the efficiency of page updates. Last-generation compression technologies have reached their limits “and actually slow data if they try to compress it further,” said Satcom Direct’s Michael Christensen.

The company has complemented its SDR with WiFi Hub, which can serve as a stand-alone, less expensive router with more limited features than SDR, or a hub for an SDR installation on an executive private airliner.

Satcom Direct has also partnered with Lufthansa Technik in a new entertainment service, offering business jet operators DRM-secured and licensed movies and TV shows. Initially available on aircraft equipped with LHT’s nice HD cabin systems via an easy-to-use portable memory device, no

Internet connection is needed to view content, and new movies and TV shows will be added monthly. The service is available for all IFE/CMS platforms via LHT’s nicemedia Smartbox, powered by SD, enabling passengers to view content on cabin monitors, or via streaming on personal devices.

Rockwell Collins

As an avionics manufacturer Rockwell Collins has long developed and supplied onboard connectivity, CMS and IFE hardware and software. Its purchase of data and services provider ArincDirect—in conjunction with distribution partnerships with Inmarsat, Iridium and ViaSat—has pushed it to the forefront of connected cabin advocates

and providers. Rockwell Collins points to its Venue CMS integration with Arinc Direct’s airborne connectivity services as an example of the bundled products it can now offer in the cabin, tailored to each operator’s needs. With a fiber-optic backbone the company describes as “future proof,” Venue provides wired and wireless access points throughout the cabin, delivering licensed Hollywood content, live TV, video conferencing capability and seamless use of personal and smart devices, along with high-speed Internet and social media access. Almost 1,000 Venue systems are flying today.

Meanwhile, whatever the CMS or network, Rockwell Collins’s acceleration and compression protocols can add 100 to 400 percent bandwidth capacity

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to a cabin network, not only speeding communication but also lowering costs, according to the company.

Rockwell Collins is now launching Stage, a wireless streaming media server and content service announced two years ago. The stand-alone unit, compatible with any CMS, offers two terabytes of storage for content that can be quickly uploaded via USB or Wi-Fi. A head-of-state 747 based in the Middle East is the Stage launch platform, while a Falcon 900 is slated to be the first European installation, according to Taylor Prosba, director of business jet cabin solutions.

Also new is the Airborne Data Router line of smart cabin routers, enabling cabin and flight deck connectivity for mobile devices and electronic flight bags. The flange-mount design provides wired or wireless Ethernet connectivity, enabling access for multiple LAN clients, as well as WAN connectivity to multiple communications networks such as GSM, Inmarsat SBB and Ka/Ku, ViaSat and Iridium.

Meanwhile, ArincDirect recently rolled out its 3G/4G Ground Connect service, which enables seamless connectivity via terrestrial cellular networks when the aircraft is on the ground, avoiding the use of high-cost satcom airtime for data and software updates and IFE downloads. Another recent product release is the ArincDirect Network Analyzer app, which helps customers see how they are consuming various types of content as well as troubleshoot connectivity problems.

Honeywell

The rapidly growing adoption of high-speed broadband via its JetWave hardware is the cabin connectivity headline at Honeywell Aerospace this year, but the company also introduced the GoDirect suite of connectivity services at the NBAA Convention, underscoring a shift

“from a transportation company into more of a software and services” company, said Curt Gray, senior director of connectivity support. Under a recent corporate reorganization, service and connectivity became one of four groups within the company, along with engines, cockpit electrical systems, and space and defense.

The GoDirect portal gives operators management tools and control over data usage to maximize efficiency and reduce data costs. While the majority of GoDirect services are aimed at cockpit and operational applications, real-time network information will also help operators optimize individual users’ connectivity experiences. Under an agreement with charter management companies Arab Wings and Gulf Wings announced at MEBA in Dubai last year, Honeywell will provide worldwide VHF and satellite data links for all capable aircraft in the operators’ growing fleets, enabling companies to track data usage across every aircraft via the GoDirect portal, among other applications.

Meanwhile Honeywell is relying on a dozen channel partners to develop STCs for JetWave installations on various aircraft models. A dozen STCs have been approved and two dozen more are in development, Gray said. “We prioritize platforms” in line for STCs, he said. “A lot [of partners] have a relationship with a customer’s platform. If one is working on a 737 BBJ, we know we’ll want an STC for BBJs. We leverage those partners’ experience and customer relationships.”

Future demand for high-speed service could be accelerated by a generational shift in corporate leadership. “Every few years, CEOs change,” Gray noted. “As younger, tech-savvy CEOs are coming, they’re using the Internet like crazy. In the

past, older CEOs would fly at night and use time in the airplane to sleep. Today people are using [business jets] all the time because they’re always connected.”

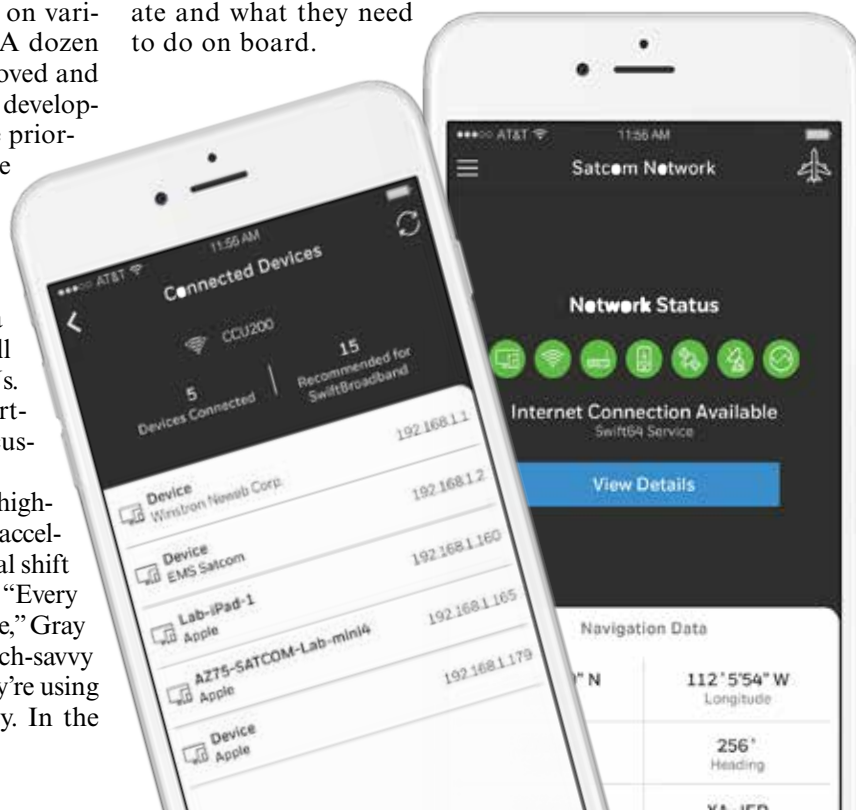
Honeywell has a five-year exclusive license as hardware provider to the business aviation fleet for JX service, and also offers SwiftBroadband from Inmarsat’s network. Meanwhile, Embraer is joining Bombardier and Gulfstream in providing factory installs of Honeywell’s system, selecting it for Wi-Fi service aboard the Lineage 1000E. Embraer has selected Ovation 2s, the new version of Honeywell’s Ovation Select CMS and IFE systems, as the baseline offering on the Legacy 450, 500, 600 and the Lineage 1000E.

AirSatOne

An Inmarsat and Iridium service distribution partner, AirSatOne eschews the integrated offering bandwagon. “We just sell airtime, not hardware,” said president Jo Kreamsreiter, a focus that allows him to offer clients unbiased advice on equipment and upgrade options based on their aircraft type, where they operate and what they need to do on board.

Though it doesn’t sell hardware, AirSatOne does offer Flightstream SA, a free, ground-based data-management and web-filtering and compression service that can speed up onboard connectivity and save on data usage, obviating the need for an onboard router, said Kreamsreiter. Flightstream SA requires no hardware or software installation on the aircraft.

The system is configurable via a web portal, enabling users to track and manage data consumption and change compression levels, either for a single aircraft or fleet. “We’ve been using this on a private 737, and we’re even on PC-12s,” Kreamsreiter said. Suitable for “smaller aircraft or cost-conscious operators looking to add in-flight broadband connectivity” according to Kreamsreiter, it works well in conjunction with Cobham’s Aviator 200, a light, compact airborne broadband transceiver with a low-gain Jet Blade antenna that supports broadband data and voice services. The system delivers 200 kbps via Inmarsat SBB, supporting emails with attachments, and smartphone and



Connectivity Projects and Programs



Global 5000/6000

Bombardier's new cabins for the Global 5000/6000, introduced at EBACE in Geneva in May, will have the OEM's version of Rockwell Collins's Venue cabin-management system. The ultra-fast fiber-optic system features dual-band Wi-Fi with dual Wi-Fi networks "because it's important that our passengers stay connected at all times to the cabin-management system as well as to the Internet," said Mathieu Noel, director of product strategy and design. The system allows any type of entertainment device or media source to run through a dedicated media bay in the galley area. It includes power ports, along with HDMI and USB inputs. The optional Honeywell JetWave Ka-band high-speed satcom installation was introduced to Bombardier Globals last year.

Bell Helicopter and Mecaer Aviation Group introduced at the Monaco Yacht Show

last September an interior for the in-development Bell 525 Relentless. The cabin's in-flight Entertainment Enhanced Lounge (I-Feel) incorporates Wi-Fi, moving maps, ambient light controls and audio/video functions, all manageable via smart device. Monitors can retract into the large consoles on which they're mounted, and windows change from clear to full tint electrochromically. A Speech Interference Level Enhanced Noise System (Silens) with limousine-style privacy window

quiets the cabin, allowing passengers to converse without using headsets.

GDC Technics has completed the first Ka-Band satcom installation on a private 787, the company announced at EBACE. The Texas-based completions specialist is "on track to deliver the STCs for installing the Honeywell Ka-band JetWave solution" for Airbus and Boeing private airliners "from the 747 down," said Muhammed Alzeer, GDC general partner. GDC has invested \$11 million on developing the STCs, rather than waiting for customers to ask for the installations, Alzeer said.

Airbus Corporate Jet Centre announced last fall the first installation of VoIP (Voice Over IP) technology on an aircraft, performed as a retrofit on an ACJ320 during an upgrade and heavy maintenance check. The VoIP installation allows making and receiving calls over the Internet, and the retrofit included upgrading Airbus SwiftBroadband satcom, which



Ka-Band



Bell 425



Nice HD CMS package

required replacing the aircraft's top fuselage skin panel.

FDS Avionics has partnered with MRO StandardAero to develop STCs for the Georgia company's Do Capsule, a wireless server enabling a suite of cabin IFE features. Products include Do 3D, providing 2D and 3D in-flight maps; the Edge series of monitors; and Do 360, a subscription service providing access to movies and other entertainment, including DRM-protected content such as the latest Hollywood releases through its partnership with Global Eagle Entertainment, primary provider of DRM content to the world's airlines.

Duncan Aviation became the exclusive U.S. distributor for Inairvation's Integrated Smart Cabin Upgrade (ISCU) for the Gulfstream G450 and G550, said Mike Minchow, v-p of service sales. The modular ISCU features a Lufthansa Technik (LHT) Nice HD CMS package that replaces the aircraft's out-of-production factory-installed CMS. Meanwhile, LHT itself completed two BBJs for Royal Jet, the world's first BBJs outfitted with Ka-band antenna systems in their initial completion. The systems support a fully digital mobile phone network (GSM) and high-speed broadband connectivity, and incorporate LHT's integrated niceview moving-map flight information system. □



The FDS do capsule makes available a suite of IFE options.

LOW-COST AIRBORNE CONNECTIVITY OPTIONS

	Company	Equipment	Description	Equipment price*	Airtime cost	Speed ("up to")
Air-to-Ground	Gogo Business Aviation	ATG (1000 through 5000)	Air-to-ground system, coverage begins above 10,000 feet. Coverage area Continental U.S., portions of Alaska and Canada. Two simultaneous voice calls plus texting, email with attachments. Up to five devices can connect simultaneously via Wi-Fi. System weight 17 lb. ATG-1000 includes Gogo Text & Talk to use own smartphone. ATG-2000 adds web-browsing, but extra fee required to add software key for Text & Talk. Gogo Business Aviation also offers cockpit applications for all systems, which enables connectivity for popular mobile device apps such as ForeFlight, FlightAware, Honeywell myGDC and WSI Pilotbrief Optima.	ATG-1000 \$35,000 ATG-2000 \$47,000	\$39 per hour for ATG-1000 service \$99 per hour for ATG-2000 service (\$39/\$99 per hour rates include data, voice, cockpit apps) Pay-As-You-Go \$6.95/MB Monthly rates from \$395/month for 60 MB and \$5.95/MB for overage to \$2,395/month for 2.5 GB and \$1.95/MB for overage Unlimited data \$3,995/month (voice calling is an added fee, from \$1.30 to \$1.50 per minute, depending on plan purchased)	3.1 Mbps
		Gogo Biz 4G	New higher-speed air-to-ground system. Same coverage area as ATG systems. Incentives available for upgrade from ATG4000/5000. Gogo Vision included, requires \$895/month subscription. Includes unlimited viewing of top 200 Hollywood releases or latest TV series/episodes.	\$126,000	Unlimited data \$3,995, streaming, voice calling requires additional fees	9.8 Mbps
	SmartSky Networks	SmartSky	Air-to-ground system, coverage begins above 10,000 feet. Coverage area Continental U.S. Service begins late 2017. System weight less than 40 lb. Requires two antennas. 4G LTE allows video streaming, email, text, voice calling (including VOIP, FaceTime, Skype).	\$93,000 (introductory pricing)	5 GB \$2,500 (\$500/GB) 15 GB \$3,800 (\$254/GB) 25 GB \$4,500 (\$180/GB) (all packages include voice calling)	4G LTE (actual speed not specified)
Iridium	Avionica	SatLink Max	Permanently installed Iridium system. Two voice channels. Two-box system, with Wi-Fi. Total weight 2 lb, 5 oz. Generally used for FANS and air traffic voice and data services.	\$45,000	NA	2.4 Kbps
	Bizjet Mobile	Chiimp Smart	Portable Iridium system, includes Bluetooth for wireless connectivity. Requires connection to Iridium antenna. Text and light email. Up to 10 simultaneous users. (Purchase price includes one year unlimited data, 500 minutes voice).	\$9,990	\$599/month	2.4 Kbps
	Garmin	GSR 56	Permanently installed Iridium system. Works only with certain installed Garmin avionics (does not have its own Wi-Fi or Bluetooth).	\$9,995	Starts at \$79.99 per month (includes unlimited texting, 30 minutes voice calling)	2.4 Kbps
	Latitude Technologies	SkyNode S100	Permanently installed Iridium system. Weight less than 1 lb. Bluetooth and Wi-Fi capable. Includes WAAS GPS receiver. Generally used for flight tracking, also S200 for FANS and air traffic voice and data services.	NA	NA	2.4 Kbps
	Send Solutions	Airtext	Portable Iridium system. Requires connection to Iridium antenna. Text and light email. Bluetooth LE, up to 16 users simultaneously. System weight 1.1 lb. Can be installed permanently or using Velcro for easy switching into other aircraft.	\$9,750	\$100 for 2,000 text messages (5 cents/text)	2.4 Kbps
		Airtext+	Same as regular airtext, but adds voice calling. Weight 1.2 lb. FAA STC'd.	\$14,950	Voice calls about \$1.60/minute (through Iridium service provider)	2.4 Kbps
	Skytrac Systems	Skytrac 2	Permanently installed Iridium system. Primarily for fleet-tracking, flight data monitoring. Offers voice and data services as well as Wi-Fi connectivity.	NA	NA	2.4 Kbps
	Wabnet	AviatorWifi	Permanently installed Iridium system. Includes Wi-Fi. Price includes antenna. Up to five simultaneous users. One voice channel text, light email. DO-160 compliant. Installable as minor modification for aircraft weighing less than 12,500 lb., according to Wabnet.	\$17,650	\$165 per month, includes 2.5 hours voice, unlimited data/text/emails	2.4 Kbps
Inmarsat Swift Broadband	BendixKing	AeroWave 100	Inmarsat SwiftBroadband system, works over most of the world except for polar areas. 3 to 4 simultaneous users. Voice calling, email, texting.	\$24,995 without router, \$31,995 with Wi-Fi router	\$40 per hour	104 Kbps, but 200 Kbps available at higher cost through Inmarsat service provider
	Cobham Satcom	Aviator 200	Inmarsat SwiftBroadband system, works over most of the world except for polar areas. 3 to 5 simultaneous users. Voice calling, email with small attachments, texting.	Less than \$100,000 installed	\$5 to \$7 per MB (through Inmarsat service provider)	200 Kbps

Notes: Mbps = megabits per second. Kbps = kilobits per second. *Unless otherwise specified prices do not include installation.