



## **Global Xpress® Land Terminal Features**

Raising the bar on VSAT

# A new standard for mobile connectivity

Inmarsat’s revolutionary high-speed Ka-band service, Global Xpress (GX), promises to deliver seamless global broadband connectivity via satellite unlike any other service currently available in the Very Small Aperture Terminal (VSAT) marketplace. Leveraging its leadership in mobile satellite communications terminal technology through its global L-band network, Inmarsat’s driving goal has been to deliver a user experience for Ka-band users that is simple, robust and high quality with customisable terminal systems for the Enterprise and Government markets - wherever the mission calls.

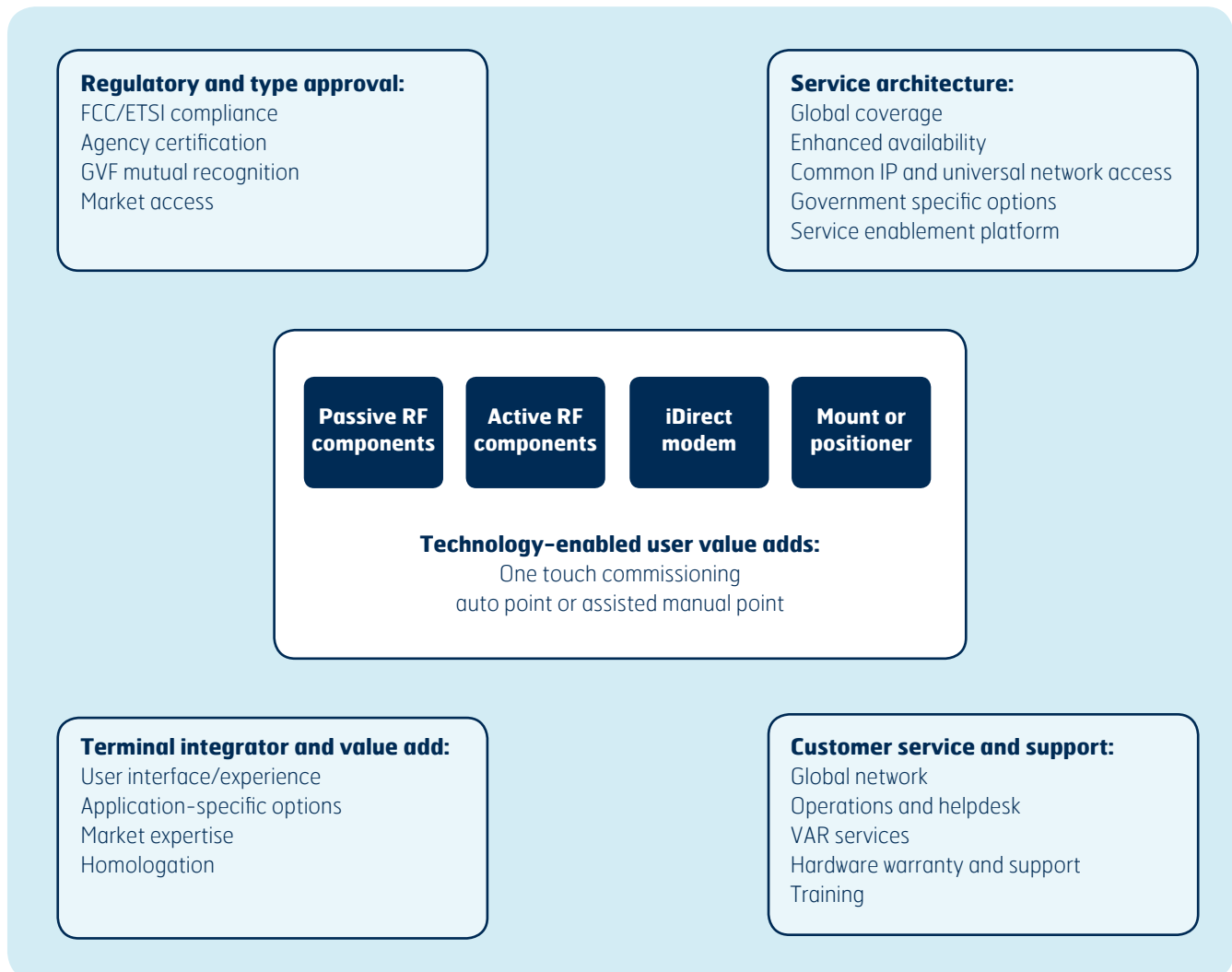
Built upon a new generation of iDirect networking technology called Velocity, a family of terminals to support users across the spectrum of needs and budgets is being delivered by Inmarsat in partnership with Cobham Satcom, L3 GCS, Paradigm Communications and Skyware Technologies.

Delivering simplicity, reliability and global mobility for a range of operator skill levels requires a unique approach to system design, integration and certification.

This paper outlines the five key components of GX terminals (Figure 1) that will deliver new levels of global mobility, ease of use and value to mobile VSAT users.

> A deliberate approach to network architecture development, paired with common user terminal integration requirements provides a unique opportunity to deliver more robust, consistent and high performance deployment options for users of land deployable VSAT systems.

**Figure 1: Inmarsat GX terminal value components**



## Core terminal features

From the outside, GX terminals have a similar look to other VSAT products on the market, and comprise four primary components. What is unique about these components is the way they are specially integrated in order to deliver Inmarsat GX's unique value proposition. Inmarsat takes all approved terminal providers through a rigorous design and acceptance test process to ensure the highest standards of quality and performance of the integrated system.

### iDirect modem

Also known as the 'Core Module', the iDirect CX750 Series of satellite modem products, released under iDirect's revolutionary Velocity architecture, is unique to Inmarsat GX terminals, integrated only by Inmarsat's family of approved partners. Supporting a range of features, including advanced adaptive modulation and coding techniques in both forward and return link directions, the iDirect technology is uniquely designed providing substantial dynamic range to combat the effects of rain fade, where legacy Ka-band systems have often suffered. Additionally, the CX750 Series provides advanced beam switching technologies to take advantage of Inmarsat's global architecture, and beam switching speeds not previously seen in multi-beam networks. Through Inmarsat's approved terminal partners, system configurations are available providing options for indoor or rack mounted core module enclosures, as well as ruggedised outdoor enclosures to provide greater deployment flexibility.

### Passive RF components

The terminal's passive radio frequency (RF) components primarily comprise the aperture (dish or reflector) and the terminal feed system. The design of these components is particularly critical in high frequency bands like Ka, where small design anomalies can have a huge impact on the performance of the entire terminal system. In particular, the reflector surface of Ka-band terminals must adhere to the highest standards of surface accuracy (often quoted as RMS, or Root Mean Square), in order to meet Inmarsat's stringent qualifications standards. Such qualification requirements ensure consistent and superior efficiency and throughput, and adherence to global standards for terminal performance which maximises the potential deployment locations of GX terminal users.

### Active RF components

At the heart of the transmit and receive capability of GX terminals are the signal amplification systems, provided through a Low Noise Block Down Converter (LNB) and Block Up Converter (BUC) or Transceiver (XCVR – BUC and LNB combination). The BUC or XCVR capability (quoted in terms of BUC/XCVR Power (Watts) and Gain (dBi)), the LNB capability and the size of the reflector will determine the transmit and receive performance, both throughput and link availability, for the terminal.

The harmonised operation of all modem, receive and transmit components of a satellite terminal is driven by a common electronic signal, known as the reference. During the early GX architecture design, Inmarsat and iDirect made a conscious decision to implement a 50MHz reference, over the traditional 10MHz reference seen in many legacy VSAT networks. Important for a number of reasons, the 50MHz reference is particularly critical for the transmit chain. Implementing a higher frequency reference signal produces significantly less phase noise, an important consideration in BUC performance. However, the use of a 50MHz reference also results in simpler componentry in BUC manufacture, improving reliability and environmental performance of BUCs and XCVRs.

### Positioner

The positioner or mount provides the stable base on which the terminal is mounted and pointed at the satellite. While a seemingly mundane part of the terminal system, the positioner's stability and accuracy is absolutely critical in high frequencies like Ka-band in order to meet stringent international regulatory requirements to minimise adjacent satellite interference (ASI). The Ka-band frequency range is up to two times higher than the next closest common satcom band, being Ku-band. As such, Ka-band signals are inherently narrower in beam width, providing greater scope for mispointing. This can result in the potential to radiate power onto adjacent satellites, and interfere with other satellite users and operators, as well as reducing transmit and receive throughput efficiency of the terminal. Each fraction of a degree a terminal is mispointed leads to less efficient signal transmission and reception, reducing the maximum potential data throughput of the terminal, waste of satellite resources and increasing the overall operational cost for the users of terminals.

As such, Inmarsat's terminal partners have implemented both manual and auto-point systems with terminals to support maximum terminal efficiency and pointing accuracy, taking the guess-work out of the terminal pointing process.

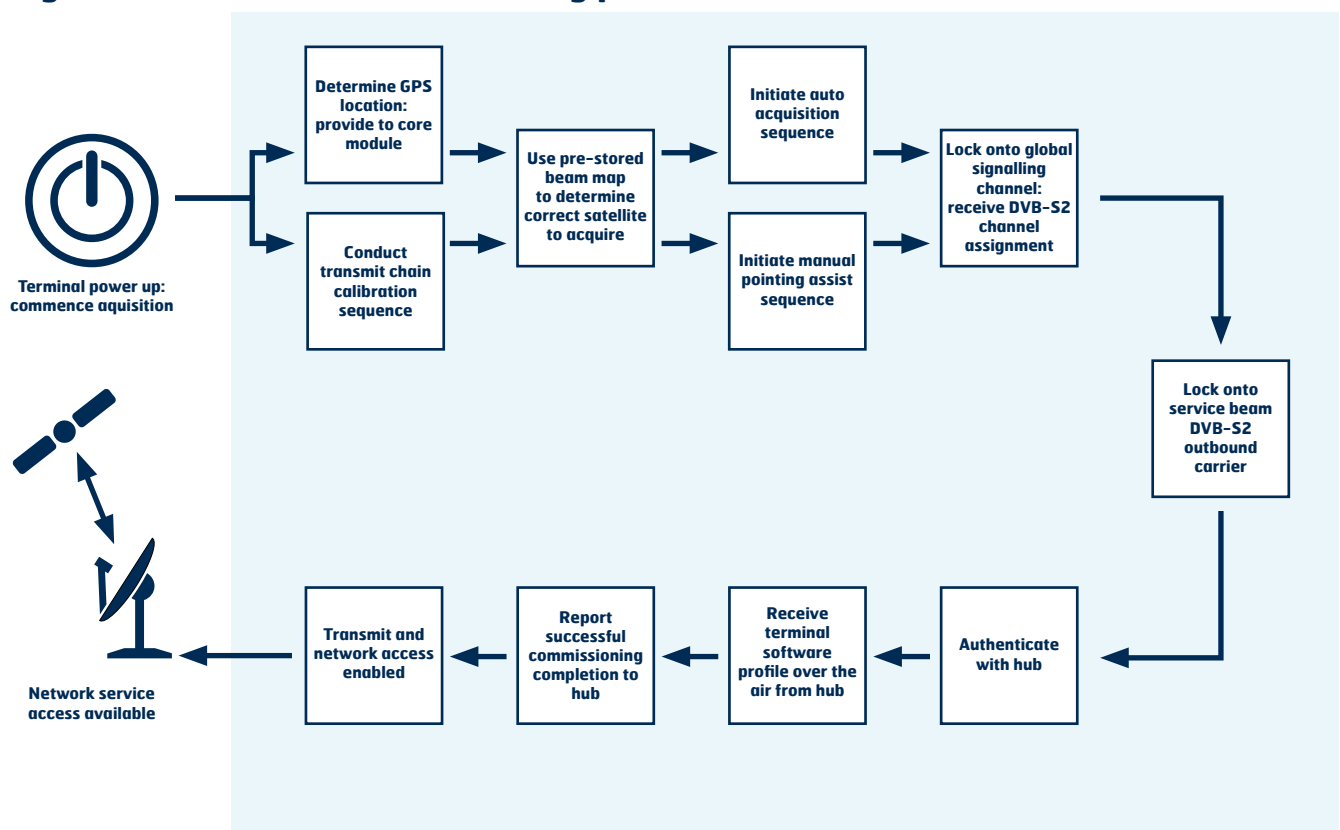
## One Touch Commissioning (OTC)

OTC is unique to the GX capability and common to all GX terminals. OTC is fundamentally a concept whereby the core module, BUC/XCVR and terminal positioner (or pointing mechanism for manual terminals) are tightly integrated through the implementation of a number of standard iDirect protocols, called OpenAMIP and OpenBMIP.

Pictured below, OTC is largely transparent to the terminal user, conducting a number of vital network commissioning processes that, in many cases, have been manual operations for users in the past when operating VSAT terminals.

- Automatic provision of the terminal's geographical location to the core module allows interrogation of pre-loaded beam maps to determine the most appropriate satellite to point to.
- BUC or XCVR calibration is conducted, driven by the Core Module, to determine the correct transmit power levels and attain the 1dB Compression Point (ie. the point where BUC input power ceases to be linearly related to BUC output power, thus reducing the efficiency of the BUC impacting terminal performance).
- Acquisition of the satellite is performed either automatically (by an Auto-Acquire feature fitted terminal), or manually. For manual terminals, users are guided by audible and visual cues from the terminal interface (eg. external GUI, smartphone app, laptop, etc.) to conduct both coarse and fine pointing sequences to attain the optimal terminal pointing to the satellite.
- First locking onto a globally transmitted Global Signalling Channel (GSC) and then guided to the respective service beam DVB-S2 broadcast channel, the terminal securely authenticates with the network hub and is transmitted configuration parameters from the hub, over the satellite link.
- Authentication of both Core Module ID and BUC/XCVR ID with the Hub, linked with a service profile to trigger access to network resources, ensures the terminal is in its approved configuration and will deliver the service level expected according to its design.

**Figure 2: One touch commissioning process**



Assuming the terminal is linked to a service plan with an authorised GX service provider, from commencement of the OTC process to network service enablement, there is no requirement for the terminal user to enter manual terminal configuration parameters, contact the network operations centre for permission to commission, or conduct manual terminal peaking with the satellite operator. The OTC feature provides unprecedented ease of use and deployment flexibility for GX terminal users. Inmarsat takes all approved terminal integrators through a rigorous design and factory acceptance process to ensure all GX terminals strictly implement these features, and maximise the user experience. Additionally, Inmarsat's participation in these design processes ensures its confidence in the expected performance of the terminal system to deliver the end user service levels across the globe.

## **Other terminal value enablers**

Besides the core technical enablers of the GX terminals, there are a number of factors that both enable and enhance the usability of terminals in a global setting.

- Regulatory and type approval
- Service architecture
- Terminal integrator value add
- Customer service and support

## **Regulatory and type approval**

Adherence to international and regional regulations regarding transmission systems and user devices is fundamental to supporting the global mobility value of GX terminals. Unconditional FCC and ETSI compliance of terminals is a cornerstone of this aspect, to ensure users have the confidence to operate terminals within these regulatory frameworks, and rely on protections that these also afford. As an extension of this, Inmarsat, as a global network satellite operator has committed significant resources to obtaining operating licenses in available key markets to deliver a truly global service offering to users that require the ability to deploy to global locations at short notice.

While adherence to national and international RF performance standards is fundamental to the reliable maintenance and operation of the satcom spectrum, the proliferation of a wide variety of VSAT systems has resulted in valid concerns over current and future RF interference. So called 'reactive' measures like carrier identification (CID) have been implemented to combat intentional and unintentional interference in single channel per carrier (SCPC) and digital video broadcast (DVB) systems, with much work currently underway by modem manufacturers (like iDirect) to design protocols to support TDMA waveforms. Inmarsat has also adopted proactive measures in the GX architecture design, similar to the highly successful and robust L-band MSS architecture, whereby many of the potential opportunities for RF interference are mitigated in terminal design and network operation. As a centrally controlled network architecture, and supported by such features as OTC, the GX terminal transmit frequency, transmit power, network timing, authentication and polarity are strictly controlled and verified by the central hub, transparent to the user, both at the initial time of commissioning and continually during terminal operation. This ensures the negative impacts of user error, terminal malfunction and malicious operation by GX terminals are quickly identified and eliminated. Inmarsat's type approval processes and involvement in the terminal design and qualification process with approved GX terminal manufacturers ensure technical compliance and high terminal quality.

Agency certifications, including such standards as CE and ROHS, ensuring conformity to product quality and safety standards, are also critical for legal use of terminals in many countries. GX terminal manufacturers are required to conform and certify to a number of such common standards, as well as certifying to local market-based standards where applicable.

Finally, Inmarsat's type approval standards for GX terminals are harmonised with the Global VSAT Forum's (GVF) Mutual Recognition Agreement (MRA). Members of the MRA initiative agree to a minimum standard for type approval of satellite terminals, in order to provide terminal fleet owners easier access to other GVF-member satellite operators, and minimise time and cost of type approving terminals.

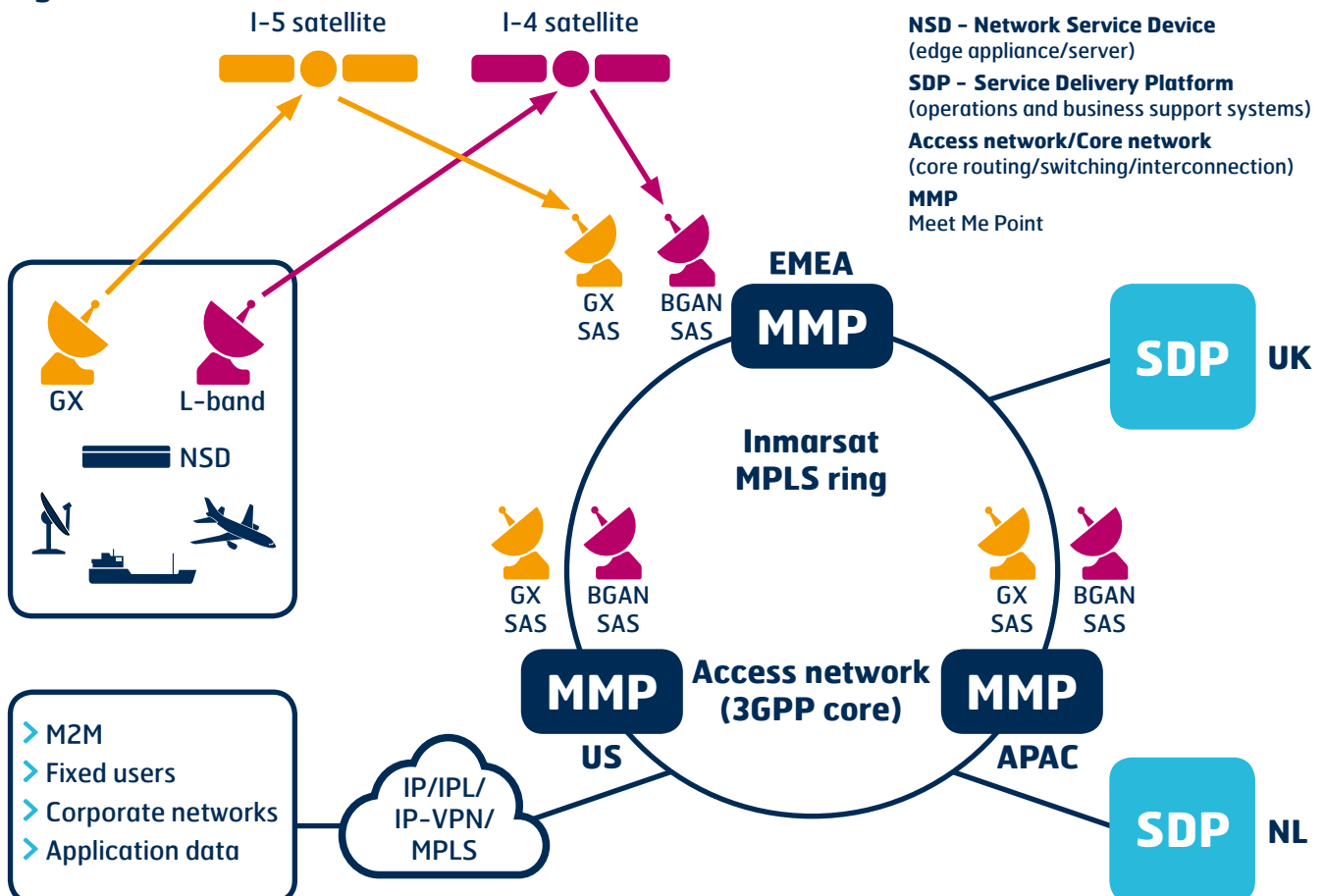
## Service architecture

Figure 3 below provides an overview of the Inmarsat network architecture, integrating existing global L-band networks with the new GX Ka-band infrastructure. Underpinned by the Service Enablement Platform (SEP), is a range of core and modular services including voice, web-browsing, video chat, content delivery and billing services. Enhanced end-user productivity is enabled through Inmarsat's Certified Application Provider (CAP) ecosystem, delivering a range of value-added apps to end users. Such capabilities, including sophisticated integration of new GX and existing L-band terminals at the user platform, are provided by the Network Service Device (NSD), a hardware or software enabled device, with 'one touch' installation for easy installation and activation.

Outside of some specialised military satellite networks, GX offers the first truly global end-to-end broadband solution for mobile users. Where users, like satellite newsgatherers, have had to contract in advance with various network service operators via a patchwork of hub and satellite networks, or delay network deployment until network access can be arranged, GX offers a single global network service from a single network operator. Implementing such features as a single global network IP address for a terminal, regardless of deployment location, and universal access via a network of Inmarsat-owned teleport facilities (whether Ka or L-band), deployment times and configuration changes are significantly reduced. Offering a fully geographically redundant teleport network also ensures maximum availability and access to network services at the terminal site, enhanced further when the end-user platform integrates GX and L-band terminal capabilities via the NSD, providing graceful degradation of services in the event of high rain fade events, while maximizing total network availability.

Augmenting the core commercial service architecture, a number of special features reflecting the need for enhanced security of operations are offered to specialist government users. Features like MAC-compliant teleport facilities (providing assured network connectivity) and discrete terminal operation (preventing GPS location transmission from the GX terminal to mask operational location) provide a secure overlay to the core operational environment for GX terminals.

**Figure 3: Inmarsat network architecture overview**



## Terminal integrator value add

While all terminal integrators will conform to a standard core implementation of the networking and RF technology to comply with GX requirements, individual integrators have significant latitude to customise terminal solutions in order to meet specific market and customer requirements. Indeed, GX-approved terminal manufacturers have been selected because of their market experience in different verticals, as well as unique capabilities to add value for these verticals through their approach to integration. Whether through physical value-added features (like terminal packaging, transportability enhancements, modular features, peripheral device interfaces, etc.), or software enabled value-added features (like mobile device apps for terminal pointing, customised graphical user interfaces, etc), the terminal, supported by the core GX technology previously discussed, can be specified and adapted to meet the mission needs of users across all vertical markets.

In addition, homologation is a term related to the compliance of user terminals with individual national requirements for hardware operation in the country of use. As globally postured manufacturers, GX approved terminal partners are experienced in the processes related to homologation of terminal hardware for use in global market destinations, and work closely with Inmarsat, VARs and Service Providers to gain necessary certifications for terminal operation in user required areas.

## Figure 4: Sample GX launch terminals



## Customer service and support

The final element of the GX terminal solution ensures once the terminals are purchased, distributors and end users have access to the necessary training, network support, and after sales support to enable the success of their various communications missions. Terminal partners work closely with Inmarsat's VARs to structure and deliver training, equipment support and warranty services leveraging terminal partner and VAR networks around the world. Additionally, Inmarsat's role in taking terminal manufacturers through the design and development process helps ensure reliable terminal performance and a high level of supportability for the various network support tiers.

The Inmarsat Training Academy also ensures VARs and end-users are equipped with the training and support mechanisms to maximise confidence in end-user operation of terminals in the field, as well as the quality of tiered network support organizations whether provided by VARs or Inmarsat help desk facilities. The Training Academy will provide a mixture of user and 'train the trainer' course suites covering all levels of user needs from high level management awareness training, through to operator level maintenance across the range of approved products.

## The final word

While redefining the standard for delivery of truly global communications for critical government and enterprise missions, Inmarsat is committed to a similar shift in the quality and usability of the VSAT products used to access the GX networks, through its partnership with a range of technology and terminal manufacturing partners. Acknowledging the user terminal is not just a dish and modem, but a complex collection of technical and non-technical components (shown in figure 1) enabling an end-to-end communication solution, is central to this philosophy.

Inmarsat's catalogue of user terminals will be available for network service operation from mid-2014 on the I-5 constellation, available from Inmarsat resellers and manufacturing partners.

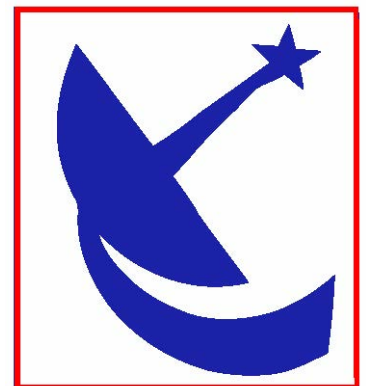
**COBHAM**



**GCS**



H.M.S. Telecom, LLC  
PO Box 701156  
Houston, Texas 77270-1156  
U.S.A.  
Phone +1 (832) 298-5003  
Fax +1 (832) 550-2802  
Email [sales@hmstelcom.com](mailto:sales@hmstelcom.com)  
[www.hmstelcom.com](http://www.hmstelcom.com)



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