



LAND MOBILITY MARKET OVERVIEW

The Drive for Greater Connectivity

Land Mobility refers to a range of land-based vehicles and markets that need connectivity on the move to maximize utility. Markets from defense to agriculture to transportation now have vehicles enabled with new levels of intelligence that can generate large amounts of data and interact with both the people and the environment around them. On board these moving vehicles, applications bring information and entertainment to passengers, sensors track the health of engine components or goods in transport, critical software updates keep vehicles operating safely, and system automation increases operational efficiencies and simplifies complex operations. As these technologies advance, so does the importance of connectivity to the future of Land Mobility.

Meeting New Land Mobility Requirements With New Satellite Technologies

Among the many markets contained in Land Mobility, the “connected car” has uniquely captured the imagination of consumers, and so it tends to get most of the media coverage. But despite what the headlines say, connected car is only one part of Land Mobility, which encompasses many different markets beyond automotive, each with unique requirements that rely on a variety of communication technologies such as cellular, Wi-Fi and satellite.

Satellite has historically been regarded as a technology of last resort (beyond the giant dishes known for the broadcasting industry where it has been the primary transmitter for decades). Its unique capabilities have usually not outweighed its higher total cost of ownership and other limitations. Today, Land Mobility markets are beginning to rely on new developments in satellite technology as part of their overall connectivity strategy to enable business and process improvements. Very small aperture terminal, or VSAT, satellite technology is steadily gaining momentum to meet this higher demand for connectivity across mobility markets including land sectors.

Satellites Serving A Widening Range of Market Use Cases

Major satellite industry shifts are making satellites a viable and cost-effective prospect for Land Mobility use. First, VSAT’s latest terminals are more suitable for size, weight and power requirements of vehicular mounts, that is, they are smaller and lighter than ever. Flat panel antennas that are form fitted for lower profile uses are steadily becoming mainstream, and even more sophisticated electronically steered antenna technology looks very promising to Land Mobility in the near-term future. These hardware advances along with incredible waveform developments are the ground segment response to the enormous growth in capacity and performance of high throughput satellites (HTS). The power of these HTS beams allows considerably smaller antennas to do a better job than their larger counterparts. The industry is currently experiencing another technology step change as an entirely new class of constellations come online offering additional capacity, performance, and flexibility.

Across Land Mobility markets, some common requirements are forming. At the top of the list for enterprises, these requirements include business intelligence and automation to increase performance, growing use of sensor data analytics, and simplifying processes. The operational efficiency gained through these real-time applications promises enormous value that far outweighs the initial investment.

MARKET DRIVERS & USE CASES

Bus/Coach	Rail	Trucking, Mining, Agriculture & Heavy Machinery	Emergency & First Responders	Automotive
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VSAT-supported connectivity is the best option for customer entertainment on buses in operation around the world, especially for longer distance and intercity transport on roads and in regions that don't have consistent connectivity. Broadband will strengthen operational efficiencies in safety and security, fleet management, telemetry and on-board diagnostics helping to extend the life of these vehicles.

In the rail industry, digitalization is having an impact in both freight and passenger rail segments. The rail industry is working to standardize communications technologies to create a path to greater performance and insight. VSAT technology is being used to provide connectivity across vast areas that are covered by tracks but may have insufficient coverage by other access technologies.

Bringing intelligence to vehicles operating in harsh environments, travelling across long distances, or working off the grid improves situational awareness, efficiency, business operations and profitability. Agriculture, mining and trucking sectors show tremendous growth in IoT applications. Increasing connectivity requirements to collect and use data.

The reach and reliability of VSAT makes it vital to many different use cases during times of emergency, often because other communications technologies cannot cover the area of need. From emergency response to border patrol, the need for reliable communications is essential to keep people safe and connected to loved ones.

Connected cars and autonomous vehicles will revolutionize land transport as we know it. Vehicles will soon begin to consume as much data as they generate using such innovations as high-density maps for autonomous operations. VSAT technology will enable land transport vehicles with guaranteed continuity of service complementing other access technologies.

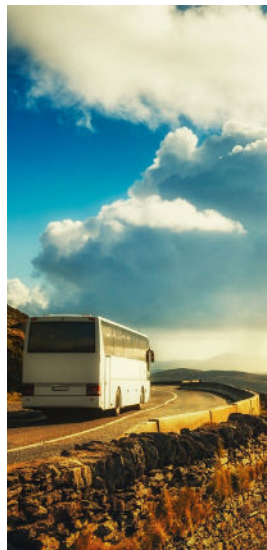
- Passenger infotainment for long intercity routes
- Fleet Management, telemetry and onboard diagnostics
- Driver monitoring and video surveillance

- Passenger connectivity and entertainment
- Passenger information and payment systems
- Operational efficiency improving performance and fuel consumption
- Preventative maintenance for engine and other key mechanical elements
- Real-time video surveillance for security and monitoring of safety systems

- Vehicle monitoring and fleet tracking
- Driver/worker safety and activity tracking
- Remote or autonomous vehicle operation
- Load management, freight condition monitoring
- Optimizing production volume, cost and capital expenditure, process improvement
- Heavy equipment maintenance and performance analytics

- Critical communications during natural disasters or terrorist activity
- Border security in isolated areas or during times of conflict or pandemic
- Command center connectivity, situational awareness or ISR
- Essential government services after infrastructure failures (healthcare, banking)

- Frequent software updates to improve vehicle operation
- Infotainment and content delivery with multicast capabilities
- Data offload for non-latency sensitive applications
- Backup path for other access technologies
- Increased availability of eCall services



The ST Engineering iDirect Solution

ST Engineering iDirect is the leader in satellite ground infrastructure and platforms with over 20 years of experience in mobility, offering a diverse range of boards, modems and terminal solutions that span a variety of use cases.

Leading satellite operators and service providers around the world rely on our multiservice platforms to deliver exceptional performance, efficiency and service capabilities with the scale and flexibility necessary to meet global connectivity requirements. Our platforms are designed to provide the highest quality of service (QoS) across a full spectrum of network sizes and bandwidth requirements while minimizing capital and operational expense. This becomes even more important when supporting large segments in land mobility where service providers require a VSAT platform that can scale to meet demand and seamlessly integrate into a hybrid networking environment.

At ST Engineering iDirect we offer market-leading platforms with unique attributes that help our customers choose the best option for their service offerings.

The Velocity platform is designed for satellite operators who provide managed services for large HTS networks that require massive scale. Velocity's bandwidth management capabilities make it easier for satellite operators to offer unique packages

for their multi-spot beam capacity that better meet global customer needs. Advanced mobility features have made Velocity an especially popular choice for large networks in maritime, aero and Land Mobility.

Evolution, our most installed platform across our partner network, combines efficiency and performance with flexible management and QoS capabilities. It's ideal for starting small with pay-as-you-grow options all the way to large deployment supporting many different markets and services based on specific business objectives. Evolution has also been deployed in many government and military environments with enhanced security options.

Dialog is built for flexibility and performance allowing the service provider to address multiple markets by optimizing the usage of infrastructure and satellite capacity with advanced mobility capabilities to support high-capacity links. The scalability of the Dialog platform allows service providers to easily adapt Dialog to their specific needs. With its Mx-DMA® return waveform technology service providers must no longer choose between different technologies. This patented multi-access waveform incorporates the scalability of MF-TDMA with the efficiency of single channel per carrier (SCPC) into a single return technology. Now service providers can cover a myriad of use cases in a single return link without making tradeoffs between speed, efficiency, scale and cost.

SATELLITE IOT FOR SERVICE PROVIDERS

The Internet of Things (IoT) – an expanding ecosystem of connected devices, industrial sensors, and intelligence sharing assets – is on a rapid growth trajectory.

The GSMA report that by 2025 there will be more than 30 billion IoT devices connected with the information grid. They report the market size will be double the size of PC, smartphone, connected car and wearable markets.

Service providers that want to build new IoT service offerings will require a highly efficient, cost-effective solution. They need a path forward that mitigates risk and amplifies reward. ST Engineering iDirect offers its customers a complete IoT connectivity solution comprised of an IoT optimized waveform, a cloud-based NMS, and a small form-factor IoT terminal for mobile applications. The key for customers is that our IoT solutions are built on our scalable iDirect Evolution®, iDirect Velocity®, and Newtec Dialog®.

IoT Solution Dynamic Terminal

- Compact solution for portability and mobility use cases
- Phased array antenna for automatic acquisition and tracking
- Fast beam switching with polarization and frequency switching
- Portability for COTM out of the box
- Mobility provided through optional one-time license add-on

LAND MOBILITY PLATFORM ADVANTAGES

ST Engineering iDirect is the leader in SATCOM ground systems for mobility-based markets. Our VSAT platforms enable our partners to successfully offer unique services through a suite of industry-leading capabilities. As the leader in VSAT mobility, we have tremendous experience working with our customers to implement features based on real market requirements and constant feedback. As Land Mobility markets' demand for VSAT rises, ST Engineering iDirect will leverage its considerable expertise in aeronautical and maritime to address Land Mobility use cases.

Multi-service, scalable platforms	Serve multiple segments on the same platform to maximize revenue and lower the risk
Very highest throughput rates	Powerful DVB-S2X outbound and Mx-DMA return link waveform technology to optimize capacity
Increased network availability	Waveform technology that automatically adjusts to changing conditions
Advanced Quality of Service (QoS)	Automatic bandwidth allocation and traffic prioritization in a shared bandwidth pool enabling the creation of tiered services with guaranteed SLAs
Security	Ensuring secure links with 256AES link encryption
OpenAMIP support	A standardized interface between modem and outdoor antenna equipment (ODU)
Terminal integration	A range of terminal partners who can integrate our technology for land mobility markets
Automatic beam switching	Enable vehicles in motion to switch quickly between satellites and beams with no manual intervention
Fast acquisition and re-acquisition	Instantaneously connect and keep constant connectivity to the user during beam outages
NMS and Tracking	Configure and manage onboard remotes and monitor to ensure high-quality connection
VL-SNR	Improved link resiliency and bandwidth efficiency for small, disadvantaged antennas
Spread spectrum waveform technology	Support very small, cost effective antennas on land vehicles
Layer-2-over-satellite	Seamless integration with terrestrial networks



UP IN
SPACE

IN THE
CLOUD

ON THE
GROUND

A Change is Coming

Next-generation Satellites

The expansion of capacity by non-geostationary (NGSO) satellites in low- and medium-earth orbits will have a dramatic effect on the quality of satellite service once such constellations are in full operational service. Leveraging the inherent characteristics of each orbit will help drive down costs, allow for further reduction in terminal size, increase performance capabilities, and result in a wider range of solutions. Satellites in every orbit are becoming more flexible through software-defined capabilities that allow for satellite reconfiguration on orbit. Ground infrastructure is responding with its own innovations to meet new demands and achieve greater scale associated with expected growth. Ultimately, service providers will switch between beams, satellites, constellations and other access technologies to provide the coverage and availability that is needed in Land Mobility environments.

5G Impact

The proliferation of 5G technology is enabling a broader communications structure to be established. But realizing the full promise of 5G requires the implementation of industry standards for all access technologies, so ST Engineering iDirect is aligning our platforms with the 3GPP and MEF standards. For a communications provider, such standards make it possible to set up, provision, configure and manage traffic across networks with high levels of automation and to route traffic between the various access technologies.

As 5G rolls out, we are moving into an environment of decoupled software and hardware. Software-defined satellites

and software-defined networking solutions deliver much greater speed, flexibility and power. Shifting customization to the software side has significant cost savings. This is good news for Land Mobility service providers because in a virtualized environment, operators can quickly adapt their network to optimize capacity and services in real time.

Hybridization

It's true that cellular connectivity is the best option in urban areas where the coverage, density, availability and speed of the network surpass other technologies. But the quality and reliability of a cellular network can vary greatly outside of metropolitan areas where satellite often has great coverage and availability. So attaining a seamless experience of connectivity as cellular coverage dwindles requires a hybrid solution. As powerful as cellular is, it can't stand alone as the single access technology.

Only a truly hybrid ecosystem can adeptly support "always-on" access for Land Mobility users and move data seamlessly across terrestrial, wireless and satellite networks. Communication service providers know this, and they are increasingly developing hybrid solutions that provide high-quality, high-availability services and offer customers access to the latest applications. These emerging hybrid networks require the interoperability of 4G LTE, IoT, satellite, and the imminent ubiquity of 5G, which reinforces the necessity of standardization across all of these access technologies. Taken together, these advancements in satellite, cellular and networking are bringing a more cohesive telecommunications fabric to fruition.



Bringing It Together

Land Mobility sectors are prioritizing connectivity. End customers want communications solutions that allow them to be more productive, more efficient, and more intelligent across a fleet. ST Engineering iDirect Land Mobility technology is committed to bringing the value of satellite solutions to customers in concert with the broader telecommunications ecosystem. Our platforms enable service providers the advanced mobility features necessary to offer customized satellite or hybrid services to the full gamut of Land Mobility customers.