TRAIN AND TRACKSIDE USE CASES FOR SATELLITE CONNECTIVITY

Enabling the rail industry to reduce maintenance costs, improve network efficiency and safety outcomes

ABOUT INMARSAT

GLOBAL MOBILE SATELLITE COMMUNICATIONS

Market leader since **1979**

Fleet of **14** satellites deliver communications to land, sea and air

Revenues of **$1.5 billion**

Private owned by **Connect Bidco**

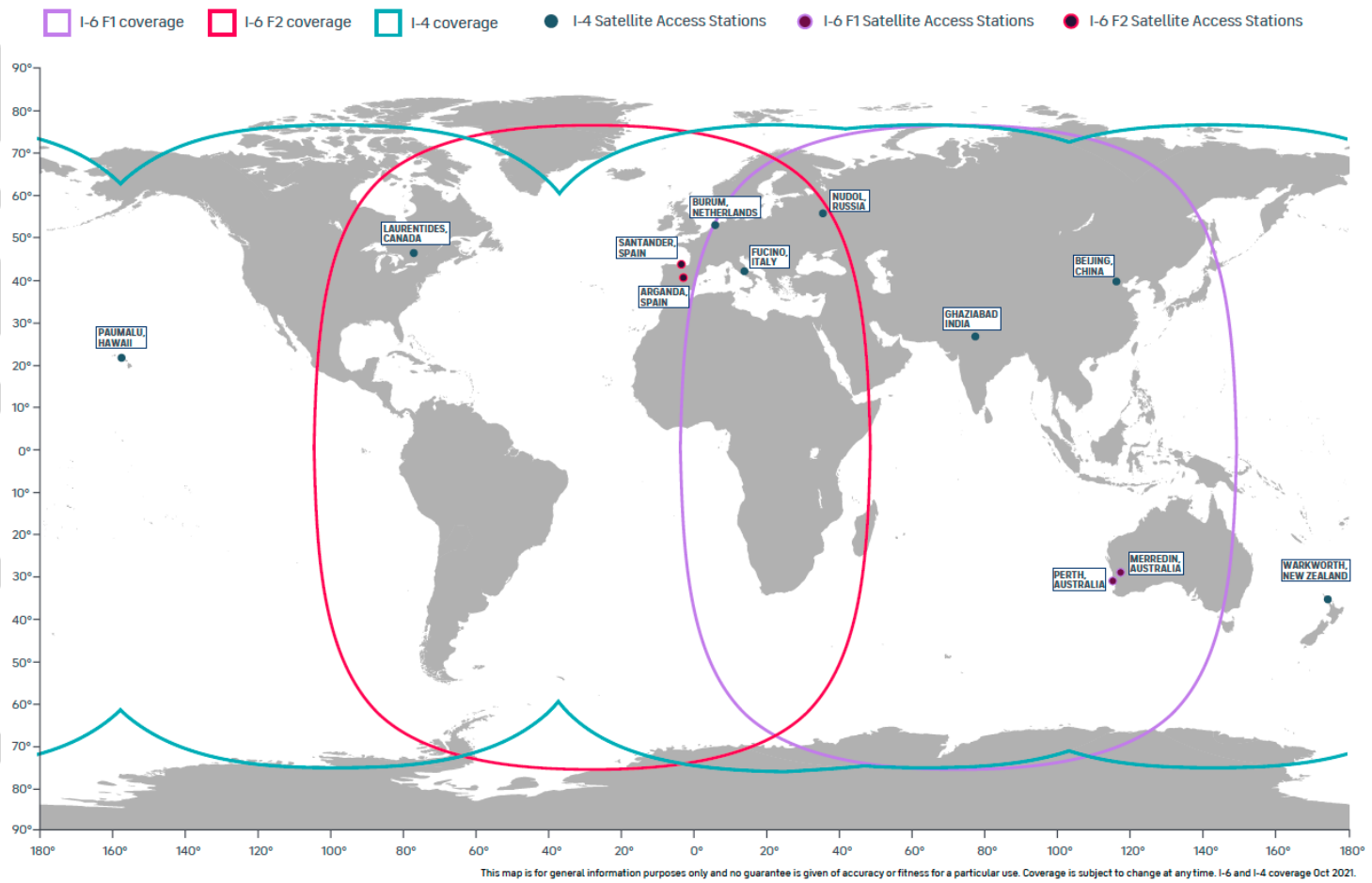
60 locations across the world

2,000+ staff

24/7/365 customer support

Solutions delivered through **5** business units:

- **Maritime**
- **US Government**
- **Global Government**
- **Enterprise**
- **Aviation**


I-6 F1 coverage
I-6 F2 coverage
I-4 coverage
I-4 Satellite Access Stations
I-6 F1 Satellite Access Stations
I-6 F2 Satellite Access Stations
LAURENTIDES, CANADA
PAUMALU, HAWAII
BURUM, NETHERLANDS
NUDOL, RUSSIA
SANTANDER, SPAIN
FUCINO, ITALY
ARGANDA, SPAIN
BEIJING, CHINA
GHAZIABAD INDIA
PERTH, AUSTRALIA
MERREDIN, AUSTRALIA
WARKWORTH, NEW ZEALAND
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CHALLENGE #1: NEW SIGNALLING AND TELEMETRY-BASED SOLUTIONS REQUIRE UBIQUITOUS, HIGHLY RELIABLE CONNECTIVITY

$59,000 – $170,000/km The cost of deploying dedicated infrastructure to achieve ubiquitous connectivity on the rail network*

Challenges

- **Cost of connectivity:** most rural rail networks do not have full public terrestrial coverage. Infrastructure managers and operators have turned to dedicated networks to overcome this which are expensive.
- **Equipment and infrastructure is the largest cost** of deploying dedicated infrastructure
- **Cost can be higher on rural lines**

*Based on a per km figure that is based on deploying GSM-R. Assumes a 10 year infrastructure lifetime. Low estimate based on Rispoli (2020) and Systra (2016), high estimate based on Network Rail published costs for GSM-R rollout available here.

CHALLENGE #2: MORE AND MORE TRACKSIDE EQUIPMENT NEEDS TO BE CONNECTED TO CREATE OPERATIONAL EFFICIENCIES, IMPROVE SAFETY AND REDUCE DOWNTIME

It is often not practical to deploy terrestrial connectivity to remote and rural sites

5,800 train – car crashes on rail networks each year in the United States – most on un-monitored level crossings*

Challenges

- **Cost of control of trackside equipment is high,** mainly due to the cost of cabling and civil works
- **In rural areas the cost is even higher** due to an increased cabling requirements and lack of access to power
- **Cable is vulnerable to theft** which leads to significant extra costs and downtime
- Un-monitored infrastructure such as level crossings and bridges **raise the risk of accidents significantly** and **are costly to manually monitor as well as increasing occupational safety risk**
- **But rural areas suffer from a lack of reliable connectivity** making terrestrial wireless solutions deployment challenging – satellite is a cost-effective solution to this problem.

*US Department of Transportation

Enabling Digital Rail through Satellite Connectivity

On the Crew

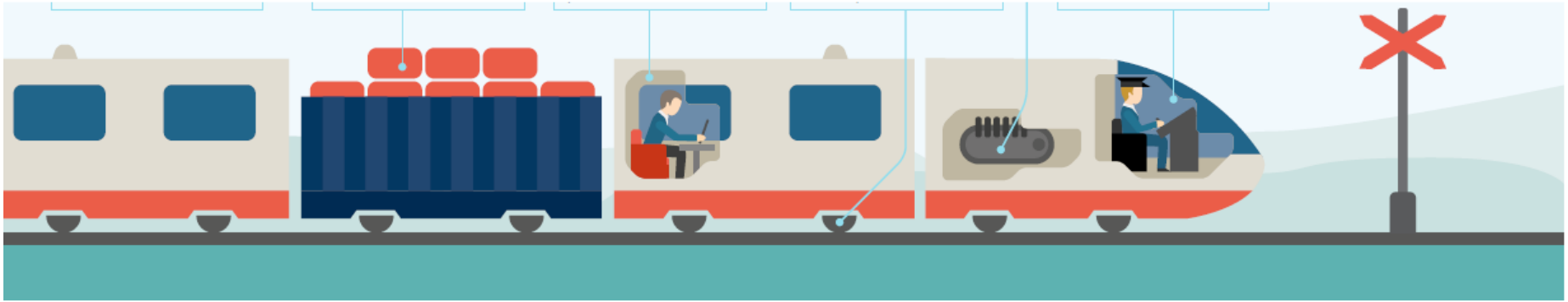
- Connecting maintenance crews

On the Train

- Cargo Monitoring
- Passenger Services
- Transfer of Telemetry Data & Signalling Systems
- Extending voice communications

On the Track

- Environmental Monitoring
- Emergency Telephony
- CCTV



What if you could take advantage of highly reliable communications bearer that works everywhere – deployed at a fraction of the cost of private terrestrial networks?

ELERA

Guaranteed Reliability

- Unmatched **99.95%** network availability
- Complete, consistent **global coverage**
- Relied on by **000's** of businesses & **80+** governments worldwide for **over 40 years**

Scalable and Flexible

- Achieve ubiquitous connectivity **50-70% cheaper than with dedicated networks** by using Inmarsat satellite as part of a multi-bearer architecture
- Can be deployed almost **anywhere** for reliable connectivity, either as a primary bearer or a backup.
- **Compact terminals** rated for mission critical applications
- **Low power consumption** terminals - can be powered by renewable energy such as solar in a standalone system.

INMARSAT IS THE LEADING SATELLITE OPERATOR IN THE RAIL INDUSTRY

Satellite as part of a multi-bearer 5G architecture for ETCS

Mobile satellite connectivity for Point of Sale applications and driver radio in Colorado

Enabling location based telemetry services for Heavy Haul Rail

Enabling location based telemetry, access to internet applications and voice communication

Enabling voice communications and application access for maintenance crews

L Band connectivity enables driverless trains in Western Australia (Level 2 ERTMS)

Inmarsat's Services

Land Xpress

Ka-band

Up to 16 Mbps receive, 4 Mbps send

Live video and audio streaming, high-speed broadband for internet access, high-speed file transfer, video surveillance

Highly portable broadband solution for remote workers

BGAN

L-band

492kbps

Mobile connectivity for train telemetry data, voice over IP, data backhaul, video streaming, transfer of critical safety data

Rail signalling and critical comms, emergency voice communications for driver and crew, communications for remote workers

BGAN M2M

L-band

Up to 448 / 464kbps (send / receive)

Data backhaul, Remote fixed asset monitoring, video and mage capture of trackside environments, control of wayside objects, backhaul for long range networks

CCTV, environmental monitoring, image capture, wireless wayside object control

LoRaWAN enabled end devices

IsatData Pro

L-band

6,400 / 10,000 bytes (send / receive)

Environmental monitoring, data backhaul for sensors, control of trackside infrastructure, cargo tracking, low resolution image capture

Environmental monitoring, cargo and wagon tracking, remote monitoring of sites non-critical telemetry data

IsatPhone 2

L-band

2.4kbps voice codec

Voice, SMS, short- message email, tracking and emergency assistance

Emergency voice communications for remote crew

CASE STUDY: AUTONOMOUS TRAINS

A HIGHLY RELIABLE COMMUNICATIONS BACKBONE FOR DRIVERLESS TRAINS

- Inmarsat is working with a leading mining operator to enable their autonomous train system on 1,500km in the Pilbara region of W. Australia
- Inmarsat's BGAN connectivity solution employed on 200 locomotives to provide network resiliency and black-spot failover for a private TETRA network
- + 500,000km travelled to date with BGAN used as primary telecom bearer for Automatic Train Protection & Automatic Train Operation – a world first for the use of satellite as part of critical safety systems

Case Study: Remote Monitoring and Control of Critical Infrastructure

- Inmarsat's Elera network enables remote monitoring and control on tens of thousands of assets worldwide
- Terminals have a very low power consumption and are easy to install and maintain
- Typical lifespan is 15 years with minimal/no maintenance
- Remote diagnostics as standard
- Low power consumption, typically used with solar + battery
- Small form factor and robust – frequently used for critical infrastructure

Use Cases		
	Environmental Monitoring	▪ Monitoring trackside conditions to alert if there are landslides, flooding or other adverse events.
	CCTV	▪ Enabling CCTV in remote locations for monitoring of yards, level crossings and other sites to enable prosecutions and security.
	Emergency Telephony - Lineside	▪ Enabling emergency fixed line telephony in remote locations with no connectivity or power

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ORCHESTRA

A unique, multi-dimensional, dynamic mesh network

ELERA (L-BAND)

A critical layer of always-on connectivity with all-weather resilience.

GLOBAL XPRESS (Ka Band)

Reliable, high-speed, global coverage with security and full redundancy.

LEO

Small complementary constellation layering additional high capacity over further high demand areas.

TERRESTRIAL 5G

Ultra-high capacity at high demand hot spots - supplemented by the power of dynamic wireless mesh networking.

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