RADWIN FiberinMotion®

Train-to-Ground Wireless Broadband Communications

Ron Porter, Transportation Solution Expert
RADWIN is a leading provider of **Sub-6 GHz broadband wireless solutions** for telecom operators, transportation, public safety, critical facilities, oil & gas

- Offers **carrier class** high capacity, wireless solutions for fixed and mobile connectivity
- Complete portfolio of point-to-point, point-to-multipoint and mobility solutions
- Proven installed base in over 150 countries
- Global presence with offices in major locations and a network of partners
RADWIN Target Markets

Carrier Market:
High-capacity access and backhaul connectivity to underserved urban and rural environments and advanced small-cell Non-Line-of-Sight (NLOS) backhaul in dense urban environments

Vertical Market:
broadband wireless transmission for government and enterprise, including fixed and mobile video and data applications

Public Transportation:
Highly reliable wireless train-to-ground communications, including complex environments addressing winding underground tunnels and NLOS scenarios
Deployed in Over 150 Countries
RADWIN Solutions for Vertical Markets

Public Transportation
Public Safety
Municipalities
Oil & Gas
Airports
Utilities
Mines
Education
Finance
Maritime & Ports

RADWIN 5000 PtMP
RADWIN 2000 PtP
Fiber in Motion Mobility
RADWIN SOLUTIONS FOR RAIL & METRO
Broadband Services for Transportation

**OPERATIONS**
- Signaling and CBTC
- PA systems
- Information offload at Depot
- Maintenance information

**SAFETY & SECURITY**
- Real time CCTV
- Level crossing real-time view by the driver
- Stations view by the driver

**PASSENGER SERVICES**
- Internet access (Wi-Fi)
- PIS - Passenger Information Systems (news, weather, commercials)
- VOD - Video On Demand
Complete Solution for Train-to-Ground Communications

- FIBERinMOTION®
  - Train-to-Ground Wireless Mobility

- Management Tools

- Services
Radwin Fiber in Motion Solution Architecture - Underground

- Radio Mobile unit (HMU) installed inside the train, connected to 2 special train antennas installed on top
- Optional dual radio + antennas to improve redundancy and coverage

- Radio Base Stations (HBS) deployed along the tunnel, supporting multiple trains simultaneously
  - 2/4 antennas
  - Optional redundancy

Typically 1Km / 0.6M
RADWIN FiberInMotion Solution Architecture – Above Ground

- Radio Base Stations (HBS) deployed along the route, supporting multiple trains simultaneously
- 2/4 antennas directed eastbound and westbound for extended coverage
- Optional redundancy

- Radio Mobile unit (HMU) installed on-board the train, connected to 2 x train antennas installed on top
- Optional dual radio + antennas to improve redundancy and coverage
High capacity: Installed and proven to deliver up to 100Mbps per Base Station / Mobile Unit

Extended coverage for each Base Station
  - Up to 1Km/0.6miles underground
  - Up to 5Km/3miles above ground

High speed – up to 300 KMH / 190 MPH

Uplink / Downlink configurable asymmetric traffic

Guaranteed bandwidth per train

Seamless handover < 50msec (without a controller)
- Guaranteed bandwidth per train
- QoS over the air, enabling prioritization of multiple services
- Optional redundancy 1+1
- Low & fixed latency and jitter
- IP67 outdoor support
- Support of railway standards
  - EN 50155, EN 61373, EN 50121
- Multiband support in a single H/W
- Customization capabilities (special frequencies, architecture, etc.)
RADWIN Solutions for Rail & Metro – Management Tools

MANAGEMENT TOOLS
- Network Planner
- Radio Network Management
- Real-time Performance Monitoring
- Offline Analysis application
- Drive Test Tool
1. RADWIN Manager

- SNMP based local and remote management
- Management of a complete Link with a single IP address
- On Line Monitor of the air interface and the services

- Supports Traps and Alarms
- Includes:
  - Local and remote
  - “Over the air” SW upgrade for multiple links
  - Performance Monitoring
  - Active Alarms
  - Backward compatibility
# 2. RADWIN RNMS Network Management

<table>
<thead>
<tr>
<th>Features</th>
<th>PLATINUM</th>
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<tbody>
<tr>
<td>Managed Links</td>
<td>Up to 10,000</td>
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<tr>
<td>Managing Clients</td>
<td>10</td>
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<tr>
<td>Automatic Network Discovery</td>
<td>✓</td>
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<tr>
<td>Hierarchical Network Views</td>
<td>✓</td>
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<tr>
<td>Performance Monitoring and Trend Reports</td>
<td>✓</td>
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<td>Scheduled Report Generation</td>
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<tr>
<td>User Access Control Management</td>
<td>✓</td>
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<tr>
<td>Distributed Polling Agent Architecture</td>
<td>✓</td>
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<tr>
<td>SNMP Protocols v1, v2c and Secure SNMP v3</td>
<td>✓</td>
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<tr>
<td>Remote Java Console Connection to RNMS Server</td>
<td>✓</td>
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<tr>
<td>Backup Server</td>
<td>✓</td>
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<tr>
<td>Support Services</td>
<td>Advanced support including onsite service</td>
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</table>
3. RADWIN Drive Test Tool

Drive Test Tool

- Data collected while driving along the track can be aggregated and displayed in a KMZ summary file:
  - RSS, data rate, speed, GPS location, etc.
- Used for advanced analysis and troubleshooting
4. Real Time Monitoring Tool

**Real time monitoring tool**

- Snap shot tracking and monitoring
- Location, RSS, data rate
- Trains distribution along the track (connection to bases)
- Customized per rail/metro system
5. ALPM – Air Link Performance Monitoring

ALPM – Air Link Performance Monitoring tool (offline database analysis)

- Accumulation of all relevant events to enable in-depth analysis and performance optimization during implementation as well as ongoing operations
Any Questions?

Recent Results from Existing Metro

Single Train Passing Bases
Each Height change is a Base HO

Graphs showing RSS and Throughput.
2 lines represent each HMU on-board the train
System automatically assures, the HMU with higher data rate is the active one per train
Typical throughput – 70Mbps per train
RADWIN Solutions for Rail & Metro - Services
Services

- Radio Planning
- System Design (networking and synchronization aspects)
- Site Survey
- On the Job Training
- POC, trials on-site support
- Network commissioning
- Performance analysis
- Post-sales services
- Customization (radio, networking, synchronization, management tools)
CASE STUDY EXAMPLES
Metro Moscow (Russia): Broadband Wi-Fi for Passengers

- No. 3 in the world (9 million passengers/day)
  - 12 lines
  - 700 trains
  - 180 stations

- 325Km / 200Miles length

- RADWIN Train-to-Ground solutions chosen after evaluation thanks to capacity and coverage

- Deployment of entire project in 14 months!

- Current performance:
  - 90 Mbps per Base station
  - Base station every ~900 meters
Moscow Metro – Daily Traffic Statistics

Moscow Metro: Usage of 45TB per day….and growing!
Honolulu Light Rail – New Project

- New line – elevated train over 20 KM
- Requirements for real-time connectivity: 35Mbps per train
- Applications include: CCTV, PA and operational data
- RADWIN won after successful trials, demonstrating highest capacity and longest coverage
- Implementation expected during 2015-2016
Broadband Wi-Fi on Trains - Europe

**Application:**
- High-speed Internet access on-board trains travelling along 1,350 Km / 850 Miles of tracks
- 70% of the wayside network deployed

**RADWIN Solution:**
- Up to 35Mbps per train over distances of up to 5 KM between base stations (20MHz)
- RADWIN 2000 point-to-point used for backhaul to fiber termination points
- Frequency Re-Use – single frequency customized solution
Rome Metro

- Project funded by the EU to enhance security in Rome Metro (Pandora project)
- Provide real-time CCTV in Line A
- 36KM line, 38 trains
- Trial for 1st section conducted successfully
- Complete deployment planned by 2016
Metro Medellin – New Project

- New line under construction
- Provide real-time CCTV
- Implementation expected during 2015
Recent Trial results (Metro Operator in APAC): Uplink Capacity

- Two sites approximately 0.9 Km apart
- Total track of 1.4 km, 900 meter above ground + 500 meter tunnel
- 5.8 GHz, 40 MHz

30Mbps uplink from the train
Recent Trial Results (Metro Operator in APAC): Downlink Capacity (Simultaneous) & Jitter

Downlink: 40 Mbps
Jitter: typical less than 1 mSec
Ceiling Installation Examples
Way-side installation
Side Installation Examples

Flat panel antenna
19 x 19 x 3 cm
Tunnel Installation
Any Questions?