HIGH CAPACITY END TO END CONNECTIVITY
Agenda

- About RADWIN
- Point to Point
- Point to Multi Point Radwin 5000
  - Funcionalidad y especificaciones principales
  - Tecnología
  - Modelos de equipos
  - Aplicaciones
  - Conclusiones

- Summary
RADWIN at a Glance

- Leading provider of Sub-6GHz broadband wireless solutions
- Deployments in over 120 countries
- Offering Backhaul and access (last mile) solutions
- Market leading sub-6GHz portfolio for end to end connectivity.
  - Point to Point - Up to 200Mbps net throughput; up to 16xE1s/T1s+ Ethernet
  - Point to Multi-Point – Up to 200Mbps net throughput; Ethernet
- Target Segments: Cellular Operators, Service Providers, Surveillance & Security and variety of private networks verticals
- Customer base includes leading tier 1 cellular and fixed operators, globally
- Operating from Israel with regional headquarters in North America, Latin America, EMEA and APAC
RADWIN Products

**Point to Point**
- High capacity wireless links
- Up to 200 Mbps throughput
- Up to 16 E1s/T1s and Ethernet
- Seamless migration to IP
- Long range
- Easy to install
- Simple to maintain
- Competitive pricing

**Point to Multi-Point**
- Highest capacity Base Station
- Up to 200 Mbps throughput
- Highest Bps/Hz
- Secure SLA capacity
- For enterprise & heavy data applications
- Long range
- Carrier grade PtMP
Highly advanced radio technologies:
  » OFDM
  » MIMO
  » Diversity

Sophisticated air interface to ensure:
  » Native Ethernet and Native TDM
  » Interference mitigation techniques
  » Robustness and link stability

Unmatched performance at sub-6GHz
Target Markets

- Mobile carriers
  - Rural to urban cellular backhaul
  - Access for large corporations
- Fixed Service providers & ISPs
  - IP backhaul for 4G /broadband PtMP
  - Access for large corporations and SME
- Private Networks
  - Government, Utilities, Transportation, Education, Healthcare, Enterprises
- Security & Surveillance Projects
  - Homeland security, Municipality ‘Safe City’ projects, Border Control
RADWIN Technology Adopted by Tier 1 Carriers
High capacity end to end connectivity

Building a high capacity network with:

- PtP Radwin 2000 links
- PtMP Radwin 5000
RADWIN Product Portfolio

POINT TO POINT
PRODUCT OFFERING
Cellular Backhauling, Corporate access & Private Network Applications

- Securing future proof backhaul that is more affordable and easier to install than existing wireless alternatives
- Delivering high speed end-to-end broadband access to anyone, anywhere
- Connectivity solutions that enable you to own and control your private network
RADWIN Solution Architecture

- TDM Service 4 to 16E1/T1 + Data
- TDM & Ethernet Redundancy
- SFP (small form factor) interface- E1, E3
- Multi band radios
## RADWIN Product Portfolio

### RADWIN 2000
- 200 Mbps net throughput
- Up to 16 E1s/T1s
- Superior OFDM and MIMO
- Extended range – 120km
- Multi bands: 2.3, 2.5, 3.3-3.8, 4.9-6.06 GHz
- Low Power (20-35W)

### WinLink 1000
- 18 Mbps full duplex
- Up to 4 E1s/T1s
- Superior OFDM technology
- Extended range – 80km
- Multi bands: 2.x, 4.8-6.06 GHz
- Low Power (10-20W)
RADWIN Product Portfolio

POINT TO POINT
RADWIN 2000
## RADWIN 2000 Portfolio 4.x and 5.x GHz

<table>
<thead>
<tr>
<th>Product Series</th>
<th>Max. Throughput</th>
<th>Target Applications</th>
</tr>
</thead>
</table>
| C-Series       | ▪ 200 Mbps net aggregate *(Symmetric. or Asymmetric)*  
▪ Support up to 16E1s / T1s | IP backhaul |
| B-Series       | ▪ 50 Mbps net aggregate *(Symmetric. or Asymmetric)*  
▪ Support up to 8E1s/T1s | IP + TDM |
## RADWIN 2000 - 3.x GHz

<table>
<thead>
<tr>
<th>Product Series</th>
<th>Max. Throughput</th>
<th>Target Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-Series</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 100 Mbps net aggregate throughput</td>
<td>IP+TDM backhaul</td>
</tr>
<tr>
<td></td>
<td>▪ Support up to 16E1s / T1s</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 20, 10, 5MHz channel BW</td>
<td></td>
</tr>
<tr>
<td>X-Series</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 20 Mbps net aggregate throughput</td>
<td>IP+TDM Access</td>
</tr>
<tr>
<td></td>
<td>▪ Support up to 3 E1s/ 4 T1s</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 5MHz channel BW</td>
<td></td>
</tr>
</tbody>
</table>
POINT TO POINT
RADWIN 2000
Ethernet Service Performance

- 1 or 2 Ethernet interfaces
- 10/100/1000 BaseT with auto-negotiation (IEEE 802.3)
- Layer 2 Ethernet bridge
- QoS* – 4 levels of queues, 802.1P / ToS Classifiers
- VLAN Tagging & QinQ
- Latency < 3msec
- Retry mechanism for loss-less connection (Fast ARQ)
- Support up to 2048 bytes frames
- Service protection through 1+1 and Ring Topology

* RADWIN 2000-C only
Ethernet 1+1
Ethernet Protection Through 1+1 Network Topology

**Before 1+1**
- Use external switch
- 3rd party Switch
- PoE

**After 1+1**
- IDU save external switch
- RADWIN IDU
- PoE
- RPL

RADWIN
Ethernet Ring Protection

- Link failure protection is achieved through linking users in a Ring
- Assure high service availability for high-end applications
- Save CAPEX, Spectrum and valuable room on the Hub tower
POINT TO POINT
RADWIN 2000
RADWIN 2000 C-Series

- Ultra-Capacity
  - Up to 200 Mbps net aggregate throughput
  - 5/10/20/40 MHz channel bandwidth
  - Multi band radios
  - Advance networking features
    - 3.3 to 3.8 GHz up to 100 Mbps @20 MHz
- Optimized for high capacity IP backhaul applications
RADWIN 2000 C-Series - Throughput Performance

- Asymmetric traffic mode enables
  - Up to double capacity per direction
  - Greater range for a given capacity
  - Greater capacity and link robustness per given range

RADWIN 2000 C Total Throughtput Performance @ 40MHz Channel BW

28dbi Antenna
RADWIN 2000 L & C - Symmetric Ethernet Performance @20MHz

Full Duplex Rate @ 20 MHz
RADWIN 2000 B-Series

- Up to 50 Mbps aggregate throughput
- Asymmetric and Symmetric traffic
- Up to 8 E1s/T1s
- Advanced networking & QoS
- 5/10/20 MHz channel bandwidth
- Flexible combination of native TDM + Ethernet
- Supporting converged IP + TDM Access & backhaul application
RIDE THE WIRELESS HIGHWAY WITH RADWIN 5000 HPMP

RADWIN 5000
High Capacity Point to Multipoint System
PtMP Industry Solutions Segmentation

- **For Business and High end applications**
  - Built for residential mass market
  - Requires Licensed band only (3.x, 2.x)
  - 35Mbps/ sector, limited to 10MHz
  - Mostly downlink capacity
  - complex Network (ASN, AAA)
  - No Roadmap

- **For Residential Mass Market**
  - Native 802.11n
  - Nor QoS neither guaranteed SLA (Air interface is not scheduled)
  - Available only in unlicensed 2.4, 5.x band
  - Address low end residential
  - Low cost BS & CPE but unstable performance as technology is for indoor
  - Lack of MiMO/Diversity
  - No guaranteed SLA

- **Proprietary Pre WiMAX PtMP**

<table>
<thead>
<tr>
<th>Capacity (Mbps)</th>
<th>Residential</th>
<th>Enterprise</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>200</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

End user
RADWIN 5000 HPMP Solution Highlights

- High capacity per Sector
  - 200Mbps aggregate throughput
- Ethernet connectivity
- Symmetric or asymmetric operation.
- High capacity end user equipment – 10, 20, 50Mbps
- Up to 16 SUs per sector with dedicated bandwidth.
- Guaranteed SLA and capacity per Subscriber Unit
- Small and constant latency - 4 to 10msec typical under full sector load
- Wide range of frequency bands - 4.8 to 6GHz, 3.3-3.8GHz
- 3.3 to 3.8 GHz up to 100 Mbps @20 MHz

High capacity PtMP for bandwidth demanding applications and guaranteed SLA
RIDE THE WIRELESS HIGHWAY WITH RADWIN 5000 HPMP

RADWIN 5000 HPMP
Background
PtMP Building blocks

- **A *Star* network topology comprises of the following elements:**
  - Base Station sub system – BS
  - Subscriber Unit - SU

**Base Station (RADWIN-HBS)**

- Located at the HUB sites
- Illuminates an area- *Sector*
- Using dedicated RF channel
- Manage traffic resources between SU s and the Network
- Aggregate the SU s’ traffic
PtMP Air Interface – Introduction

Traffic resource management approaches

- Air Interface Traffic resource management approaches:
  - **Radwin** Dedicated resource allocation – fixed guaranteed and configurable
  - Shared resource allocation - Bandwidth is allocated upon need
Radwin 5000 Dedicated Bandwidth

- There is a total of 16 time slots to be assigned among the HSDU.
- Example in case of 3 HSU,: To gain the maximum capacity for a single HSU – we assign 8 Time Slots per HSU.

In this example we can see 3 HSUs handled by the HBS:
- HSU #1 (8 slots)
- HSU #2 (7 slots)
- HSU #3 (1 slot)
When a user needs to transmit requests access to the medium, which is granted by the base station.

If the user has interference or propagation problems request more times the access to the medium, taking transmission time from other subscribers.
Weak points of **Shared** BW Allocation

- **SLA can NOT be guaranteed**
  - Degraded link of an SU in a sector affects other SU's capacity
  - Phenomena is even worse in unlicensed band

- **High link latency** and latency variation

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**Diagram**

- Total capacity – 30Mbps SLA users
- Total capacity – 15Mbps
- Interference

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**Image Signature**

RADWIN
### PtMP Sector Capacity: Shared VS. Dedicated

<table>
<thead>
<tr>
<th>SHARED BANDWIDTH</th>
<th>RADWIN’S DEDICATED</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SU-4</strong></td>
<td><strong>SU-1, SU-2, SU-3</strong></td>
</tr>
<tr>
<td><strong>SU-3</strong></td>
<td></td>
</tr>
<tr>
<td><strong>SU-2</strong></td>
<td></td>
</tr>
<tr>
<td><strong>SU-1</strong></td>
<td></td>
</tr>
</tbody>
</table>

- **All users located at equal distances to BS**
- **Sector Capacity (Air Rate) = 40Mbps**
- **SU Air Rate at 64QAM 3/4 = 40Mbps**
- **Actual throughput = 10Mbps**

- **SU-4 suffers link degradation**
- **SU Air Rate at 16QAM 1/2 = 20Mbps**
- **BS applies Fairness – short distance SUs suffer degradation as well**
- **Sector Capacity (Air Rate)= 32Mbps**
- **Actual throughput (SU 1,2,3,4) = 8Mbps**
- **SLA cannot be guaranteed**

- **BS allocates dedicated time slots to each SU**
- **As a result, the degraded SU does not affect the short distance SUs**
- **Sector Capacity (Air Rate)= 35Mbps**
- **Actual throughput (SU 1,2,3) = 10Mbps**
- **Actual throughput (SU 1,2,3) = 5Mbps**
- **SLA can be guaranteed**
## Dedicated BW Allocation VS. Shared BW Allocation

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Shared BW Allocation</th>
<th>RADWIN Dedicated BW allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BW allocation</strong></td>
<td>Upon traffic</td>
<td>Fixed, configurable</td>
</tr>
<tr>
<td><strong>Efficient when...</strong></td>
<td>Many users in a sector, Users’ throughput is low</td>
<td>Few users in a sector, Users’ throughput is high</td>
</tr>
<tr>
<td><strong>Oversubscription</strong></td>
<td>1:N N users per channel</td>
<td>1:1 Single user per channel</td>
</tr>
<tr>
<td><strong>User average rate</strong></td>
<td>Depends on traffic load</td>
<td>Depends on the configuration</td>
</tr>
<tr>
<td><strong>What enables SLA?</strong></td>
<td>CIR / MIR – CIR might not secured</td>
<td>CIR - Fixed allocation time per user</td>
</tr>
<tr>
<td><strong>Is SLA guaranteed</strong></td>
<td>No</td>
<td>Guaranteed</td>
</tr>
<tr>
<td><strong>Service latency</strong></td>
<td>Long and variable</td>
<td>Short</td>
</tr>
</tbody>
</table>

Which allocation method is better?
RADWIN 5000 HPMP
Components
RADWIN HBS 5200 High Capacity Base Station

- Fully outdoor
- Small form factor ODU
- Low Power consumption
- High TX power for long range
- MIMO/Diversity
RADWIN HSU5xx - High Capacity Subscriber Unit

10 Mbps & 20 Mbps
Small Form Factor Antenna. ODU is connectorized

20 Mbps & 50 Mbps
High Gain Integrated Antenna

50 Mbps
Connectorized ODU
## RADWIN 5000 – 3.x GHz Portfolio

<table>
<thead>
<tr>
<th>Product Series</th>
<th>Max. Throughput</th>
</tr>
</thead>
</table>
| HBS 5100       | ▪ 100 Mbps net aggregate *(Symmetric . or Asymmetric)*  
|                | ▪ 5, 10 and 20 MHz  
|                | ▪ OFDM, MIMO and Diversity  
|                | ▪ 60° and 90° Sector antenna |
| HSU            | ▪ 20 Mbps net aggregate *(Symmetric . or Asymmetric)*  
|                | ▪ High gain integrated antenna or connectorized |
RADWIN 5000 HPMP
Features
RADWIN 5000 HPMP – Main Features

**Service**

- Configurable Maximum Information Rate (MIR) per SU
- Enhanced QoS – 4 level queue per SU
- Networking features – VLAN, QinQ per SU
- Long Range – 40km @ 20Mbps

**Radio Performance**

- Advanced OFDM & MiMO 2x2 / Diversity for nLOS performance
- Enhanced *interference mitigation* capability
- Inter & intra site sync. to *reduce self interference*
- Dedicated traffic bandwidth allocation ensuring SLA & latency
- Low latency, min < 3msec, typical 4 to 10msec
- Channel BW – 5, 10, 20, 40 MHz
- Regulation- FCC/ETSI/WPC/UNI/MII
### RADWIN 5000 HPMP – Main Features

<table>
<thead>
<tr>
<th>Operational</th>
<th>▪ Multi band Base Stations and SUs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>▪ Simple to deploy</td>
</tr>
<tr>
<td></td>
<td>▪ Fully integrated with RADWIN Legacy solutions:</td>
</tr>
<tr>
<td></td>
<td>▪ Coexists with RADWIN 2000 / WinLink 1000</td>
</tr>
<tr>
<td></td>
<td>▪ Common RADWIN Manager</td>
</tr>
<tr>
<td></td>
<td>▪ Common RNMS</td>
</tr>
</tbody>
</table>
## RADWIN 5000 HPMP – Main Features Multi Band

<table>
<thead>
<tr>
<th>Supported Bands</th>
<th>Frequency Range</th>
<th>Additional Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.8 GHz FCC/IC*</td>
<td>5.725 - 5.850 GHz</td>
<td>FCC 47CFR, Part 15, Subpart C and IC RSS-210</td>
</tr>
<tr>
<td>5.8 GHz MII</td>
<td>5.730 - 5.845 GHz</td>
<td>MII for 5.8 GHz</td>
</tr>
<tr>
<td>5.4 GHz FCC</td>
<td>5.480 - 5.715 GHz</td>
<td>FCC 47CFR, Part 15, Subpart E</td>
</tr>
<tr>
<td>5.4 GHz IC</td>
<td>5.480 - 5.715 GHz</td>
<td>IC RSS-210</td>
</tr>
<tr>
<td>5.3 GHz FCC/IC</td>
<td>5.255 - 5.350 GHz</td>
<td>FCC 47CFR, Part 15, Subpart E and IC RSS-210</td>
</tr>
<tr>
<td>4.9 GHz FCC/IC</td>
<td>4.940 - 4.990 GHz</td>
<td>FCC 47CFR, Part 90, Subpart Y and IC RSS-111</td>
</tr>
<tr>
<td>5.8 GHz WPC India</td>
<td>5.820 - 5.870 GHz</td>
<td>WPC GSR-38</td>
</tr>
<tr>
<td>5.4 GHz Universal</td>
<td>5.465 - 5.730 GHz</td>
<td>Universal</td>
</tr>
<tr>
<td>5.3 GHz Universal</td>
<td>5.140 - 5.345 GHz</td>
<td>Universal</td>
</tr>
<tr>
<td>4.9 GHz Universal</td>
<td>4.890 - 5.010 GHz</td>
<td>Universal</td>
</tr>
<tr>
<td>5.9 GHz Universal</td>
<td>5.730 - 5.960 GHz</td>
<td>Universal</td>
</tr>
<tr>
<td>6.0 GHz Universal</td>
<td>5.690 - 6.0.60 GHz</td>
<td>Universal</td>
</tr>
</tbody>
</table>
RADWIN 5000 HPMP - Unique Points

- Highest Base Station capacity for the best user experience – 200Mbps
- Highest spectrum efficiency for greater ROI - ~ 5bps/Hz
- Secured Service Level Agreement for demanding applications
- MIMO and Diversity (per HSU)
- Multi band radios
- Low latency
- Compact Subscriber Units (SUs) with low visual impact
- Carrier grade solution
RADWIN 5000 HPMP
Applications
High Capacity Inter-Office connectivity

- Two modes of operations:
  - WLAN: Traffic from branch to branch is switched back by the BS
  - “Access” – Higher network hierarchy switches the traffic
Multi sectors can be backhauled with RADWIN 2000
Safe City – Video surveillance

- Access to high capacity cameras, collocated cameras
- Backhaul of mesh WiFi cloud, carrying Video surveillance
Multi Tenants Building – WiFi Backhaul

- Residential building are covered through WiFi AP
- WiFi AP are backhauled by RADWIN 5000
Urban - High Capacity SLA Corporate Access

**SUs range 2km @20MHz Channel BW**

- Sector Capacity- 92Mbps
  - 7 clients @ 6Mbps
  - 3 clients @ 10Mbps
  - 1 client @ 20Mbps

**SUs range 6km @20MHz Channel BW**

- Sector Capacity- 75Mbps
  - 7 clients @ 5Mbps
  - 2 clients @ 10Mbps
  - 1 client @ 20 Mbps
Broadband connection to remote communities

**SU range 20km @20MHz Channel BW**

- Sector Capacity- 48Mbps
  - 8 villages @ 6Mbps

**SU range 30km @20MHz Channel BW**

- Sector Capacity- 30Mbps
  - 5 villages @ 6Mbps
Government Broadband – in 3.x GHz

Broadband connection to hospitals, and police stations and offices:

- **SU range 10km @20MHz Channel BW**
  - Sector Capacity- 80Mbps
    - 8 offices @ 5Mbps
    - 4 offices @10 Mbps

Service provider Premises

Service provider Network

Governmet connectivity
RADWIN 5000 HPMP
RESUMEN
The RADWIN Access and Backhaul Advantage

- **Robust & Reliable**
  - Operates in all environments & terrains
  - Industry-leading MIMO, OFDM & Diversity technologies
  - Field-proven air interface for optimal performance
  - Monitored Hot Standby 1+1 Support

- **Flexible**
  - Multi-band radio – one platform, multiple frequency bands
  - Complies with international regulations
  - Native TDM & Ethernet in one solution
  - Seamless migration from TDM to IP
  - Can be deployed in various topologies & configurations (PtP & Multiple Point-to-Point)
Resumen

La solución RADWIN PTMP es idónea para múltiples aplicaciones como:

• Conectividad corporativa de última milla

• Video vigilancia de alta resolución.

• Infraestructura de redes privadas (WAN)

• Aplicaciones de banda ancha de misión crítica

• Conectividad rural de banda ancha.

• Backhaul de Ip para radio bases celulares.

• Backhaul para sistemas de acceso alámbricos e inalámbricos (ej. ADSL o Hot spots de WiFi)
La más alta capacidad de una estación base para la mejor experiencia del usuario

Mayor eficiencia espectral

Asegura el nivel de servicio SLA para aplicaciones demandantes.

Alto rendimiento en condiciones adversas: con OFDM, MIMO y DIVERSIDAD

Sistema multi-banda que ofrece mayor flexibilidad de implantación.

Unidades de suscriptor compactas

¡¡ANCHO DE BANDA DEDICADO POR USUARIO!!
Gracias

Manuel Castellanos Méndez
México Managing Director
manuel_castellanos@radwin.com