RIDE THE WIRELESS HIGHWAY WITH **RADWIN 5000 HPMP**

HIGH CAPACITY END TO END CONNECTIVITY

RADWIN

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

RADWIN Technology

- 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

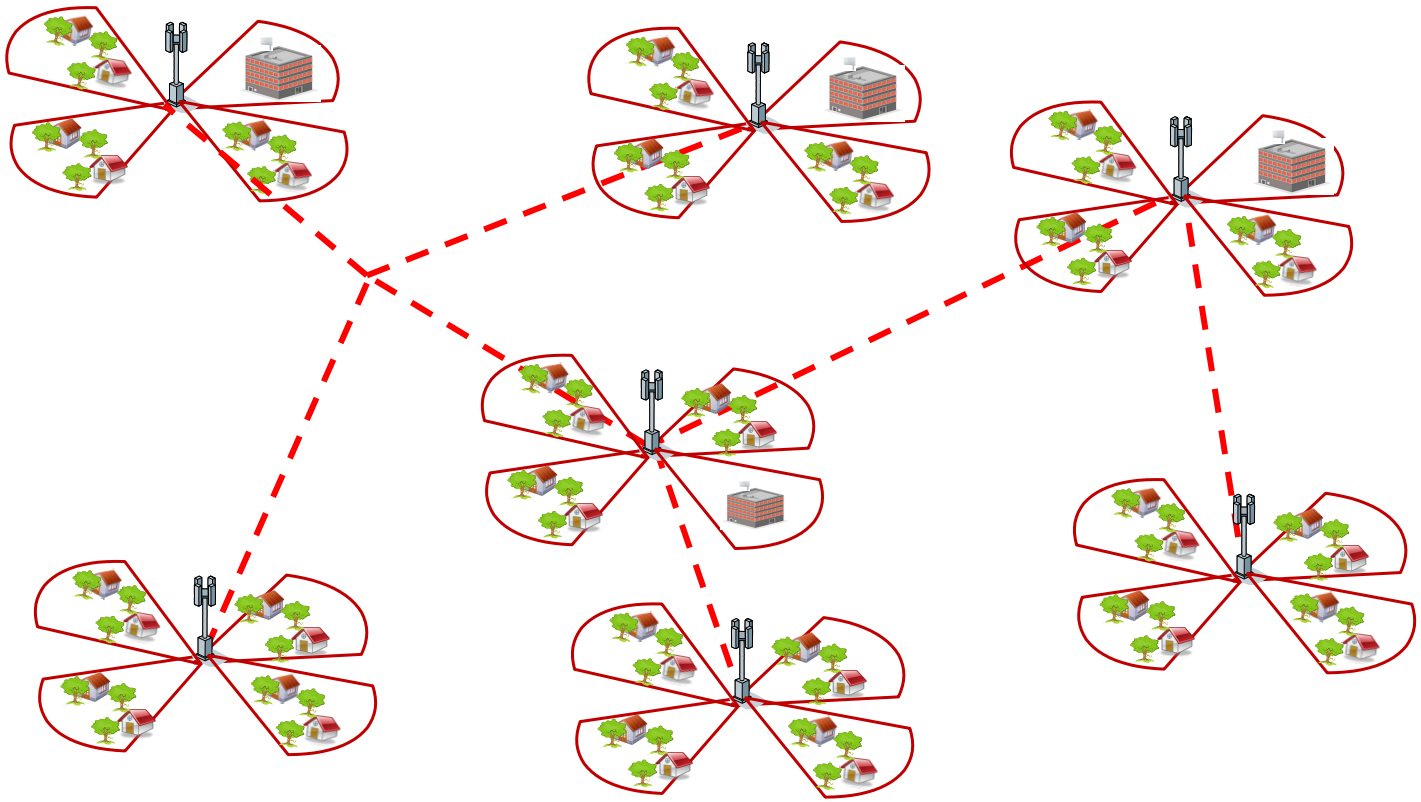
RADWIN Technology Adopted by Tier 1 Carriers

RADWIN

High capacity end to end connectivity

Building a high capacity network with:

- PtP Radwin 2000 links
- PtMP Radwin 5000



RADWIN

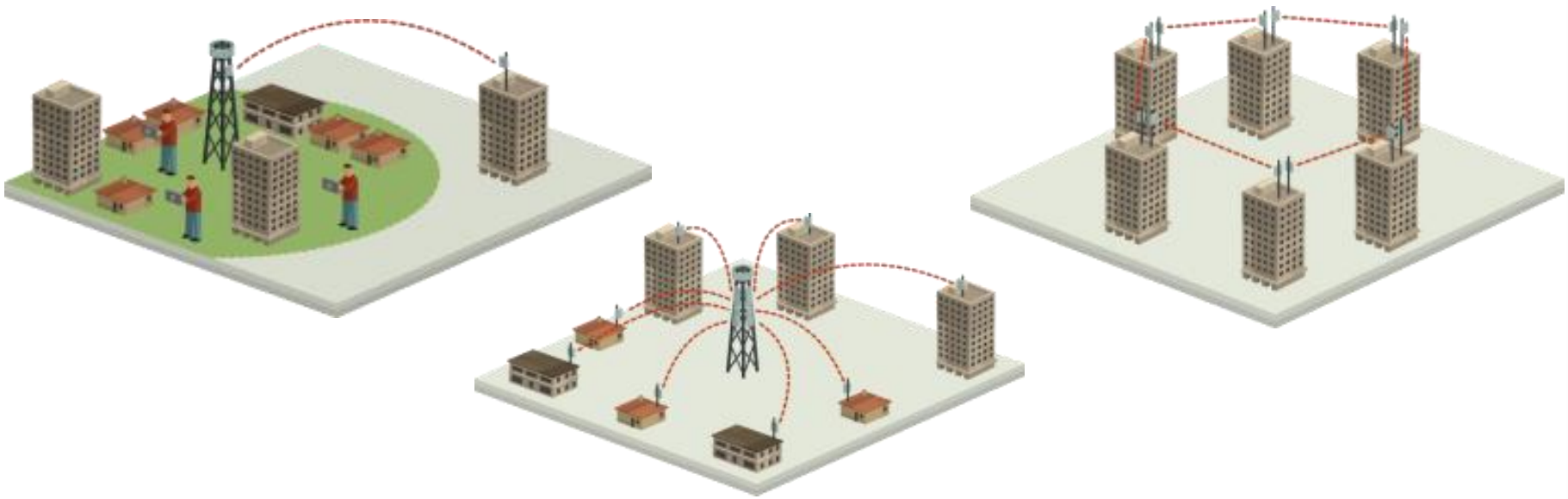
RADWIN Product Portfolio

POINT TO POINT PRODUCT OFFERING

RADWIN

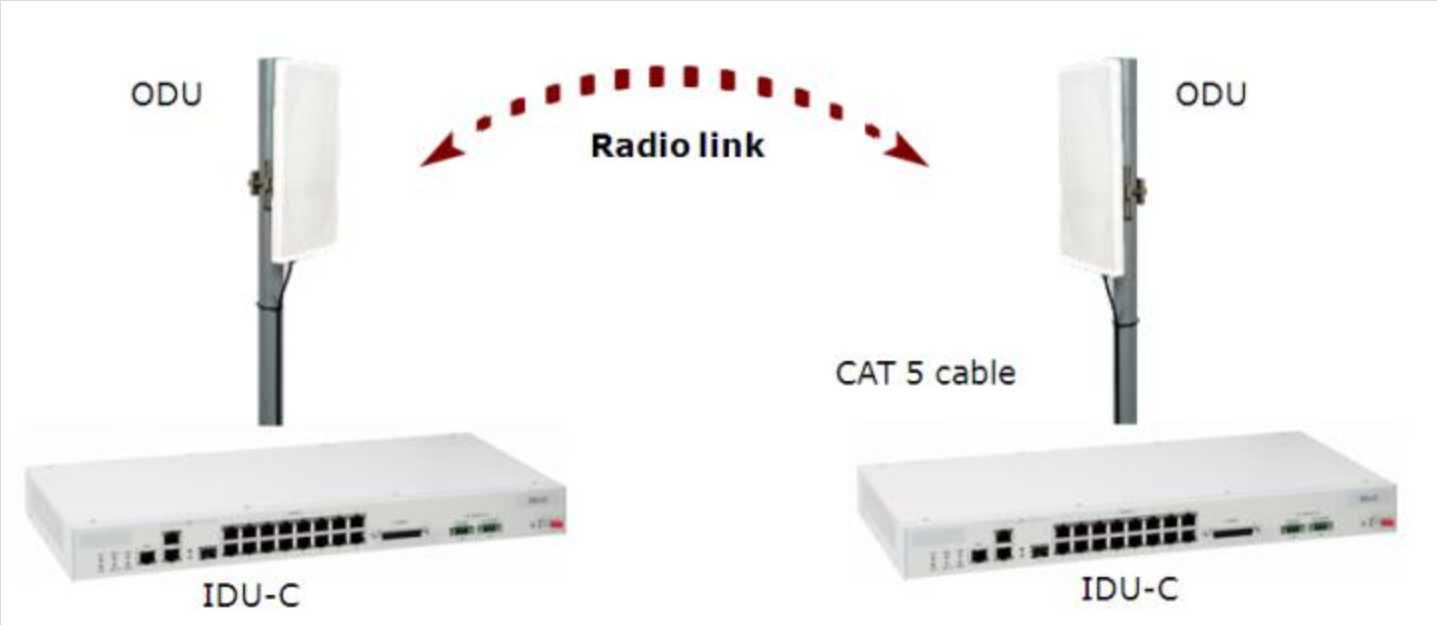
Cellular Backhauling, Corporate access & Private Network Applications

- 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

RADWIN Solution Architecture



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

RADWIN

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

RADWIN 2000 Portfolio 4.x and 5.x GHz

Product Series	Max. Throughput	Target Applications
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

Product Series	Max. Throughput	Target Applications
C-Series	▪ 100 Mbps net aggregate throughput ▪ Support up to 16E1s / T1s ▪ 20, 10, 5MHz channel BW	IP+TDM backhaul
X-Series	▪ 20 Mbps net aggregate throughput ▪ Support up to 3 E1s/ 4 T1s ▪ 5MHz channel BW	IP+TDM Access

POINT TO POINT
RADWIN 2000

RADWIN

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

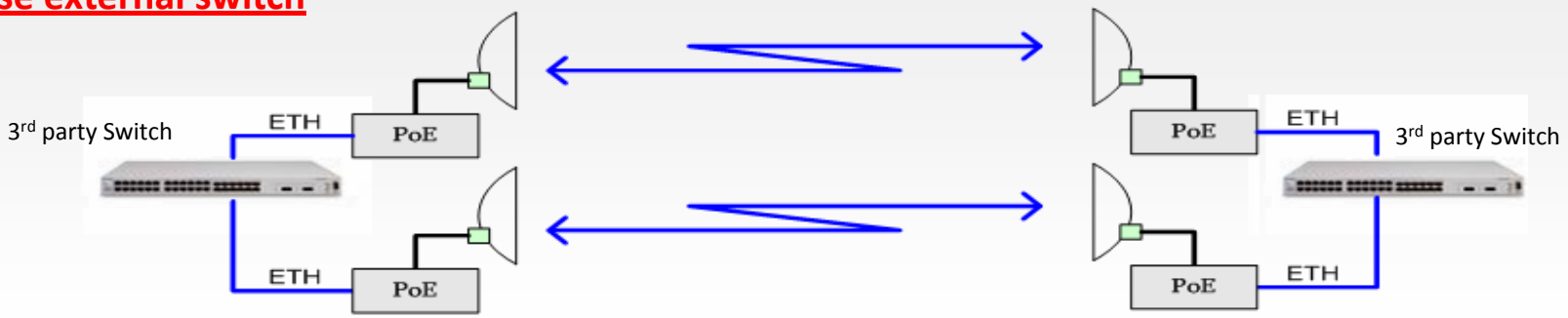
* RADWIN 2000-C only

Ethernet 1+1

Ethernet Protection Through 1+1 Network Topology

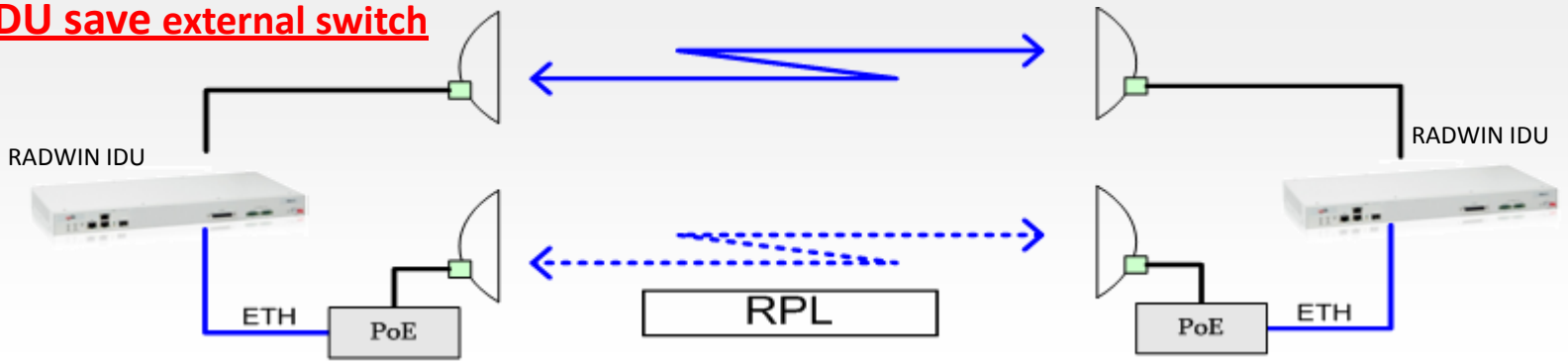
BEFORE 1+1

Use external switch



AFTER 1+1

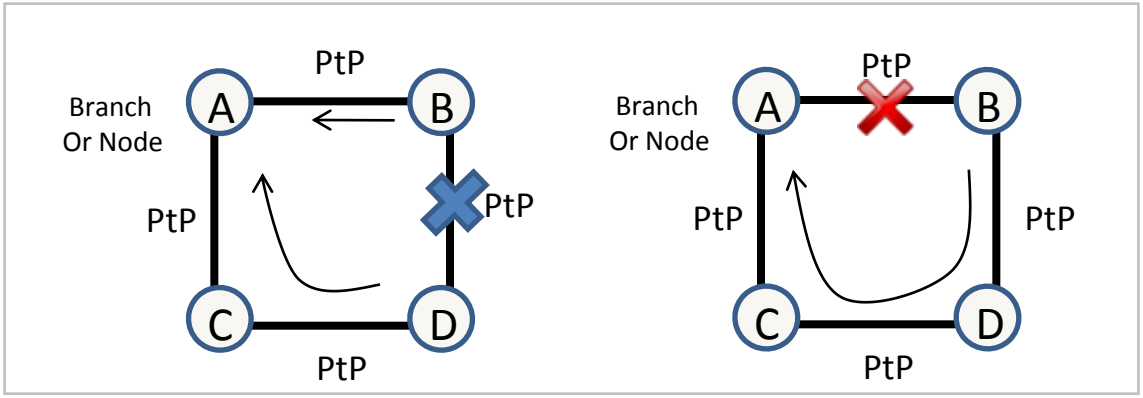
IDU save external switch



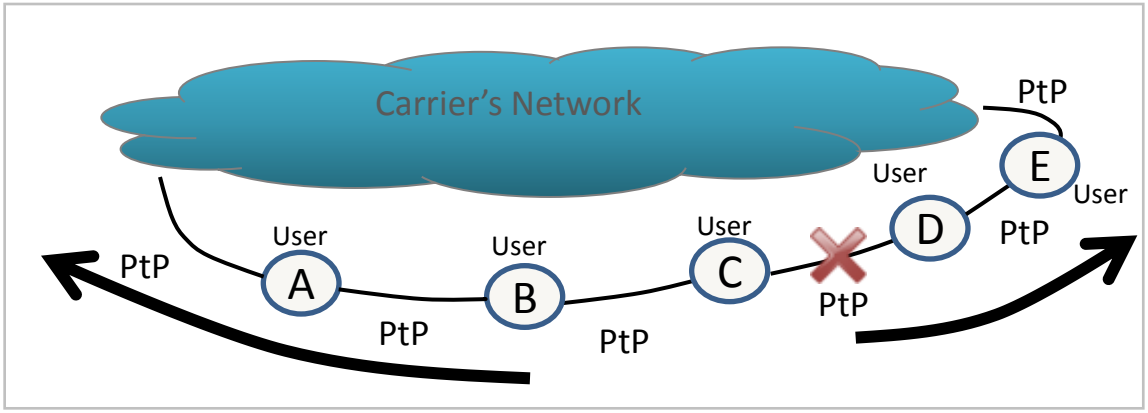
RADWIN

Ethernet Ring Protection

Private networks with a demand for high availability



Corporate Access User Solution



- 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

RADWIN

POINT TO POINT
RADWIN 2000

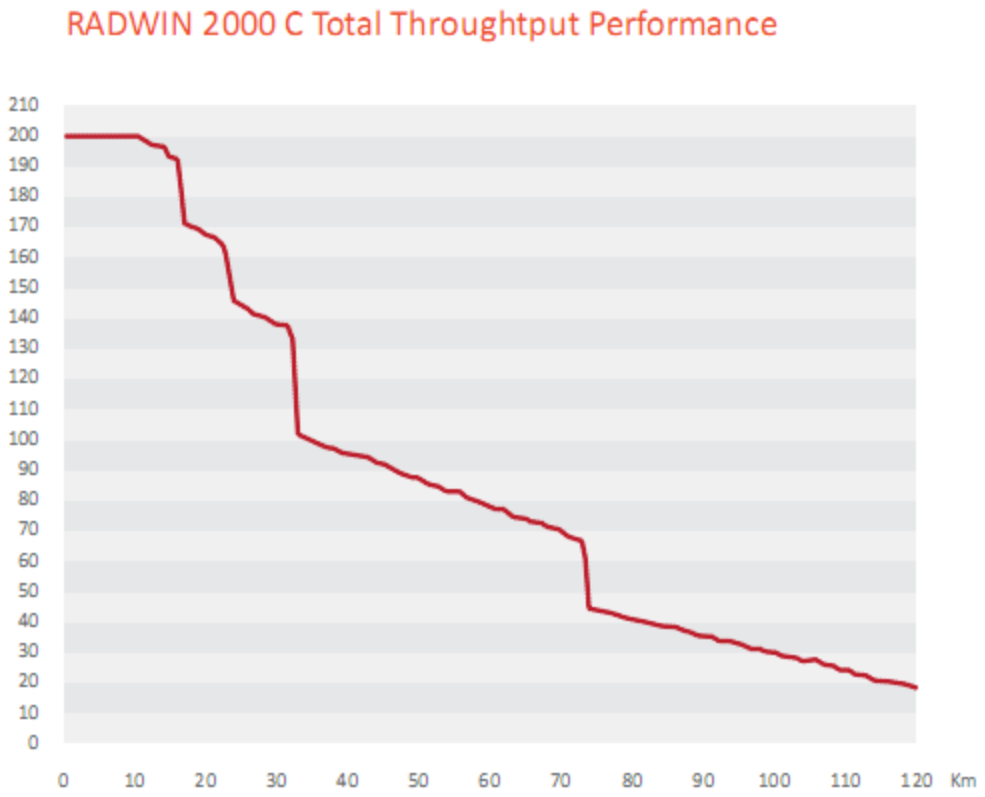
RADWIN

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

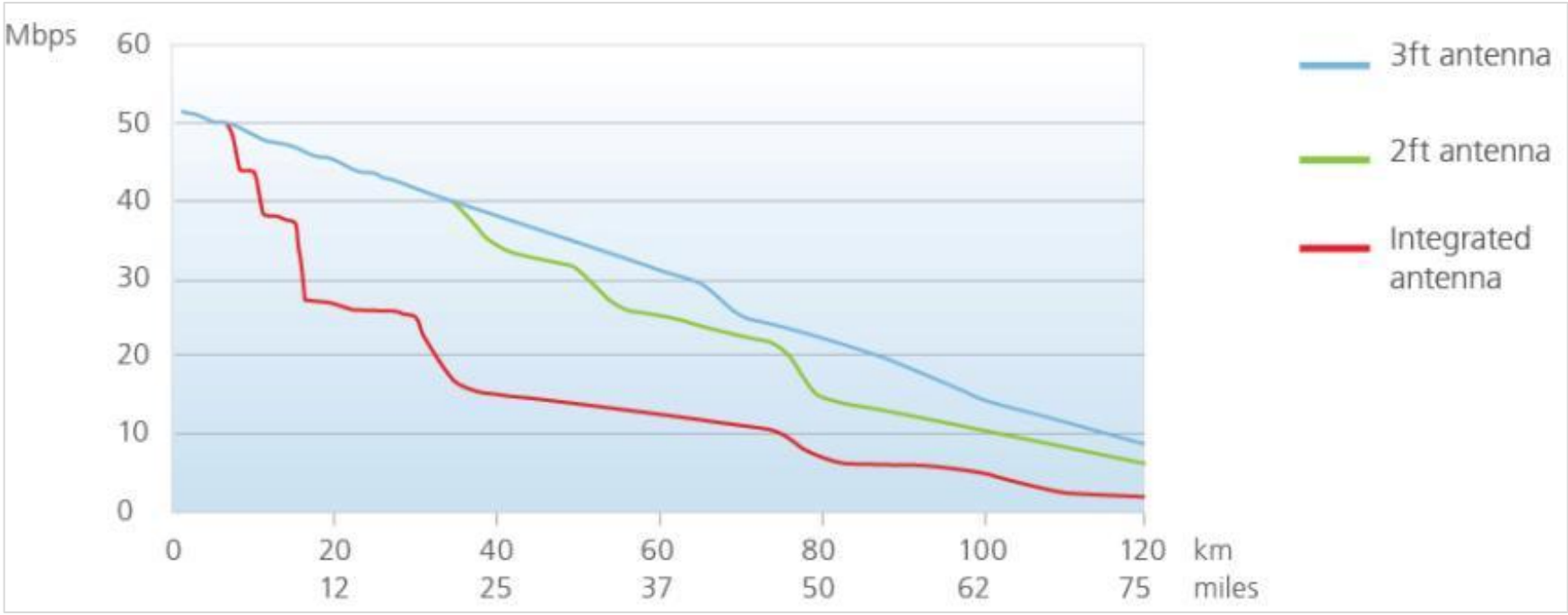


RADWIN 2000 C Total Throughtput Performance
@ 40MHz Channel BW

28dbi Antenna

RADWIN

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

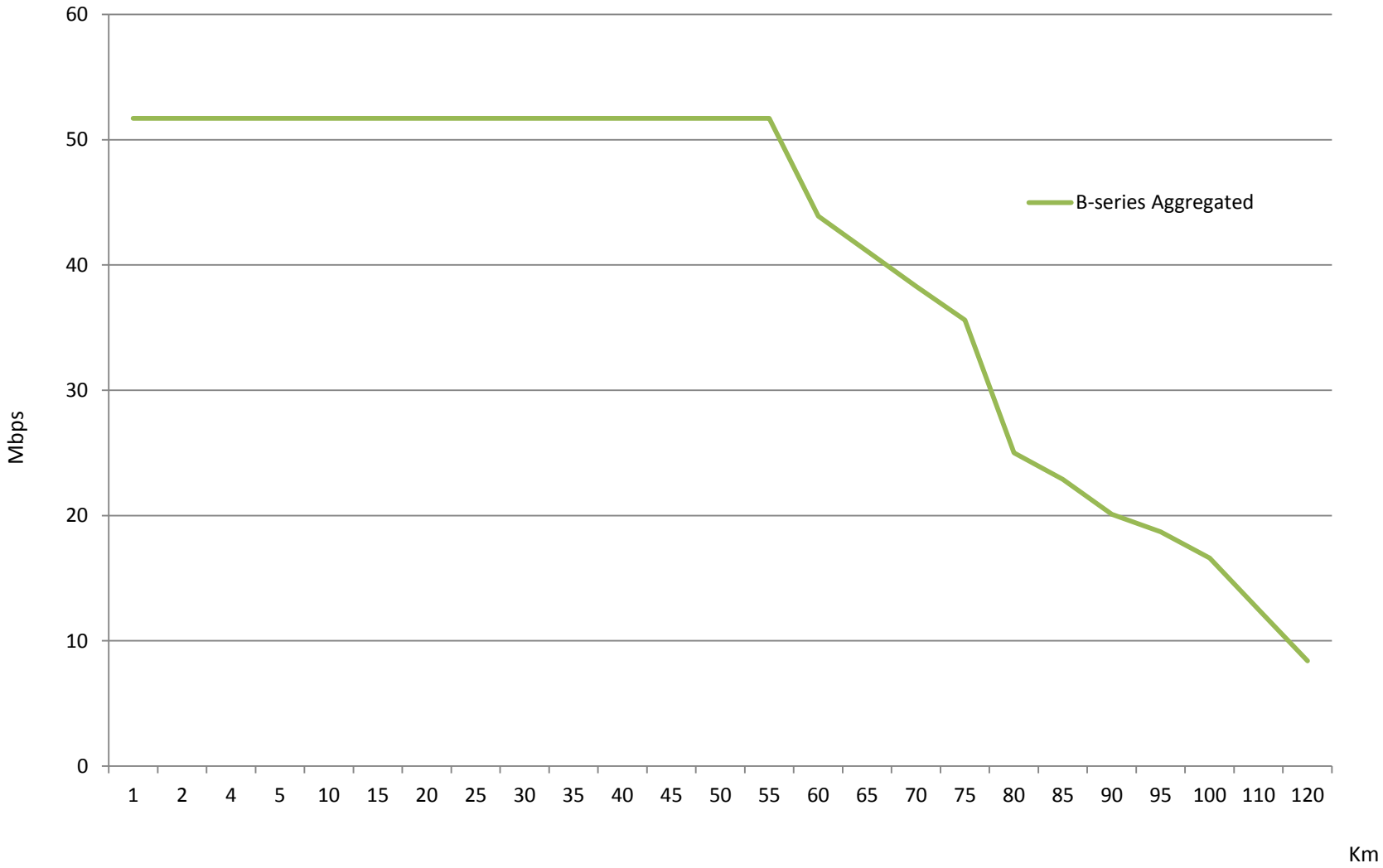


Full Duplex Rate @ 20 MHz

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

RADWIN 2000 B-Series ETH Ethernet Performance
External antenna 28dBi @ 20MHz CBW



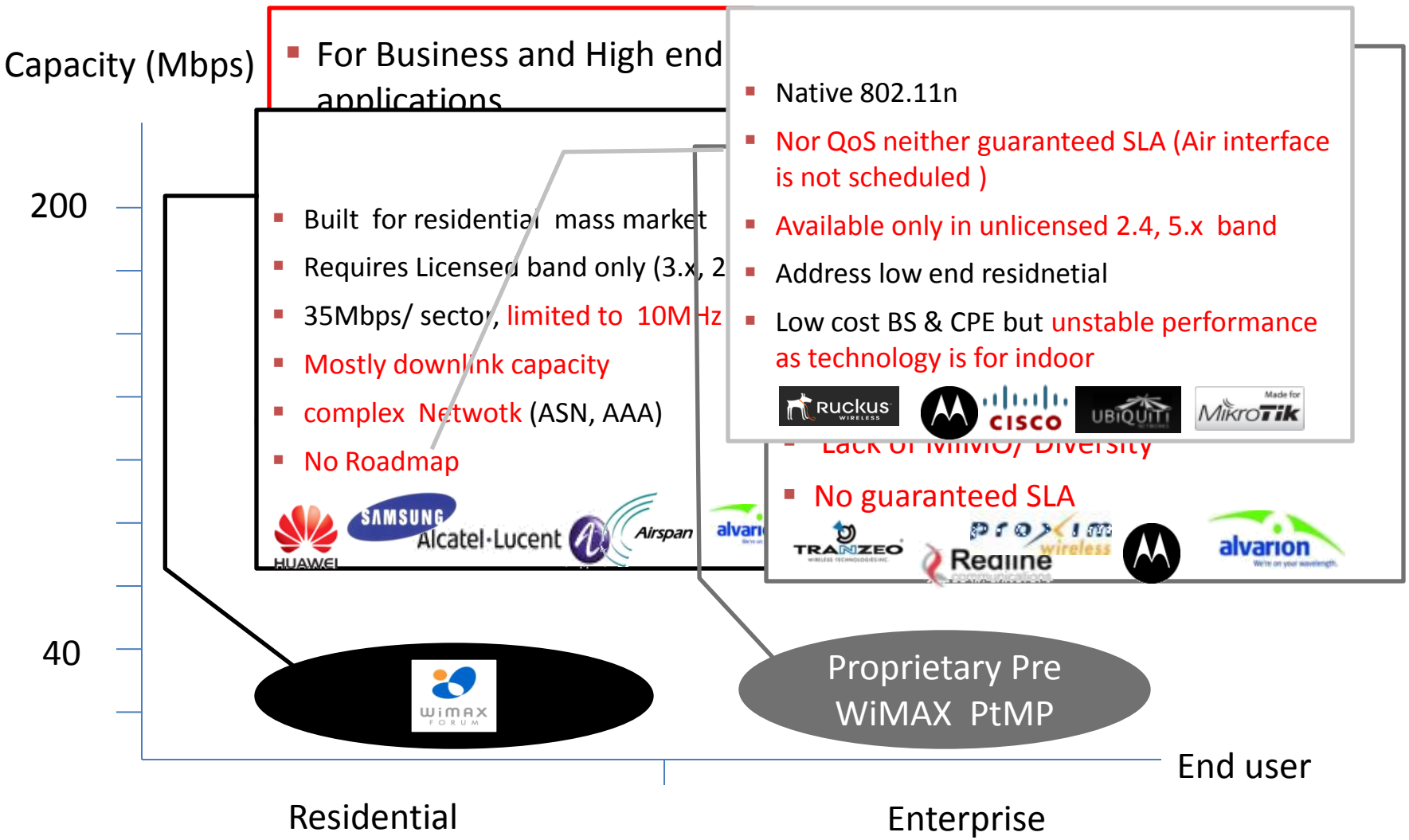
RADWIN

RIDE THE WIRELESS HIGHWAY WITH **RADWIN 5000 HPMP**

RADWIN 5000
High Capacity Point to Multipoint System

RADWIN

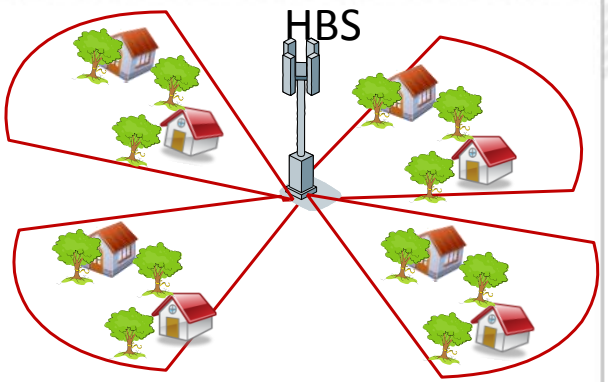
PtMP Industry Solutions Segmentation



RADWIN

RADWIN 5000 **H**PMP 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

RADWIN

RADWIN 5000 **H**PMP Background

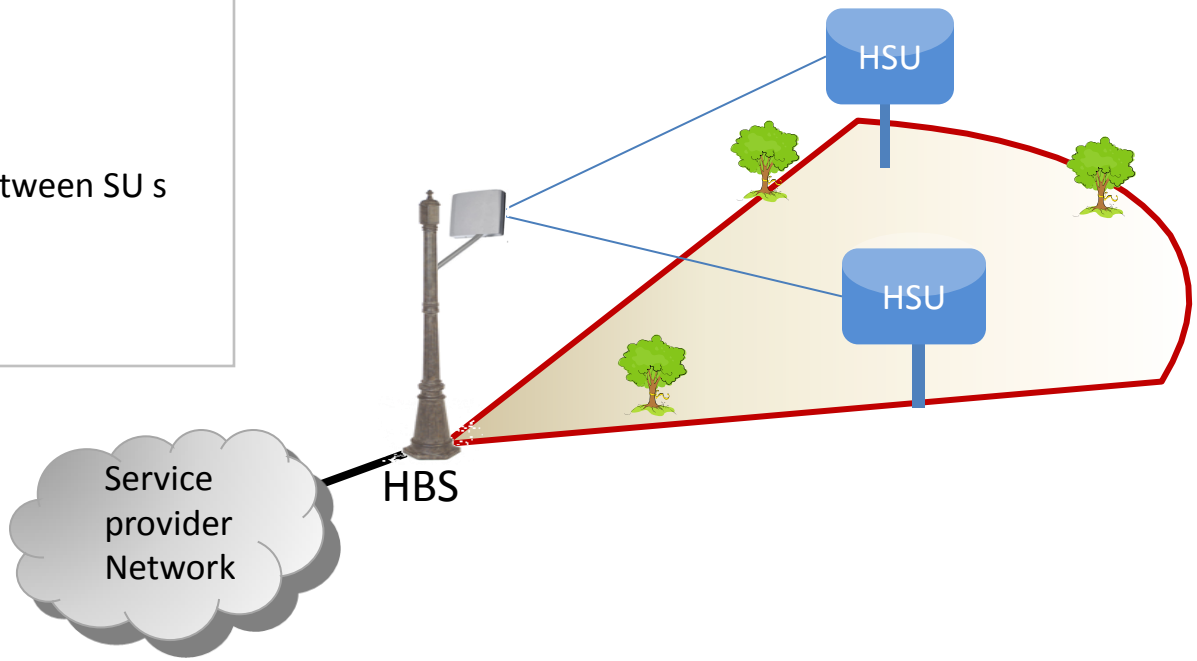
RADWIN

PtMP Building blocks

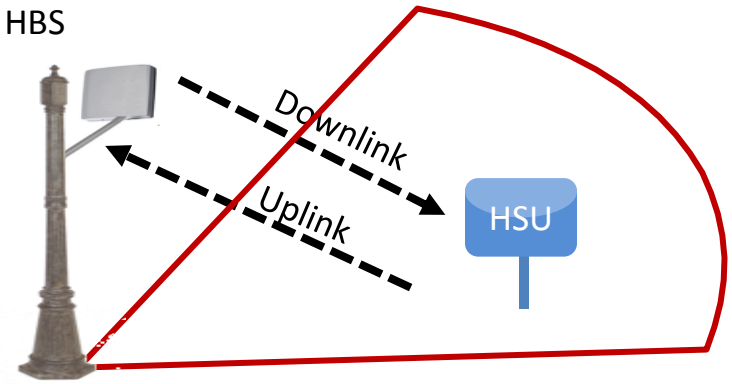
- A ***Star*** network topology comprises of the following elements:
  - Base Station sub system – BS
  - Subscriber Unit - SU

Base Station (RADWIN-HBS)

- Located at the HUB sites
- Illuminates an area- **Sector**
- Using didcated RF channel
- Manage traffic resources between SU s and the Network
- Aggregate the SU s' traffic



PtMP Air Interface – Introduction

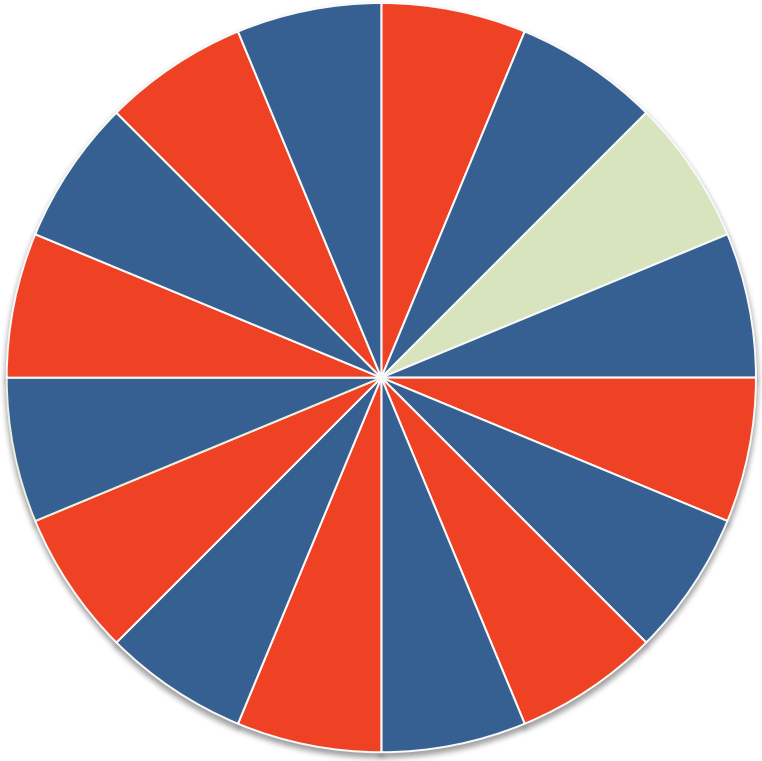


Traffic resource management approaches

- Air Interface Traffic resource management approaches:
  - Radwin Dedicated resource allocation – fixed guanteed 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 (7slots)

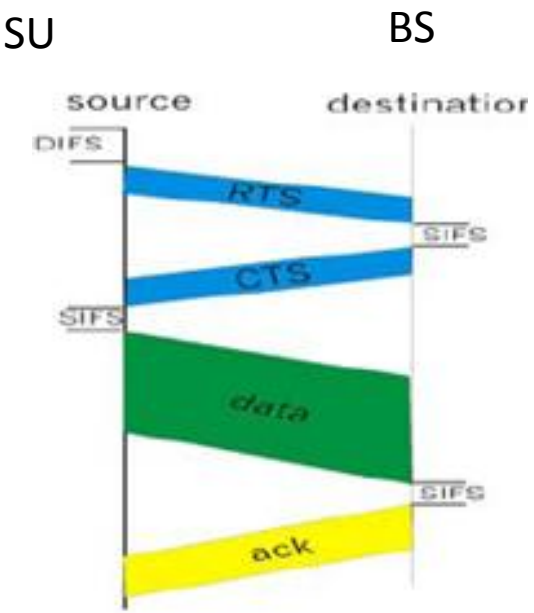
HSU #3 (1 slot)

RADWIN

Shared access method Example: 802.11

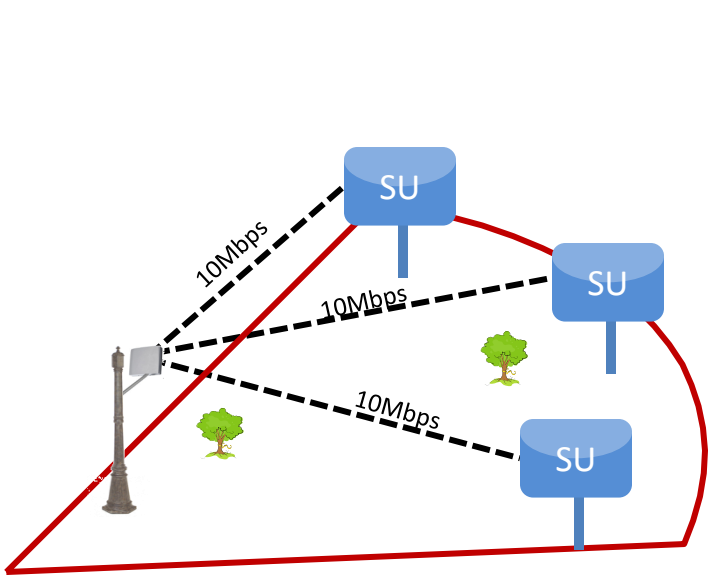
When a the user needs to transmit requests access to the medium, which is granted by the base station.

If the users has interference or propagation problems request more times the access to the medium, taking transmission time from other subscribers.

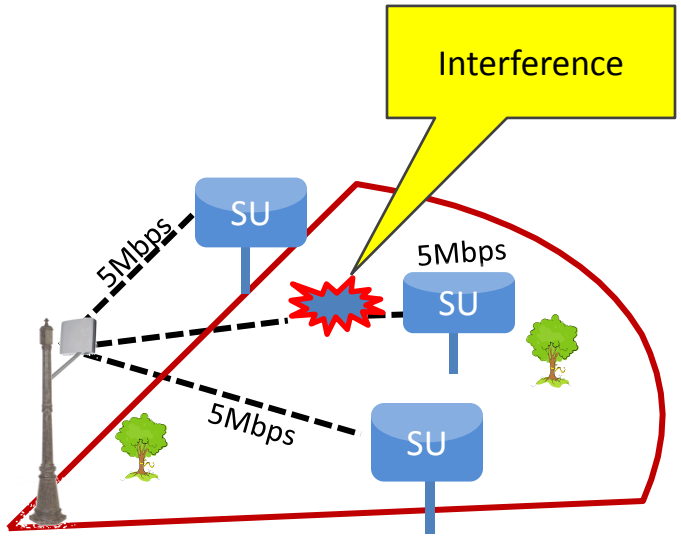


Weak points of **Shared** BW Allocation

- 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



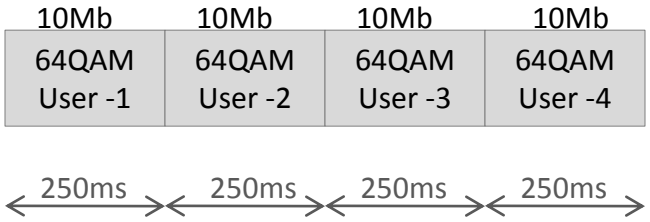
Total capacity – 30Mbps SLA users



Total capacity – 15Mbps

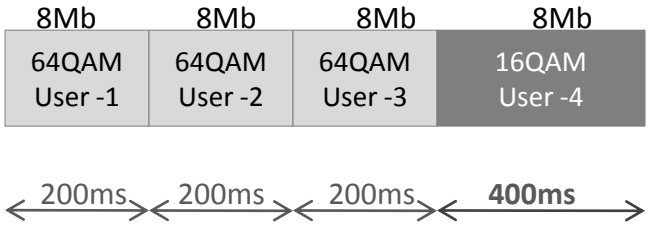
- High link latency and latency variation

PtMP Sector Capacity: Shared VS. Dedicated



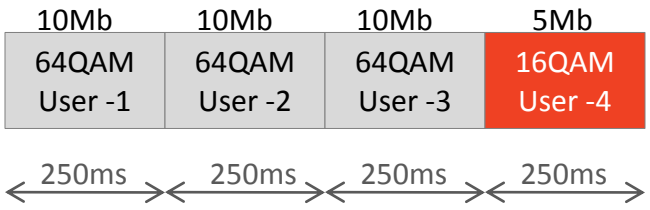
- All users located at equal distances to BS
- **Sector Capacity (Air Rate) = 40Mbps**
- **SU Air Rate at 64QAM 3/4 = 40Mbps**
- Actual throughput = 10Mbps

SHARED BANDWIDTH



- 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**

RADWIN's DEDICATED



- 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**

RADWIN

Dedicated BW Allocation VS. Shared BW Allocation

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

Which allocation method is better?

RADWIN 5000 **H**PMP
Components

RADWIN

RADWIN **HBS** 5200 **H**igh Capacity **B**ase **S**tation

Sector Antenna
60°, 90° ,120° ,

ODU

PoE Device

Single Sector BS

- Fully outdoor
- Small form factor ODU
- Low Power consumption
- High TX power for long range
- MIMO/Diversity

RADWIN

RADWIN **HSU**5xx - **H**igh Capacity **S**ubscriber **U**nit

10 Mbps & 20 Mbps

Small Form Factor Antenna.
ODU is connectorized

20 Mbps & 50 Mbps

High Gain Integrated Antenna

50 Mbps

Connectorized ODU

RADWIN

RADWIN 5000 – 3.x GHzPortfolio

Product Series	Max. Throughput
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 **H**PMP
Features

RADWIN

RADWIN 5000 **H**PMP – 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

RADWIN 5000 **H**PMP – Main Features

Operational

- Multi band Base Stations and SUs
- Simple to deploy
- Fully integrated with RADWIN Lagacy solutions:
  - Coexists with RADWIN 2000 / WinLink 1000
  - Common RADWIN Manager
  - Common RNMS

RADWIN

RADWIN 5000 **H**PMP – Main Features Multi Band

SUPPORTED BANDS RW-5200-0250		
5.8 GHz FCC/IC*	5.725 - 5.850 GHz	FCC 47CFR, Part 15, Subpart C and IC RSS-210
5.8 GHz MII	5.730 - 5.845 GHz	MII for 5.8 GHz
5.4 GHz FCC	5.480 - 5.715 GHz	FCC 47CFR, Part 15, Subpart E
5.4 GHz IC	5.480 - 5.715 GHz	IC RSS-210
5.3 GHz FCC/IC	5.255 - 5.350 GHz	FCC 47CFR, Part 15, Subpart E and IC RSS-210
4.9 GHz FCC/IC	4.940 - 4.990 GHz	FCC 47CFR, Part 90, Subpart Y and IC RSS-111
5.8 GHz WPC India	5.820 - 5.870 GHz	WPC GSR-38
5.4 GHz Universal	5.465 - 5.730 GHz	Universal
5.3 GHz Universal	5.140 - 5.345 GHz	Universal
4.9 GHz Universal	4.890 - 5.010 GHz	Universal
5.9 GHz Universal	5.730 - 5.960 GHz	Universal
6.0 GHz Universal	5.690 - 6.0.60 GHz	Universal

RADWIN 5000 **H**PMP - Unique Points

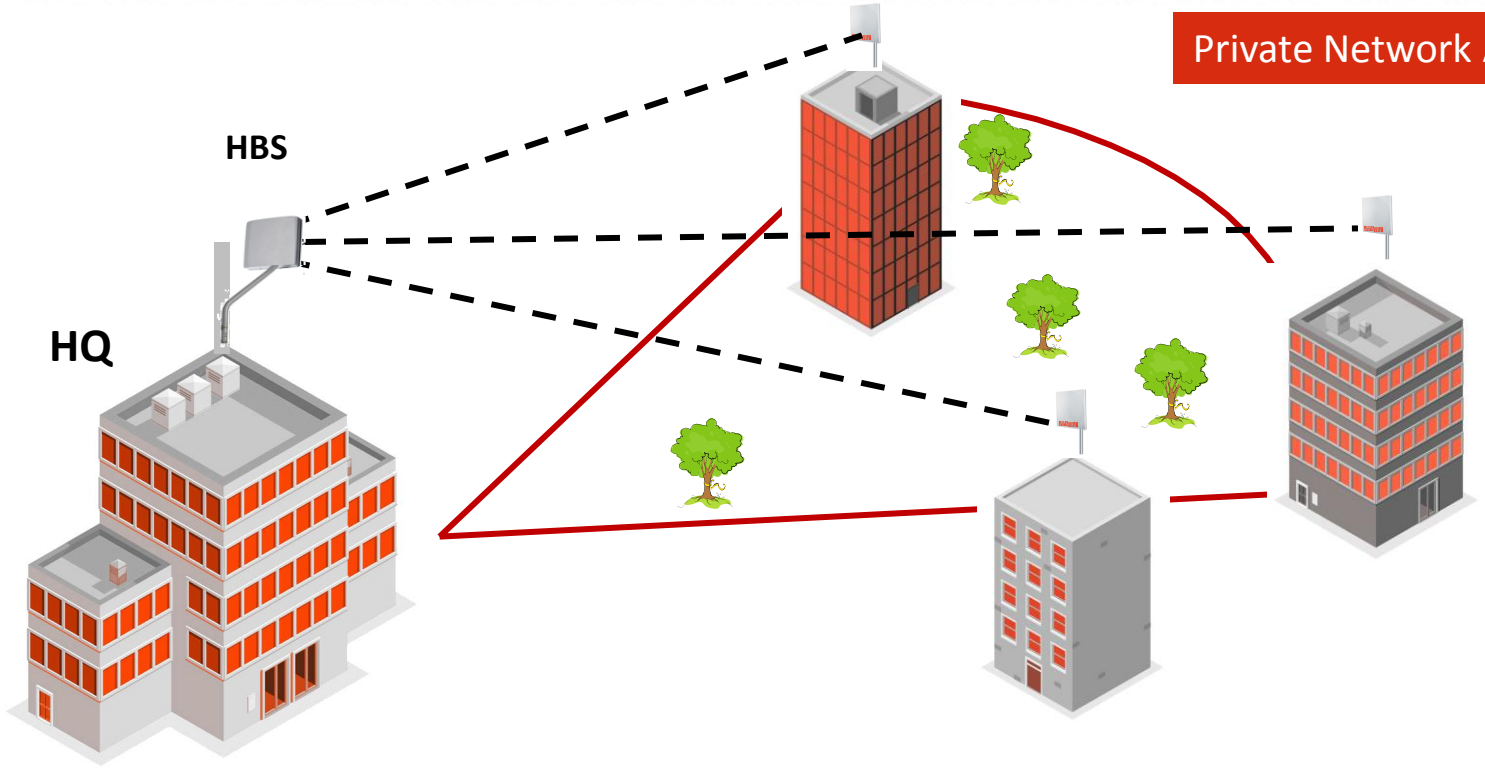
- Highest Base Station capacity for the best user experience – 200Mbps
- Highest spectrum efficiency for grater ROI - ~ 5bps/Hz
- Secured Service Level Agreement for demanding applications
- MIMO and Diversity (per HSU)
- Multi band radios
- Low latency
- Compact Subscriber Units (SUs) with low visual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

RADWIN 5000 **H**PMP
Applications

RADWIN

High Capacity Inter-Office connectivity

Private Network Application



- Two modes of operations:
  - » WLAN : Traffic from branch to branch is switched back by the BS
  - » “Access” – Higher network hierarchy switches the traffic

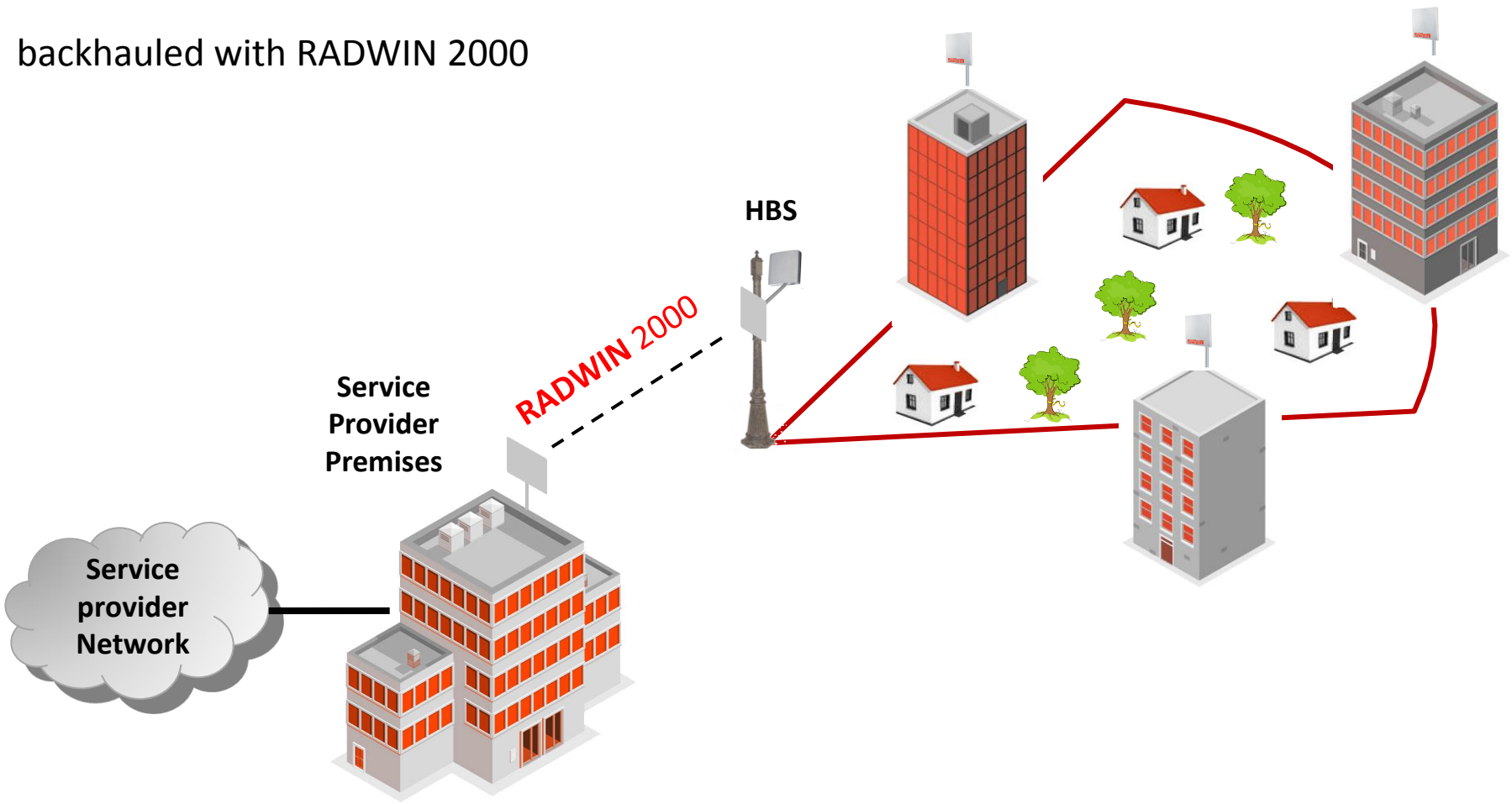
RADWIN

Urban - High Capacity Corporate Access

Service Provider Application

Multi sectors can be

backhauled with RADWIN 2000

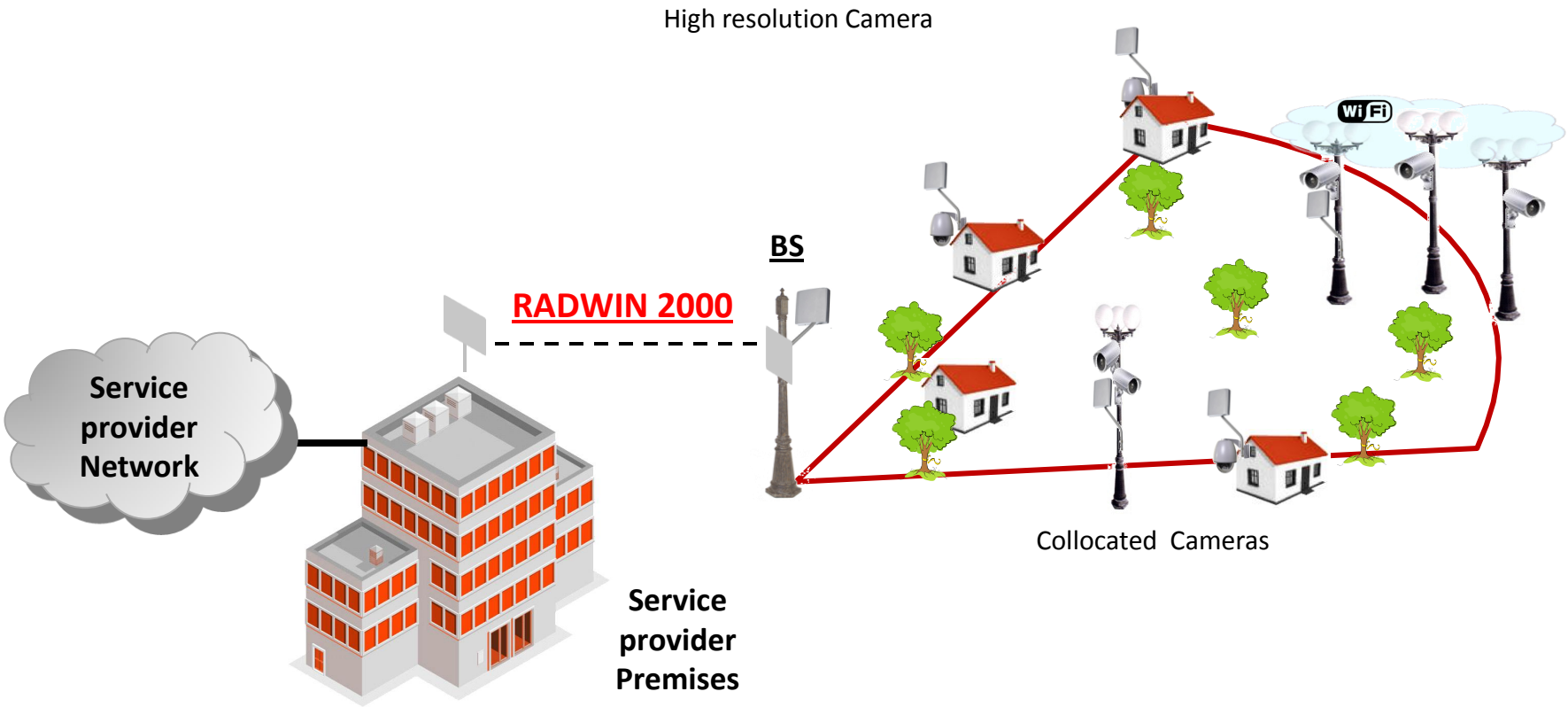


RADWIN

Safe City –Video surveillance

Private Network Application

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

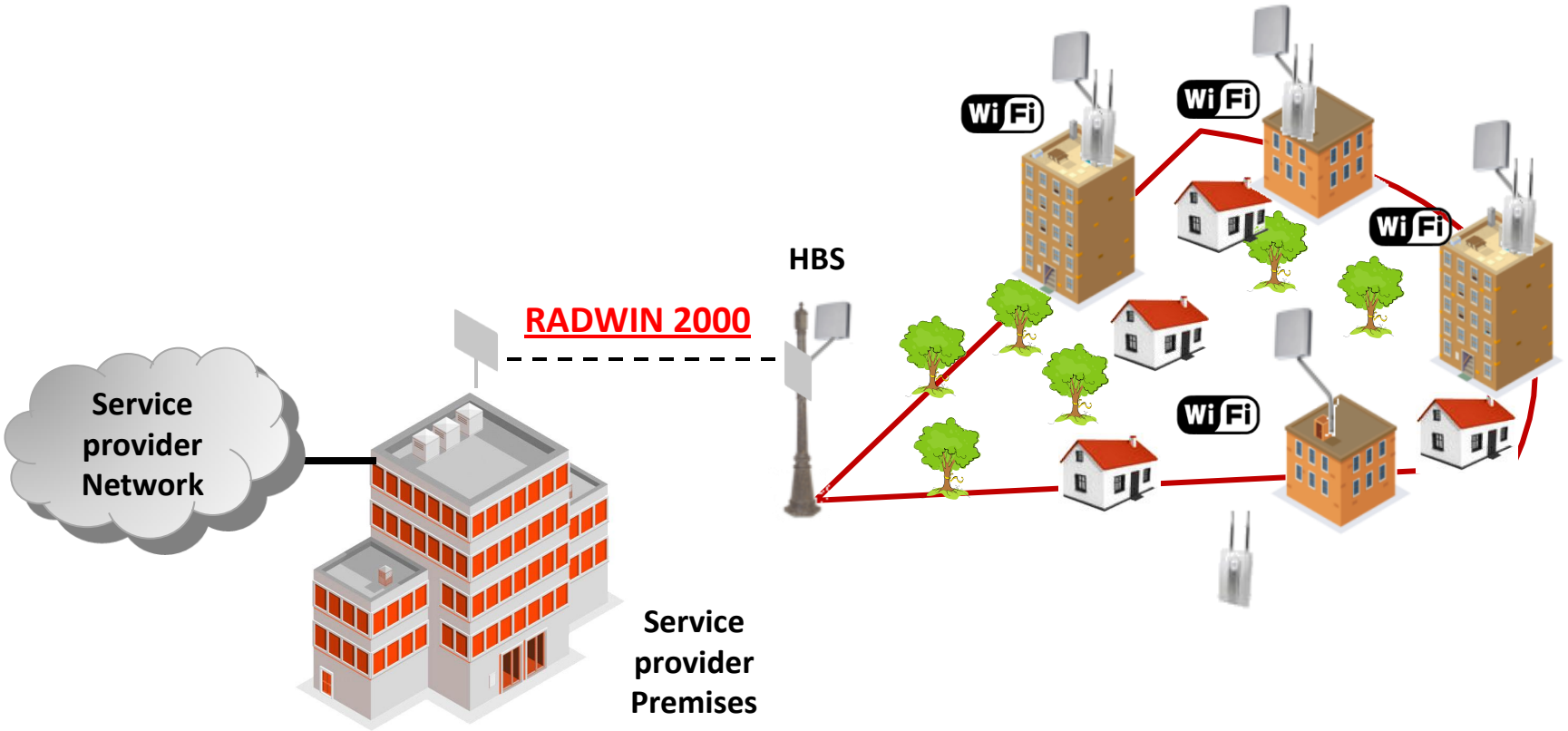


RADWIN

Multi Tenants Building – WiFi Backhaul

Service Provider Application

- Residential building are covered through WiFi AP
- WiFi AP are backhauled by RADWIN 5000



RADWIN

Urban - High Capacity SLA Corporate Access

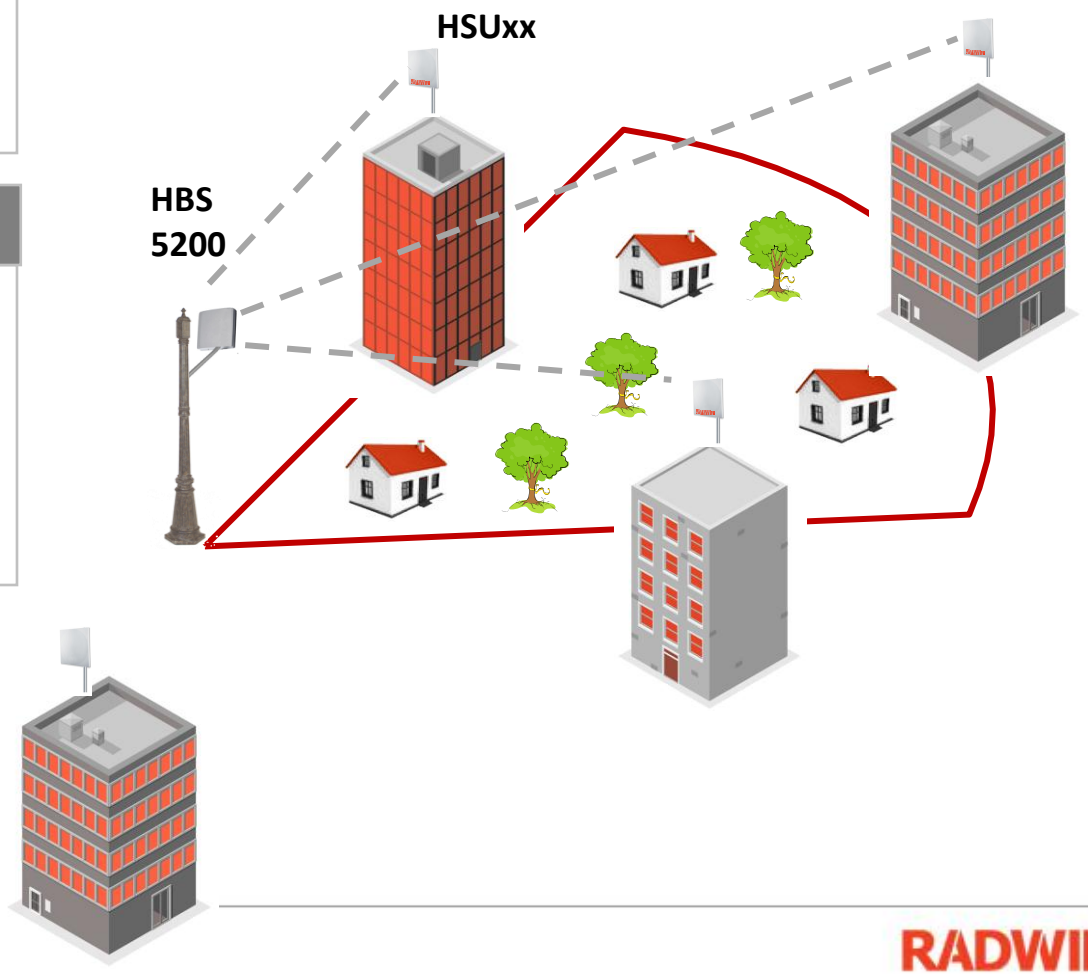
Service Provider Application

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



RADWIN

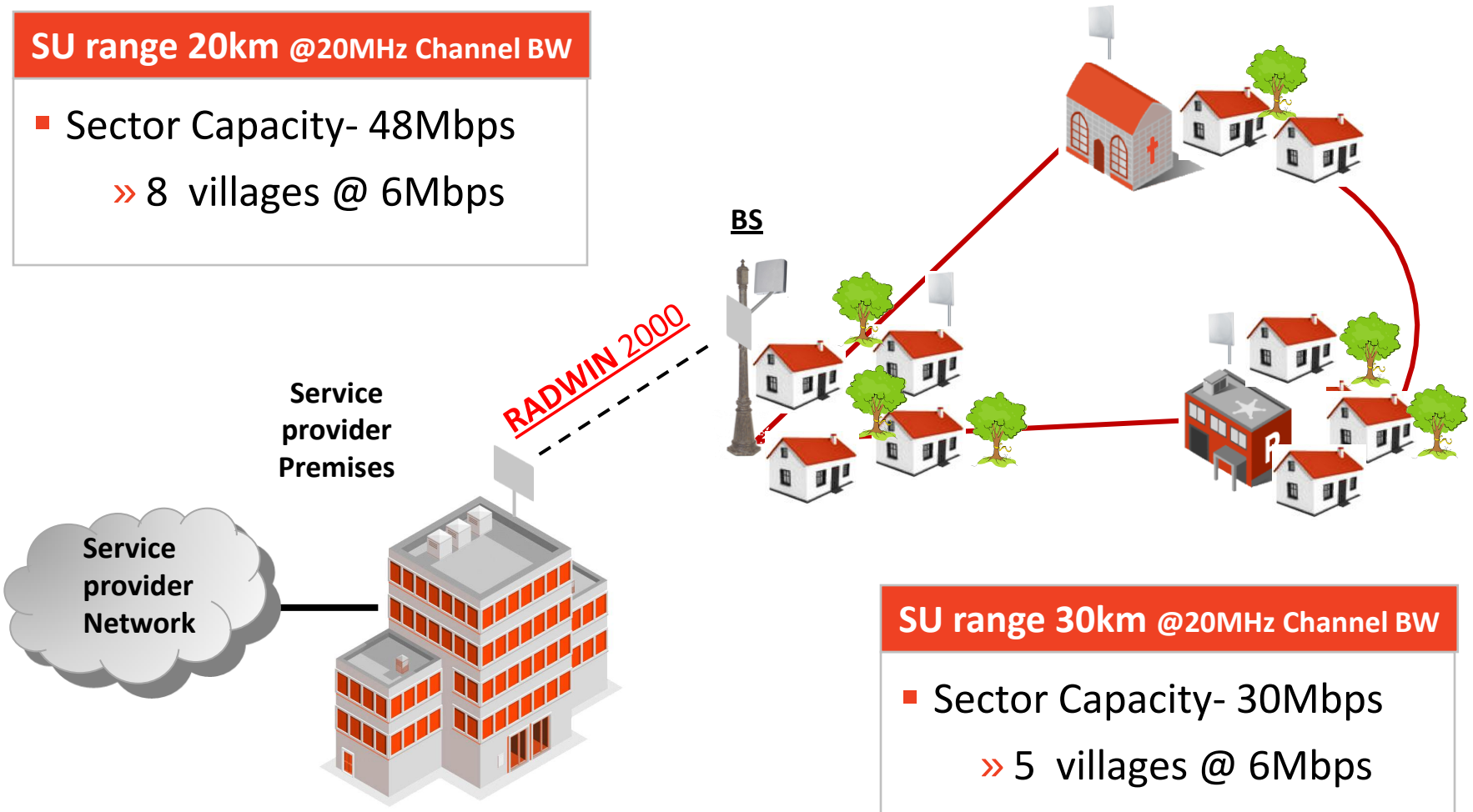
Rural Broadband – Connecting Communities

Service Provider Application

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

RADWIN

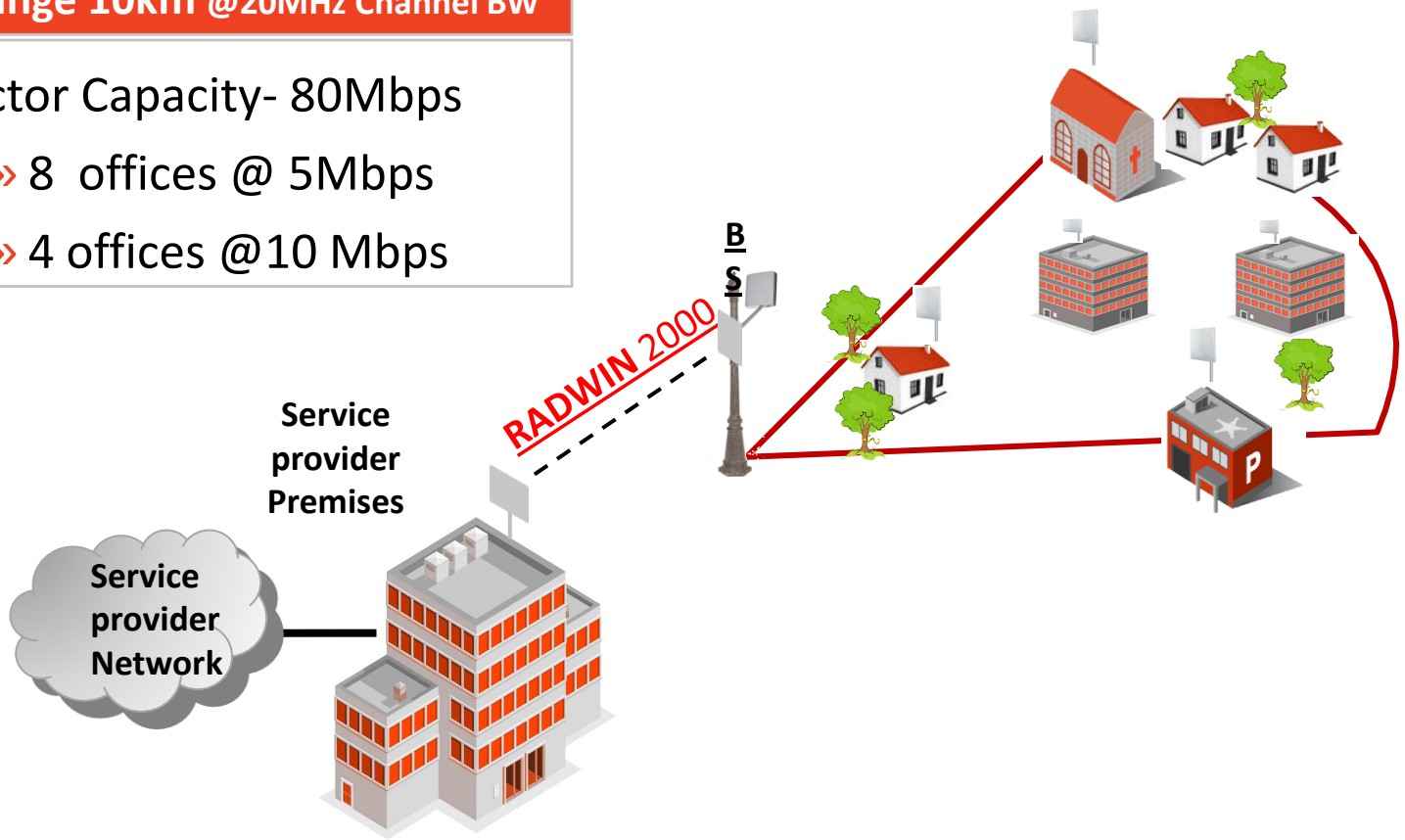
Government Broadband – in 3.x GHz

Governmet connectivity

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



RADWIN

RADWIN 5000 **H**PMP
RESUMEN

RADWIN

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)

RADWIN 5000 **H**PMP - Resumen

- 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

RADWIN