World-class Wireless Networks

Product Overview: PTP 670

Presenter: Sagar Deshpande
AGENDA

- PTP Overall Portfolio
- PTP 670 Introduction
- PTP 670 Features
  - HCMP
  - OTAR
  - PTP 670 vs PTP 650
- More Information
PTP OVERALL PORTFOLIO
Sub 6GHz PTP Portfolio

PTP 450
- 200+ Mbps
- 0.9/3/5 GHz

PTP 450i
- 300+ Mbps
- ARQ
- ATEX/HAZLOC

PTP 670
- 450+ Mbps
- HCMP
- DSO

PTP 700
- 450+ Mbps
- FIPS 140-2
- MILITARY GRADE
VERTICAL MARKETS

Wireless Internet Service Provider
- Enterprise Service Provider
- Private Service Providers

Utilities
- Mining, Oil and Gas Industries
- Electricity and Water Agency

Public Safety
- Video Surveillance
- Disaster recovery
PTP 650: Global Footprint
PTP 450i: Global Footprint
PTP 450: Global Footprint
WIRELESS SERVICE PROVIDERS
Case Study: Nepal / Mount Everest Base Camp

• Wireless broadband network connects 150 of the most remote villages in the world

• Supports education, commerce, and tourism

• Proven performance in harsh conditions

• Solution
  – PTP unlicensed backhaul links
  – PMP unlicensed distribution network
OIL & GAS COMPANIES
Critical Infrastructure

• Security
  – Reducing the risk to critical infrastructure by physical means or defense cyber measures to intrusions, attacks, or the effects of natural or man-made disasters

• Resilience
  – Prepare for and adapt to changing conditions, withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents
Case Study: Aguakan / MEXICO

• Improve water quality and reduce operation costs

• Sensor and meter communication distribution network

• High reliability

• Solution
  – PTP 650 wireless backhaul
  – PMP 450 licensed and unlicensed distribution network
  – ePMP unlicensed distribution network
PUBLIC SAFETY
Case Study: South Asia Games

- 4,500 athletes from eight nations
- Indoor and outdoor coverage for dormitories and venues
- High capacity for spectators and media

Solution
  - PTP 650 unlicensed backhaul
  - PTP 450 unlicensed backhaul
  - PMP 450 unlicensed distribution
  - cnPilot E400 enterprise indoor WiFi
  - cnPilot E500 enterprise outdoor WiFi
Introducing PTP 670

4.9 to 6.05 GHz
PTP 670 Integrated

4.9 to 6.05 GHz
PTP 670 Connectorized
**PTP 670**

**Radio Performance**
- 4.9 to 6.05 GHz
- Max Throughput: 450 Mbps
- Channel BW: 5/10/15/20/30/40/45
- 10 Bit/Hz Efficiency
- Max Tx power 27 dBm
- 13 Level Mod up to 256 QAM
- 850K processed pps
- SPF and AUX port

**Additional Features**
- Channel Selection: DSO or Manual
- Jumbo Frame support: 9600 bytes
- Online spectrum analyzer
- QOS: 8 Level
- Adaptive duty cycle
- Split Frequency
- HCMP
- TDD Sync

**Security**
- AES 128/256
- User Authentication Radius Support
- HTTPS and SNMPv3 support
- OTAR (Over the Air Re-keying) support

**Protocol Support**
- IEEE 1588v2
- SyncE
- IEEE 802.1p
- PoE output 802.3at
- IPV6 Support
PTP 670: THROUGHPUT GRAPH

THROUGHPUT CHART

MAX THROUGHPUT
450 MBPS

SPECTRAL EFFICIENCY
10.1 Bits/Hz

MAX RANGE
155 Miles /250 Km
FLEXIBLE CHANNEL SIZE

<table>
<thead>
<tr>
<th>Channel Bandwidth</th>
<th>Aggregate Capacity (Mbps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 MHz</td>
<td>10 MHz</td>
</tr>
<tr>
<td>15 MHz</td>
<td>20 MHz</td>
</tr>
<tr>
<td>30 MHz</td>
<td>40 MHz</td>
</tr>
<tr>
<td>45 MHz</td>
<td></td>
</tr>
</tbody>
</table>
ADAPTIVE MODULATION

13 LEVELS OF MODULATION

- BPSK 0.63 SINGLE
- QPSK 0.63 SINGLE
- QPSK 0.87 DUAL
- 16QAM 0.63 SINGLE
- 16QAM 0.63 DUAL
- 16QAM 0.87 SINGLE
- 16QAM 0.87 DUAL
- 64QAM 0.75 SINGLE
- 64QAM 0.75 DUAL
- 64QAM 0.92 SINGLE
- 64QAM 0.92 DUAL
- 256QAM 0.81 SINGLE
- 256QAM 0.81 DUAL

HITLESS MODULATION
Antenna Pattern

ANTENNA GAIN  23 dBi

ANTENNA BEAMWIDTH  8°

ANTENNA DIMENSIONS  12”x12”
5 GHz Analysis: Channel Size

FCC REGUALTIONS

PTP 670 RADIO CAPABILITY

4.9 GHz Band: 4.940 – 4.990 GHz  : 50 MHz
5.1 GHz Band: 5.150 – 5.250 GHz  : 100 MHz
5.2 GHz Band: 5.250 – 5.350 GHz  : 100 MHz
5.4 GHz Band: 5.470 – 5.725 GHz  : 255 MHz
5.8 GHz Band: 5.725 – 5.850 GHz  : 125 MHz
DSO - MITIGATE INTERFERENCE

• Automatically changes channels to avoid interference without dropping the link
• Narrow channels – 5, 10, 15, 20, 30, 40, 45 MHz
• Spectrum analyzer – scans the band continuously
• TDD synchronization for optimal collocation density
• Proactive channel planning
• Up to 2,500 channel combinations

5Channel width options depend on country of operation.
Always-on Wide-band Spectrum Analyzer

- Real-time and historical analytics
- Find available channels; identify sources of interference
- Scans all bands and channels from 4.9GHz to 6.05GHz
- Data available in GUI and exportable via SNMP
PHYSICAL PROTECTION

Protection Against:
- Solar Radiation
- Hurricane speed winds
- Dust and Water protection
- Harsh Weather temperature

Did you know:
- Average Category 5 Hurricane: 156 mph
- Highest Wind speed recorded ever: 196 mph

Did you know:
- Wind Speed: 200 Mph/322 kph
- Fahrenheit Scale: 32°F
- Celsius Scale: 0°C

Most electronic components sustain damage or malfunctions over time due to solar radiation.

IP 67 HOUSING

Solar Radiation Protection

Cambium Networks™
SPATIAL DIVERSITY: EXPLAINED

WHEN IS SPATIAL DIVERSITY APPLICABLE
SENDING WIRELESS SIGNAL OVER REFLECTIVE SURFACES SUCH AS OCEAN/WATER, DESERT, CONCRETE ROAD

WHAT HAPPENS IF DO NOT USE SPATIAL DIVERSITY
RADIO POSE PERFORMANCE LOW ALONG WITH RELIABILITY CHALLENGES DUE TO DUCTING AND FADING CREATED BY MULTI-PATH INTERFERENCE OVER SMOOTH SURFACE.

HOW TO APPLY SPATIAL DIVERSITY
PTP 670 HAS TWO 2 N-TYPE CONNECTOR, BY CONFIGURING ONE OF THEM AS VERTICAL AND OTHER AS HORIZONTAL AlIGNED
PTP SYNC: EXPLAINED

USING PTP SYNC WHEN:

LESS SPECTRUM AVAILABLE ON TOWER
LIMITED TOWER SPACE
REDUCE INTERFERENCE FROM OTHER RADIO

SCENARIO

LINK 1: SYNC
ALIGN TRANSMIT AND RECEIVE CYCLE

| TX | RX | TX | RX | TX |

LINK 2: SYNC

| TX | RX | TX | RX | TX |
Split Frequency / Automatic Transmit Power Control

Split Frequency Advantages

ATPC
Split Frequency / Automatic Transmit Power Control

Split Frequency Advantages

400 Mbps

ATPC
Encryption of Over the Air Data
Prevent unauthorized software
Modified Software images cannot be loaded

Prevent unauthorized software
Encrypt sensitive parameters configuration
Un-used ports and protocols locked down

Each software release tested against set of latest known attacks with industry-standard tools

Out of Band Management options
Support user installable certificates for authentication
Identity based user account: Multiple Access Level

Standard encryption protocol TLS, RSA, AES 128/256
Over the Air Re-keying capability
UPLINK-DOWNLINK SYMMETRY RATIOS

<table>
<thead>
<tr>
<th>Ratio</th>
<th>Upstream Rate</th>
<th>Downstream Rate</th>
<th>Ratio</th>
<th>Upstream Rate</th>
<th>Downstream Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:1</td>
<td>225 Mbps</td>
<td>225 Mbps</td>
<td>2:1</td>
<td>300 Mbps</td>
<td>150 Mbps</td>
</tr>
<tr>
<td>2:1 and 1:2</td>
<td>66%</td>
<td>33%</td>
<td>3:1</td>
<td>337 Mbps</td>
<td>113 Mbps</td>
</tr>
<tr>
<td>3:1 and 1:3</td>
<td>75%</td>
<td>25%</td>
<td>5:1</td>
<td>375 Mbps</td>
<td>75 Mbps</td>
</tr>
<tr>
<td>5:1 and 1:5</td>
<td>83%</td>
<td>17%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adaptive</td>
<td>Auto-adjustable depending on load</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Line-of-Sight (LOS)  
Up to **155 miles**

near-Line-of-Sight (nLOS)  
Up to **25 miles**

Non-Line-of-Sight (NLOS)  
Up to **6 miles**
HCMP Deployment Scenarios

- Building to Building
- Building to Street
- Street to Street
**HCMP Mode: Explained**

**SCENARIO:**

**HCMP MASTER:** 1
**CONNECTORIZED PTP 670 + SECTOR ANTENNA**

**REMOTE NODES:**
**TWO INTEGRATED PTP 670**

**Total Frame Capacity 360 Mbps**

**TDD 1:2 MODE**

**TDD 1:1 MODE**

*RN: Remote Node  
*M: Master*
HCMP PLANNING USING LINKPLANNER

- Path Profile
- Configuration Detail
- Performance Summary
## HCMP SPEED

### 20 MHz, 5km max range

<table>
<thead>
<tr>
<th>Symmetry</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>4:1</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>3:1</td>
<td>60 / 20</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>2:1</td>
<td>55 / 28</td>
<td>37 / 18</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>1:1</td>
<td>40 / 40</td>
<td>28 / 28</td>
<td>20 / 20</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>1:2</td>
<td>28 / 55</td>
<td>18 / 37</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>1:3</td>
<td>20 / 60</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>1:4</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### 40 MHz, 5km max range

<table>
<thead>
<tr>
<th>Symmetry</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>4:1</td>
<td>133 / 33</td>
<td>88 / 22</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>3:1</td>
<td>121 / 40</td>
<td>63 / 28</td>
<td>63 / 21</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>2:1</td>
<td>106 / 53</td>
<td>73 / 37</td>
<td>55 / 28</td>
<td>44 / 22</td>
<td>37 / 18</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>1:1</td>
<td>81 / 81</td>
<td>53 / 53</td>
<td>40 / 40</td>
<td>33 / 33</td>
<td>28 / 28</td>
<td>23 / 23</td>
<td>21 / 21</td>
</tr>
<tr>
<td>1:2</td>
<td>53 / 106</td>
<td>37 / 73</td>
<td>28 / 55</td>
<td>22 / 44</td>
<td>18 / 37</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>1:3</td>
<td>40 / 121</td>
<td>28 / 83</td>
<td>21 / 63</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>1:4</td>
<td>33 / 133</td>
<td>22 / 88</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
## HCMP: How it should look?

<table>
<thead>
<tr>
<th>ATTRIBUTES</th>
<th>PTP MODE</th>
<th>HCMP MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of Radio’s Required</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Number of Radio and Antenna at Cambium HQ</td>
<td>4/4</td>
<td>1/1</td>
</tr>
<tr>
<td>TDD Sync Issue due to multiple Radio’s</td>
<td>Yes, including PTP Sync Unit per Radio</td>
<td>No Issues</td>
</tr>
<tr>
<td>Power drawn</td>
<td>4x Normal</td>
<td>1x Normal</td>
</tr>
<tr>
<td>Alignment of 4 Radio’s on Tower</td>
<td>Huge Issue</td>
<td>Sector Antenna makes alignment easy</td>
</tr>
</tbody>
</table>
How to enable HCMP?

• Group Access:
  • All 4 PTP 670 in the diagram, share common Group Access ID
  • This group access must be same across all PTP 670 Radio’s
    • 1 HCMP Master and 3 HCMP Slave
    • Example Group Access could be any integer from 0 to 255

• In HCMP mode, there are two modes Radio can be
  o HCMP Master (Need License Key, Part number: C000067K001A)
  o HCMP Slave (Free, Built in by default)
OTAR (Over the Air Re-keying)

• What it means?
  The secret key used to encrypt the over-the-air data is automatically generated, negotiated and apply seamlessly at pre-configured intervals without any user intervention

• Advantages
  – No need for user intervention
  – Simplifies and streamlines operations while virtually eliminating risk of compromise.
  – Fulfill corporate equipment of regular key updates
670 vs 650
### PTP 670 vs PTP650

<table>
<thead>
<tr>
<th></th>
<th>PTP 670</th>
<th>PTP650</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTP Radio Performance</td>
<td>Same</td>
<td></td>
</tr>
<tr>
<td>Radio Price</td>
<td>Same</td>
<td></td>
</tr>
<tr>
<td>Integrated Antenna</td>
<td>12x12 @23 dBi</td>
<td>14x14 @23 dBi</td>
</tr>
<tr>
<td>HCMP</td>
<td>Up to 8 Nodes</td>
<td>Not Support</td>
</tr>
<tr>
<td>Capacity Key</td>
<td>Full Capacity By Default</td>
<td>License Key</td>
</tr>
<tr>
<td>Hardware Variations</td>
<td>Connectorized Integrated</td>
<td>Connectorized Integrated</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PTP650S</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PTP650L</td>
</tr>
<tr>
<td>Bracket</td>
<td>New Bracket</td>
<td></td>
</tr>
</tbody>
</table>
PTP 670 Benefits

- Faster Processor with more memory
  - Roadmaps will have exciting new features

- HCMP compatible
  - High spectral efficiency
  - Up to 8 remote nodes

- Pricing
  - Same hardware pricing as PTP 650
  - No Licensing fees for Full capacity key

- Compatibility with PTP 650
  - PTP 670 will be backward compatible with PTP 650 through special release version
  - Specific release version is scheduled in Q4 2017
  - All PTP 650 accessories are compatible with PTP 670

PTP 670 ARE CURRENTLY AVAILABLE FOR ORDERING
MORE INFORMATION
Point to Point Network: From Point A To Point Faraway

Covering the full range of radio frequencies, applications, and budgets, the PTP series is designed to perform in the real world and tested to prove it under the harshest conditions.

Point to Point Networking

Our proven Point-to-Point (PTP) series solutions are deployed worldwide, serving highly critical applications in formidable environments for the world’s most demanding users. With best-in-
Cambium Community

• Learn from network operators around the world

• Community Forum
  – Products
  – Network planning
  – Languages
  – Business issues

• Knowledge Base with technical detail documents

• Submit development ideas

• Real-world connectivity stories
Social Media

- Follow Cambium Networks to get the latest information
- Facebook
- Google+
- Instagram
- LinkedIn
- Twitter
- Weibo
- YouTube
Thank you

For more information:

Contact : Community Link:
https:\\www.community.cambiumnetworks.com