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Connecting the Last Mile

IEEE 802.19 TVWS Workshop – San Diego

wave6
the next wave of wireless

July 16, 2010 v1.2

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Agenda

1. Introduction
2. Challenges
   a) Spectrum
   b) Equipment
   c) Market
   d) R&D
3. Field Trial Results
4. Q & A

Introduction:
Company Mission & Driver

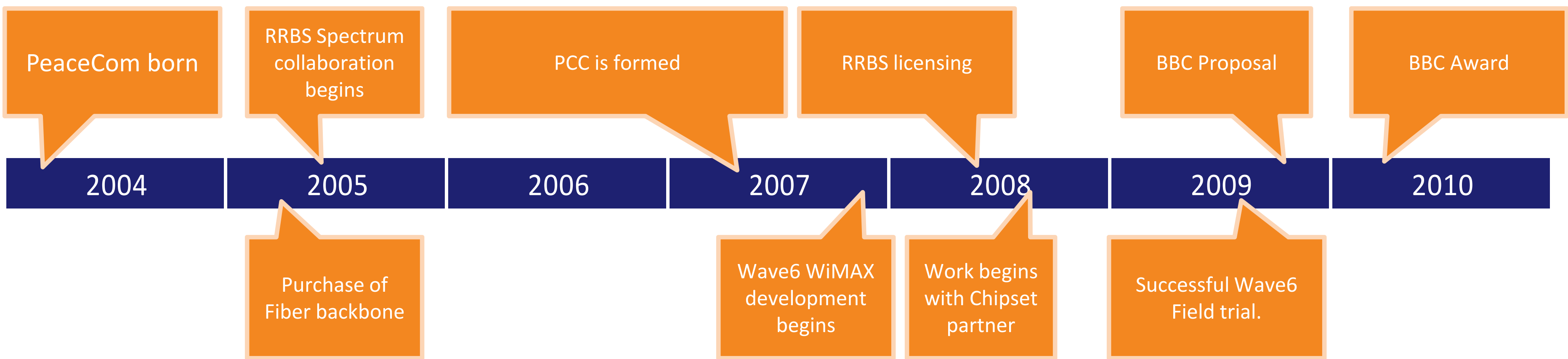
Mission

To be the world leader in rural connectivity systems

Driver

Insatiable demand for bandwidth driven by content consumption

Introduction:
PCC History



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Introduction:
PCC Key Markets

Industrial/Commercial

- End-to-end QoS, remote monitoring, SCADA
- Medium to low bandwidth, high reliability

Distance Learning/EMS/Medical/Enforcement

- Remote learning, video conferencing, worldwide education content
- High bandwidth nomadic connectivity (remote health monitors)
- Central monitoring of field (vehicle camera’s, thermal imaging, etc.)

Mega Projects

- Comprehensive site communications solutions

Residential

- Gold, Silver, Bronze service model
- Best effort but at high reliability

Challenges

a) Spectrum Challenges
b) Market Challenges
c) Equipment Challenges
d) R&D Challenges

Challenges: Spectrum

- Collaboration with IC for spectrum
- Lite-licensing, not unlicensed; case study is WIFI
- RRBS Standards development with IC through RABC meetings
  - Non-member participation, open, collaborative, working closely with CRC
  - Secondary service – Marginal RRBS receiver beside 850kW TV broadcast
  - Protection of DTV receivers – RRBS transmitter beside marginal DTV receiver
  - Emissions mask – protecting N+1, through N+16, dBc vs dBm
  - Promote coexistence, efficient use of spectrum, business viability
- Propagation
  - 121 km dead zone at border with US
  - 75% of Canada's population live within 160 km of US border
  - work with FCC to set aside channels?
- Polarization
  - Polarization diversity - horizontal polarization swamps DTV
  - Spatial diversity – 5, 6 wavelengths required
- Channel "bonding"/aggregation – 2*6MHz → 12 MHz
- Antenna technologies: Omni-directional coverage
  - Sectorization of very large cells

Challenges:
Market

- Cost of tower and land agreement dominates sustainability model
- Coverage or capacity?
- What will rural customers pay?
  - Urban market has driven residential service pricing too low
  - Get customer to pay for equipment to offset poor ROI timeline
  - Need anchor tenants:
    - Industrial, oil, gas, forestry, municipalities, medical, police, fire, ambulance
    - Symmetric DL/UL for multi-site triple play
- Consider cost of upstream
  - Learn from Clearwire, AT&T/iPhone, can't serve 4G off T1 lines
  - Trend toward higher throughput → smaller cells, or less users per cell
- Consider cost of "truck roll"
  - Large cells mean fewer towers, but subscribers are also further apart, harder to service
  - A single service call could eat 12 months of profits
  - Some sites are only accessible via a 5 hour helicopter ride
    - Consider the cost of replacing a $20 power supply

Challenges: Equipment

- Approached multiple vendors
  - WIFI – collision model, LAN vs WAN vs MAN
  - Dies when water freezes
  - Dies in Spring or Fall due to freeze thaw cycles
  - Dies at -40°C – typical Canadian prairie winter
  - Dies with large number of users, large cells
  - Dies in NLOS
  - Layer-2 bridging
  - No local manufacturing
- Approached OEMs and manufacturers
  - low volume, high cost
  - robust and reliable for Canadian climates
  - Partnership on supply chain
    - manufacturing or assembly
    - PCC value proposition
    - Long term partnership

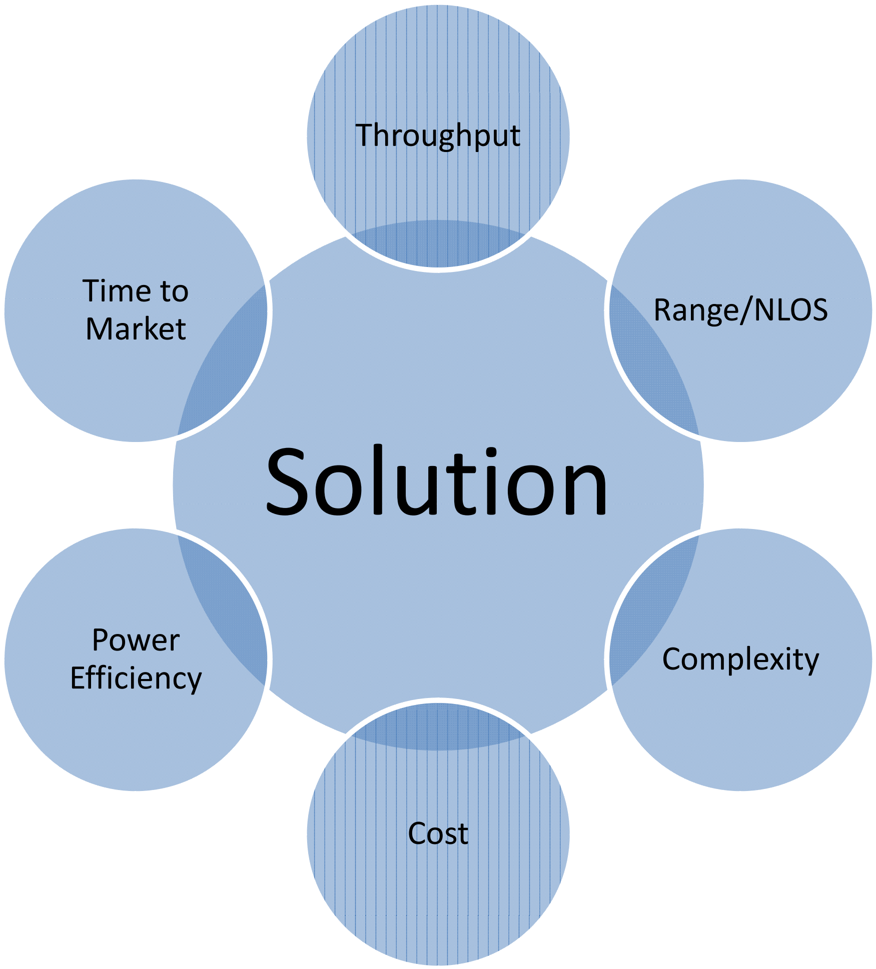
Challenges:
R&D (i)

- Design and manufacture our own
  - Reliability
  - Throughput
  - NLOS
- 512-698 MHz – breaking new ground
  - Baseband – silicon vendors won't support a small company, no potential for high volumes
  - PA – no COTS PA/LNA modules available
  - Transceiver – no RFIC available
  - Antenna - limited COTS, no design expertise, expensive to pioneer in low volume
    - Panel instead of dipole/yagi
    - Dipole on tower uses too much real estate. 8-element dipole = 19 ft
    - Omni-directional coverage with multiple antennae
- Proprietary versus WiMAX/802.16e
  - No standard for UHF
  - Simple Ethernet bridging for TLS
  - Urban WiMAX meant for islands of capacity, not coverage
  - ASN Gateway cost, and network infrastructure requirement
  - Why not 802.16d?

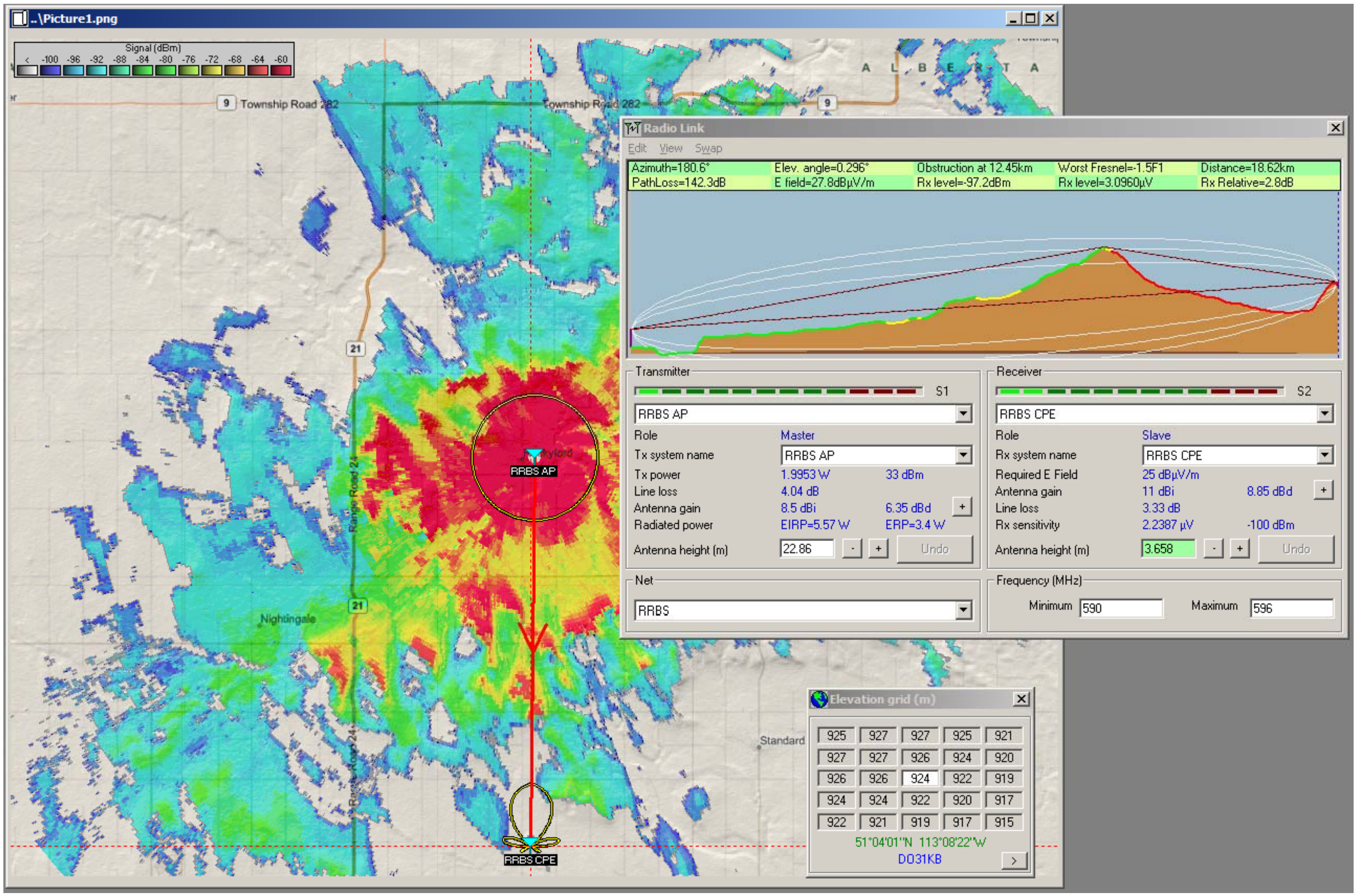
Challenges: R&D (ii)

- RRBS emissions mask
  - One HW SKU vs channel filter
  - Class A vs Class AB
  - RRBS vs WiMAX
- Dual Polarization → MIMO
  - Required for adequate throughput at cell edge, or extends cell radius
  - No dual polarized antennae in this band
- Power & Efficiency
  - Outdoor SU may be solar powered in remote location
  - PA dominated power budget
  - Reliable, efficient PA design → Class AB, harder to meet mask
  - Class A is power inefficient, and runs hot → less reliable, easier to meet mask
  - Reliable PS: most PCC service calls are because a power supply has failed
- Cellular planning
  - no frequency reuse, omni-directional coverage
- No reliable broadband propagation models
  - Adjust cell planning software model parameters from empirical data

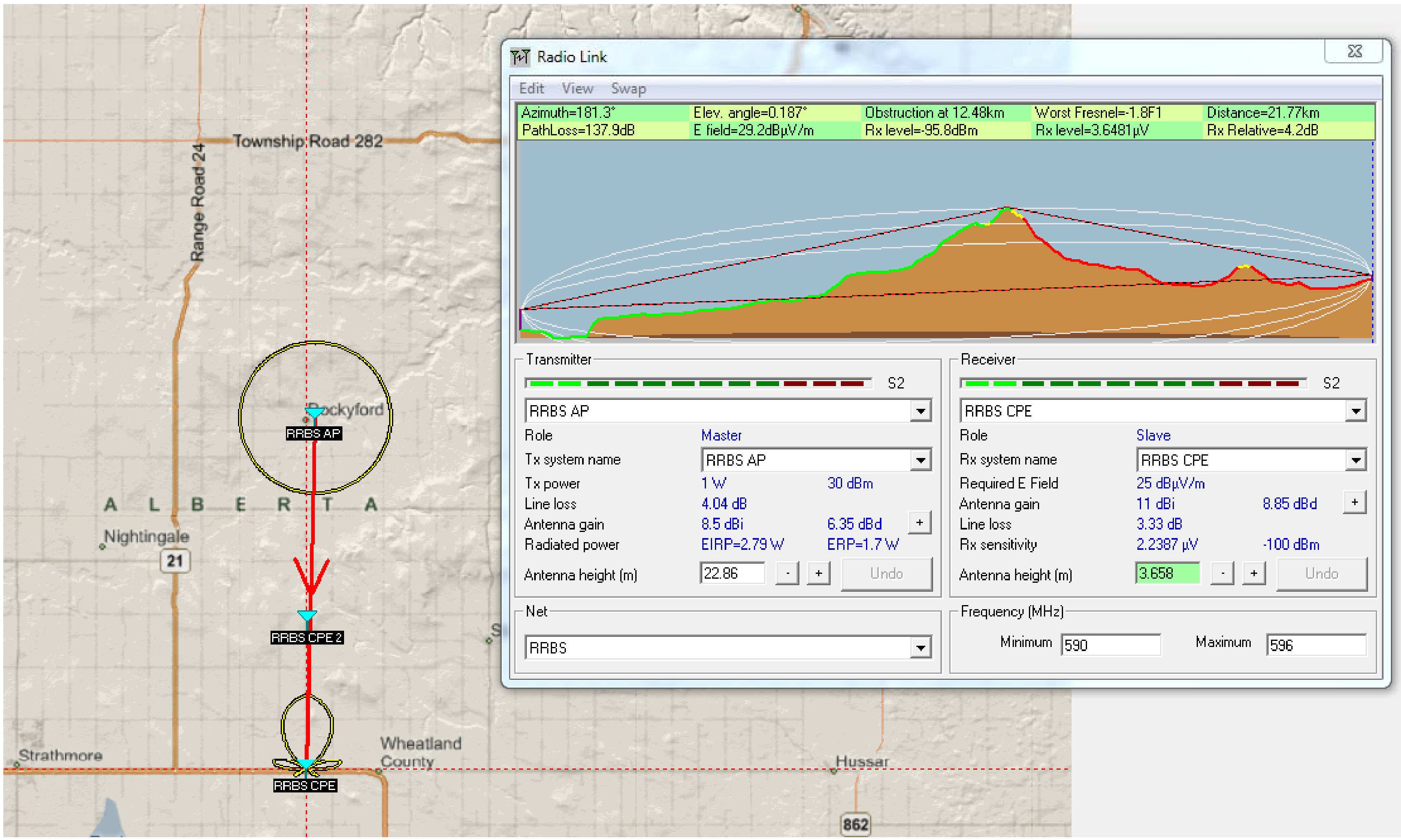
Challenges:
R&D (iii)



Field Trial Results:
March 2009



Field Trial Results:
April 2010



Q&A

Questions?

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RRBS Licenses