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Agenda

• Introduction
  ▶ Market Dynamics
  ▶ Transition Solution in Glance
  ▶ Installed Base & Upgrade Options

• Detailed scenarios for transition path to TD-LTE
  ▶ Before start: initial conditions & options for transition
  ▶ From WiMAX 802.16d (e-ready)
    ▪ BreezeMAX FDD & TDD
  ▶ From WiMAX 802.16e
    ▪ 4Motion BreezeMAX
    ▪ BreezeCOMPACT

• Common recommendations for transition process readiness
Introduction
Our Target

• To enable TD-LTE upgrade path for our large BWA installed base
  ▹ More than 200 Operators last 10 years
  ▹ About million CPEs

• Leveraging our well-designed BreezeMAX & BreezeCOMPACT solution
  ▹ Investment Protection: Lowering OPEX and CAPEX during the transition
  ▹ Minimizing service interruption
  ▹ Enabling better network performance
  ▹ Opening to wider End Device market
Market Dynamics for Transition Path

- **What is BWA?**
  - Established by WiMAX industry
  - Solution for fixed & nomadic service, *Mobility Less Significant*
  - Targeting data-centric, W-DSL, private & governmental networks
  - Focusing on QoS, IP & LAN services, simple & scalable

- **Identify Yourself**
  - GREEN or BLUE path
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- 3GPP defines mobile scenario of LTE *for cellular market only*
  - *Mobility & Roaming, Integration with 2G/3G networks, Cellular regulatory req’ts.*

- Need U/SIM CARD? – 3GPP no other option

- Transparent IP Services, Layer 2 (Eth.) services, SIP voice w/ QoS? *3GPP doesn’t support*

- **Other standards bodies taking control over BWA market transition?**
  - **GTI - TDD Spectrum Operators group**, promoting TD-LTE as a global mobile service (mostly 2.xGHz holders)
  - **WiMAX Forum** – By end 2012 approved Rel.2.x Roadmap --> TD-LTE for WiMAX transition
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2G, 3G & WIMAX MOBILE

FD & TD-LTE Rev 9/10 MOBILE

WIMAX Rel 1.x BWA

WIMAX Rel 2.x (TD-LTE)
Our Networks – Commitment to upgrade path

- Telrad is the only vendor with proved upgrade solution and field experience
- Our commitment is result of our solution design and R&D know-how including complete control over all system elements
Telrad Multi-Technology Approach

No Transition

Coexistence

Multi - Technology SDR

WiMAX

WiMAX

LTE

LTE Advanced

EPC Integral & Mini-Centralized

ASN GW

BreezeCOMPACT – The Only Real SDR solution for 4G transition
Telrad 4Motion WiMAX to TD-LTE Solution

At a Glance

- **WiMAX CPE** on WiMAX carrier
- **LTE CPE** on LTE carrier
- **Dual Mode CPE** on WiMAX or LTE carrier

**End User Devices**

**RAN (BS Site)**
- Site upgrade and HW extension for LTE support
- RRH and antenna reuse
- Ground level upgrade
- Single BH connectivity

**Core & Backbone**
- **EPC & ASN GW** enabling common network topology: distributed or mini-centralized
- **Common AAA** for WiMAX & LTE
- Minimal **IP backbone** reconfiguration
In-Band or Overlay Upgrade

What is Your reality?

- **In-Band Upgrade**
  - Utilize same band resources
  - Required multi-technologies CPE support

- **Overlay Upgrade**
  - Extra band resources required till complete CPE replacement
  - Required two technology coexistence solution in transition period
## All Our Networks are Upgradable

<table>
<thead>
<tr>
<th>Existing Platform</th>
<th>WIMAX 802.16d</th>
<th>WiMAX 802.16e</th>
<th>TD-LTE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>802.16d (e-ready) FDD or TDD deployment</strong></td>
<td>ODU BreezeMax FDD &amp; TDD</td>
<td>In-Band upgrade</td>
<td>BreezeCOMPACT</td>
</tr>
<tr>
<td></td>
<td>CPE1000 (RD2 – FDD/TDD/16e)</td>
<td>4Motion BreezeMAX*</td>
<td>overlay upgrade</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CPE1000</td>
<td>BreezeCOMPACT Dual Mode /TD-LTE CPE</td>
</tr>
<tr>
<td><strong>802.16e deployment</strong></td>
<td>4Motion ODU</td>
<td>16e / Dual Mode (WiMAX&amp;TD-LTE)</td>
<td>4Motion ODU + 4Motion LTE IDU</td>
</tr>
<tr>
<td></td>
<td>4Motion IDU</td>
<td>overlay upgrade</td>
<td>overlay upgrade</td>
</tr>
<tr>
<td><strong>New BWA deployment this year</strong></td>
<td>+ Dual Mode (WiMAX&amp;TD-LTE)</td>
<td>In-Band upgrade</td>
<td>+ Dual Mode (WiMAX&amp;TD-LTE)</td>
</tr>
</tbody>
</table>
Detailed Scenarios: Transition Path to TD-LTE
### Initial conditions for the upgrade

#### Does Your Network Require Overlay?
- **No, We have correct CPEs in the network**
- **YES, Extra spectrum is required for transition**

#### What the Minimum Extra Spectrum Does My Network Need for the Overlay?
- Depends on initial deployment

#### Should the Overlay Spectrum be adjacent?
- **No, Telrad Solution is not limited**

#### RAN Topology

<table>
<thead>
<tr>
<th></th>
<th>3-Sector</th>
<th>4-Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Deployment</td>
<td>10MHz, Reuse 3</td>
<td>10MHz, Reuse 2</td>
</tr>
<tr>
<td>Minimum Overlay</td>
<td>5MHz, Reuse 3</td>
<td>5MHz Reuse 2</td>
</tr>
<tr>
<td>Total Min Spectrum*</td>
<td><strong>45 MHz</strong></td>
<td><strong>30MHz</strong></td>
</tr>
</tbody>
</table>

* Generic statement, should be analyzed per specific network
BreezeMAX FDD/TDD transition

- **TDD or FDD**
- **ODU 1x1**
- **CPE1000**
- **BreezeMax**
- **IP Backbone**

- **WiMAX 16e TDD**
- **CPE1000**
- **WiMAX 16e CPE**
- **BS Upgrade**

- **COMPACT**
- **Dual Mode CPE Upgrade**
- **BS Upgrade**

- **WiMAX & TD-LTE**
- **COMPACT**
- **IP Backbone**
BreezeMAX TDD (e-ready) transition
4Motion BreezeMAX upgrade
In-band Scenario

<table>
<thead>
<tr>
<th>Element</th>
<th>Reuse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antenna</td>
<td>Reused</td>
</tr>
<tr>
<td>ODU</td>
<td>Reused</td>
</tr>
<tr>
<td>IF cabling</td>
<td>Reused</td>
</tr>
<tr>
<td>BMAX IDU</td>
<td>Replaced</td>
</tr>
<tr>
<td>Int. ASN GW</td>
<td>Replaced</td>
</tr>
<tr>
<td>GPS</td>
<td>Reused</td>
</tr>
<tr>
<td>4M LTE IDU</td>
<td>New</td>
</tr>
</tbody>
</table>
4Motion BreezeMAX upgrade Overlay Scenario

<table>
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<th>Element</th>
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<tbody>
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<tr>
<td>4M LTE IDU</td>
<td>New</td>
</tr>
</tbody>
</table>
4Motion ODU Upgrade Zoom-In

<table>
<thead>
<tr>
<th>ODU Type</th>
<th>Overlay</th>
<th>In-band</th>
</tr>
</thead>
<tbody>
<tr>
<td>2x2</td>
<td>Add ODU 2x2 Add 2 IF cables</td>
<td>No New HW</td>
</tr>
<tr>
<td>2x4</td>
<td>Add ODU 2x2</td>
<td>No New HW</td>
</tr>
<tr>
<td>4x4 (2*2x2)</td>
<td>No New HW</td>
<td>No New HW</td>
</tr>
</tbody>
</table>

**WIMAX ONLY**

**WIMAX + LTE (Overlay)**

**LTE ONLY (In-band)**
BreezeCOMPACT upgrade In-Band Scenario

- WiMAX CPE
- IP Backbone
- WiMAX 16e CPEs
- WiMAX 16e
  - Dual Mode (WiMAX&TD-LTE)
- COMPACT
- BS Upgrade
- Dual Mode CPE Upgrade
- LTE
- 16e / Dual Mode (WiMAX&TD-LTE)
- IP Backbone

16e / Dual Mode (WiMAX&TD-LTE)
BreezeCOMPACT Upgrade Overlay

WiMAX 16e TDD

16e / Dual Mode (WiMAX&TD-LTE)

RF

S1

S2

WiMAX 16e TDD

LTE Upgrade

16e / Dual Mode (WiMAX&TD-LTE)

RF

S1

S2

WiMAX & TD-LTE

16e / Dual Mode (WiMAX&TD-LTE)

RF

S1

S2

WiMAX 16e CPEs

WiMAX

IP Backbone

WiMAX 16e CPEs

IP Backbone
Why is it preferred making SPLIT vs. RADIO COMBINING?

<table>
<thead>
<tr>
<th></th>
<th>RADIO SPLIT</th>
<th>RADIO COMBINING</th>
</tr>
</thead>
<tbody>
<tr>
<td>WiMAX &amp; LTE Channels</td>
<td>No limitation</td>
<td>Adjacent</td>
</tr>
<tr>
<td>Diversity</td>
<td>Complete independency</td>
<td>May loose 1-2db</td>
</tr>
<tr>
<td>CORE connectivity</td>
<td>Straight Forward</td>
<td>Complicated</td>
</tr>
<tr>
<td>topology</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**WIMAX ONLY**

**OVERLAY Ready**

**WIMAX + LTE**

**(Overlay)**
Steps for successful transition

• Consider your network transition in early stage
• CPEs
  ▶ Prefer using dual mode / upgradable CPEs
    – minimize or avoid NETWORK OVERLAY investment
• RNP
  ▶ For OVERLAY plan considering extra dB for the transition stage
    – avoid costly restructuring of the network
• Site structuring
  ▶ Build your site to avoid the need for additional climb and reinstallation during the transition
• Map your end users services and plan for post-transition operation
• Consider your transport topology
  ▶ Telrad LTE CORE solution uses similar topologies as in WIMAX
    – Distributed (Integrated) and Mini-Centralized EPC

Telrad proposes case-by-case advising and planning services for Radio & Networking
Thank You...