LTE450

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LTE450 Global Seminar 2014
We are integrating 2 complementary ITM businesses

Business Strategy

Customer Decisions

Go to Market Strategy

Our Research Strengths

Quantitative

Qualitative

Telecoms & IT Research
120+ analysts

Telecoms & Media Research
60+ analysts

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# 450MHz for LTE

**Current and planned 3GPP band adoption**

<table>
<thead>
<tr>
<th>Band number</th>
<th>Description</th>
<th>First used</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2100FDD</td>
<td>2010</td>
</tr>
<tr>
<td>2</td>
<td>1900FDD (PCS 1900)</td>
<td>2010</td>
</tr>
<tr>
<td>3</td>
<td>1800FDD (DCS 1800)</td>
<td>2010</td>
</tr>
<tr>
<td>4</td>
<td>2100FDD (AWS)</td>
<td>2010</td>
</tr>
<tr>
<td>5</td>
<td>850FDD</td>
<td>2011</td>
</tr>
<tr>
<td>7</td>
<td>2600FDD</td>
<td>2009</td>
</tr>
<tr>
<td>8</td>
<td>900FDD</td>
<td>2013</td>
</tr>
<tr>
<td>11</td>
<td>1500FDD (1.5GHz lower)</td>
<td>2012</td>
</tr>
<tr>
<td>12</td>
<td>700FDD (Lower A, B, C)</td>
<td>2010</td>
</tr>
<tr>
<td>13</td>
<td>700FDD (Upper 700MHz)</td>
<td>2010</td>
</tr>
<tr>
<td>14</td>
<td>700FDD (Public safety)</td>
<td>2013</td>
</tr>
<tr>
<td>17</td>
<td>700FDD (Lower B, C)</td>
<td>2010</td>
</tr>
<tr>
<td>18</td>
<td>800FDD (Japan 800MHz lower)</td>
<td>2012</td>
</tr>
<tr>
<td>20</td>
<td>800FDD (Digital dividend)</td>
<td>2009</td>
</tr>
<tr>
<td>26</td>
<td>800FDD (800MHz iDEN)</td>
<td>2013</td>
</tr>
<tr>
<td>28</td>
<td>700FDD (700MHz APAC)</td>
<td>2013</td>
</tr>
<tr>
<td>31</td>
<td>450FDD</td>
<td>2014</td>
</tr>
<tr>
<td>38</td>
<td>2600TDD</td>
<td>2011</td>
</tr>
<tr>
<td>39</td>
<td>1900TDD (China 1.9GHz)</td>
<td>2013</td>
</tr>
<tr>
<td>40</td>
<td>2300TDD</td>
<td>2011</td>
</tr>
<tr>
<td>41</td>
<td>2500TDD</td>
<td>2012</td>
</tr>
<tr>
<td>42</td>
<td>3400TDD</td>
<td>2012</td>
</tr>
<tr>
<td>43</td>
<td>3600TDD</td>
<td>2012</td>
</tr>
</tbody>
</table>

**Source:** Ovum

450MHz, also known as LTE Band 31:

- The lowest spectrum band currently identified for LTE services
- Provides for 20MHz (2 x 10MHz) channels, running from 450MHz to 470MHz
- Capable of supporting up to 25 Mbps downlink and 12.5 Mbps uplink
- Potentially supports both data and voice
- FDD only. There is no TDD (time division duplex) allocation for 450MHz.
Technical pros and cons of LTE450

Cons:
- Limited bandwidth
- Interference challenge (5Mhz guard band between the uplink and downlink)
- Limited ecosystem
- So far standardized for Brazil only

Pros:
- Propagation - covers more territory with fewer base stations than higher bands
- Cost is appealing for covering large rural areas.
- Technical issues are being addressed
- Clear evidence of vendor interest in supporting LTE450.

<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
<th>Cell radius (km)</th>
<th>Cell area (km²)</th>
<th>Relative cell count</th>
</tr>
</thead>
<tbody>
<tr>
<td>450</td>
<td>48.9</td>
<td>7521</td>
<td>1</td>
</tr>
<tr>
<td>850</td>
<td>29.4</td>
<td>2712</td>
<td>2.8</td>
</tr>
<tr>
<td>950</td>
<td>26.9</td>
<td>2269</td>
<td>3.3</td>
</tr>
<tr>
<td>1800</td>
<td>14.0</td>
<td>618</td>
<td>12.2</td>
</tr>
<tr>
<td>1900</td>
<td>13.3</td>
<td>553</td>
<td>13.6</td>
</tr>
<tr>
<td>2500</td>
<td>10.0</td>
<td>312</td>
<td>24.1</td>
</tr>
</tbody>
</table>

Theoretical comparison of base station coverage at different spectrum bands. This performance is based on flat terrain, tower mounted amplifier with radio 60 meters above ground, and no interference.
Standardization

- Standardization is driven by the licensing of 450MHz band for LTE in Brazil.
- The aim was to define a new LTE profile that can utilize the propagation characteristics of the band to deliver coverage of around 30 kilometres for sparsely populated areas.
- Band 31 forms part of 3GPP Rel-12. FDD profile with the band plan allocation being uplink 451-458 MHz and downlink 461-468 MHz.
- Brazil’s Telecommunications Research and Development Centre, CPqD, helped address key technical areas.
- The standardization process provides the basis for the manufacturing of LTE network access equipment, terminals, and network management systems.
The LTE450 ecosystem

The 3GPP study group comprised of 14 companies, including Alcatel Lucent, HiSilicon, Huawei, Mediatek, NEC, Nokia, Qualcomm, Samsung, and ZTE.

Chipset providers are developing commercial products for LTE450

Qualcomm is expected to have a commercial LTE450 chipset available before the end of 2014

Altair was the first chipset vendor to support LTE450 and already has a commercial product

Network vendors are supporting migration from CDMA450 to LTE

Huawei’s CDMA/LTE SingleRAN already provides CDMA450 operators with a smooth migration path to LTE

ZTE’s remote radio head supports dual mode CDMA/LTE at 450Mhz.

Devices will follow

CPE devices and routers will be available for early deployments

MiFi and handheld form factor devices are expected to be available in 2015
LTE450 business case

1. Wireless local loop

- Provides fixed or nomadic connectivity via a cellular or other wireless connection.

- CDMA450 has been widely used for providing WLL systems (the CDG currently lists 46 network providers in 36 countries).

- By upgrading to LTE 450MHz, operators can provide a more spectrally efficient solution than today's most widely deployed CDMA technology, EV-DO Rev. A, but that still uses relatively limited bandwidth.

- At the same time, they can continue to exploit the extended coverage and reduced cost benefits of the lower spectrum band, in turn helping to reduce the need for backhaul in areas where infrastructure is lacking.
LTE450 business case

2. Machine-to-machine

- Around one billion cellular M2M connections globally by 2020.
- Low data volumes replicated across thousands of connected devices
- Today’s traffic mainly carried over 2G networks such as GSM or CDMA.
- LTE450 can be a serious contender for M2M applications such as medical monitoring, smart metering and smart grids, and video surveillance.
- Potentially more cost-effective than higher LTE bands, but costs must be on a par with GSM.

Global cellular M2M connections

Source: Ovum
3. Mobile broadband for rural areas

- The 450MHz band is already being used to provide mobile broadband services in around 34 markets according to the CDG.

- Upgrading an existing CDMA450 network for LTE is less costly for an operator in rural or sparsely-populated areas than rolling out coverage using alternative, newly-licensed LTE spectrum bands.

- Given the substantial mobile subscriber base for CDMA450 (probably in excess of 20 million) and significant support from equipment vendors and handset providers, the likely benefit from a move to LTE is clear.

- The same benefits that apply with regard to fixed wireless access using LTE450, also apply to mobile broadband services.
In summary

Conclusions

- The 450MHz band will help operators bring broadband to rural communities more economically than with other spectrum bands.

- LTE450 brings advantages to CDMA450 operators when it comes network capacity and long-term device ecosystem support.

- The current LTE450 ecosystem is just starting to take off, but early indications are that there is vendor interest in supporting the band.

- Technically, LTE450 is well-suited to help meet the anticipated growth in machine-to-machine communications.

- Ovum believes LTE450 will follow the development path of other emergent LTE bands, and that there will be some initial commercial offerings in this area by the end of 2014.
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