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Exploring the Deployment Feasibility for different M2M Markets

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Recent and forthcoming talks include
Mobile world congress(2007,2008,2009, 2011),

CEBIT, Stanford University - MIT Sloan - Web 2.0

expo - Ajaxworld - Supernova - CNN money - BBC - Oxford University - European parliament

Global top 20 wireless blogger
According to fierce wireless
www.opengardensblog.futuretext.com
PhD research on resilience in sensor networks on white space networks

University of Oxford Continuing Education
Delivering learning online

- ***A presentation with a viewpoint and ideas apply to all M2M markets***

- ***Machine to Machine*** (M2M) refers to the idea of devices that transmit and receive data over a network, typically from remote locations. Application domains include healthcare, energy networks etc

- **O2 + Smart metering company G4S** – deploys a remote management system including around 200,000 SIM cards, to connect smart meters across the UK to G4S' data centre.

- **Telstra** introduced a web-based self-service platform, allowing organisations to manage M2M products themselves.

- Operators like M2M because predictable billing , more connections etc

- The magic 50 billion number: Currently 5 billion users worldwide connected to mobile networks and Ericsson estimates there will be **50 billion connected devices by 2020.**
- These devices need certification, authentication, registration and management(ex SW upgrades) + QOS
- ***BUT M2M != IOT***
- Machine to machine is two (intelligent) machines communicating with each other. Internet of things is about interacting objects(active or passive) – ex includes RFID
- **M2M is thus a subset of IOT – LTE is not the only Network type for M2M- So, how will it play out wrt LTE and M2M?**

- **LTE** is all about high performance, low latency and low cost.

- But selling advantages of a network has not been easy for Operators since **customers do not understand networks,** they understand services.

- While **Operators have been good at selling simple, mass market services globally**; how they can do this in the LTE world remains a challenge.

- On a fully loaded network, individual subscribers will get between 5Mbps and 12Mbps downstream and about 2Mbps to 5Mbps upstream, latency of about 30 milliseconds(Verizon). Thus, LTE is **faster even with limitations**

- **Lower latency** – leads to applications like voice over IP, streaming video or working on a virtual desktop. Verizon claims LTE cuts latency in compared with its 3G network

LTE iPads cannot roam ..

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Sweden May Investigate Apple iPad Marketing (WSJ)

*While **Sweden** is one of the few countries in Europe with broad 4G Long Term Evolution (LTE) coverage, the new iPad will not function on Swedish 4G networks. The new iPad only supports LTE on the 700 MHz and 2100 MHz frequencies. In Sweden the 700 MHz frequency band is used for television broadcasts, while the 2100 band is used for 3G data traffic, and it's unlikely that any of these bands will be re-farmed to LTE.*

***Australian Competition and Consumer Commission** brought attention to the "4G" branding of the new iPad with a **court filing** that accused Apple of "misleading" advertisements. The ACCC has sought "injunctions, pecuniary penalties, corrective advertising and refunds to consumers affected."*

http://blogs.wsj.com/tech-europe/2012/03/28/sweden-may-investigate-apple-ipad-marketing/

Possibilities ..

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It will be worse for trucks ..

You cannot stop a transport/logistics application – ex truck - from "roaming"

Hence for M2M..

- Two extremes –
  - low bandwidth, high volume, constrained devices
  - high bandwidth applications with QOS

- And two solutions –
  - LTE complemented by other spectrum types + Spectrum harvesting (sharing)
  - LTE on it's own

http://www.carsandmotorcycles.info/trucks/

High bandwidth case ..

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High bandwidth/QOS case is the easier of the two

- As part of BL Healthcare's HD video-enabled platform, the company allows caregivers and patients to hold medical telemetry sessions using multipoint HD video conferencing. (http://www.eweek.com/c/a/Health-Care-IT/Verizon-BL-Healthcare-Show-4G-LTEEnabled-Telemedicine-Terminal-514295/)
- AT&T also has a similar application
- LTE and Wlan are presumed to co-exist (but still not clear wrt companies like Vidyo etc i.e. LTE not only solution in this case)

The wider M2M case is more complex – low power, low bandwidth, global, pervasive aka the 50 billion sensors case. Here, the challenge is: How to complement 4G(LTE) with other network types to complement the limitations for LTE to capture the opportunity for M2M?

- According to Beecham Research, "over 90% of existing M2M modules, excluding e-readers and similar consumer devices, operate on 2G networks." However, it is more expensive to move a bit on 2G than on 3G so that will change

The case for LTE is sober ..

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From Informa – at LTE Summit 2012

- 70% of operators believe now is the right time to launch LTE (4G) services
- 60% of operators globally will launch 4G services by end of 2013
- **The main reasons** operators are launching LTE is to create new revenue streams (34.7%); to increase capacity to offer mobile broadband services (23.3%); and to build brand value through technology leadership (31.3%).
- "Because LTE technology, **at the moment at least, is an extension of the mobile broadband experience**, initial evidence suggests that mobile users aren't prepared to pay a significant premium for LTE access," says Paul Lambert, Senior Analyst at Informa Telecoms & Media. Most of the operators that have been successful in signing up LTE subscribers have decided not to charge a premium for 4G access, but instead are bundling it into existing data plans.

The case for LTE is sober ..

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- The main benefits end-users are seeing with LTE are increased download and upload speeds and faster response times, in particular for **data-intensive services such as video.**
- The **lack of LTE smartphone choice** compared with 3G is one reason why LTE has yet to become truly mass-market, with smartphones comprising only 18% of LTE devices available
- LTE rollouts to date highlight the problem of spectrum fragmentation between regions and within regions between countries.
- While the majority of LTE rollouts are in the 2600MHz band, North America and Asia Pacific are deploying LTE in their own bands, Europe is focused on 800MHz and 2600 MHz, with 1800MHz roll-outs to follow. Also some TDD.
- The number of LTE connections is forecast to grow from 7 million in 2011 to close to 300 million by 2015. **(millions not billions – so M2M is fringe at best!)**

M2M is different ..

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- **M2M applications are different** – 10x more devices sending generally short messages and needing 5 year battery life, very large number of ‘subscribers’, Ability to handle large numbers of small data packets efficiently
- **There is no single standard** and network able to offer ubiquitous, low-cost, low-volume communications with features like long battery life and broadcast calls
- **White space spectrum** provides a **new opportunity** because it is plentiful, free, harmonised world-wide and has excellent propagation
- However, it is also problematic to use with **pollution from TV transmitters** and interference from other users

- Google founder Larry Page calls White Space as '**WiFi on steroids'** and Microsoft calls it 'White fi'.
- Policy makers are excited because White Space remains the best option for providing **broadband connectivity to rural areas** including services like remote healthcare.
- In a nutshell, White Space networks take advantage of the empty fragments of spectrum interspaced between frequencies in use.
- White Spaces are significant because regulators in UK and USA have opened up portions of spectrum originally used by analogue TV for use by White Space applications.
- **White Space frequencies occupy the ranges traditionally used by Analogue TV in the UHF range.** In the United States, this is 698 – 806 Mhz and in the UK it is 470 – 790 Mhz.. Many other European and North American countries are expected to follow suit.
- White Space devices are expected to have a range of miles instead of feet (in comparison to WiFi). They are expected to travel through physical obstacles like walls, trees etc just like conventional broadcast signals. **However obstacles remain mainly due to minimising interference.**

- When treated as a technology similar to WiFi, anyone can deploy it (including existing network operators). **So, it is not disruptive but complimentary.**
- Hence, white space complements existing networking technology (like WiFi and Bluetooth) and will lead to **new use cases** for both incumbents and new entrants.
- **So, can we use White space to complement LTE – more specifically look at the wider possibility of combining spectrum types to realise the market opportunities?**

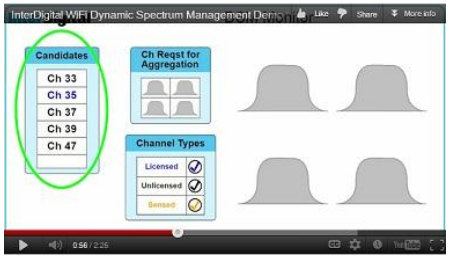
Spectrum landscape for M2M in context of white space

- White space - White Space frequencies occupy the ranges traditionally used by Analogue TV in the UHF range. In the United States, this is 698 – 806 Mhz and in the UK it is 470 – 790 Mhz
- LTE possibilities
  700 900 mhz
  (overlaps with white space 698 – 806 Mhz - UK - 470 – 790 Mhz USA)
  1700 1900 mhz
  2100 2600 mhz
- ISM bands -

(Industrial, Scientific and Medical band)
In the U.S., the 902-928 MHz, 2.4 GHz and 5.7-5.8 GHz bands
Unlicensed – and used for ISM uses but not for communication
wifi - 802.11 RF spectrums (2.4 GHz , 3.6 Ghz and 5 GHz)
microwave oven - 2.4 Ghz
Bluetooth - 2.4 Ghz
wireless personal area networks - 802.15.4
Zigbee - 802.15.4/Zigbee - lights, security alarms, smoke detectors etc
6LoWPAN

- Over time, I expect we will see a **more complex use of spectrum**.
- So far, spectrum access has been archaic, expensive and inefficiently managed.
- Spectrum is a common / public resource. Currently, countries allocate spectrum to specific companies (Operators). In developing the spectrum, Operators are expected to enable the public good and to develop an ecosystem.
- Today, we see an **exponential growth in demand and this is impacting the old way of 'pre-allocating' spectrum.**

Spectrum harvesting is one option ..



- One example is - Dynamic Spectrum Management technologies that intelligently harvest TV White Space (TVWS) and other under-utilized frequency bands. (demonstrated by : InterDigital and Spectrum Bridge)
- Spectrum harvesting opens new blocks of radio waves for use by Wi-Fi®, LTE, and other wireless systems, addressing the ever-growing demand for wireless bandwidth.
- In practise that means:
  Allocation and aggregation of contiguous and non-contiguous frequency channels across licensed, unlicensed and TV White Space;
  Database and sensing-assisted spectrum allocation;
  Extension of legacy systems such as Wi-Fi® and cellular into under -utilized frequency bands.

‘Available channels’ means all types of channels (LTE, white space, Wi-Fi)

This is truly disruptive – i.e. channels of network types are accessed transparently.

What does White Space add to Wi-Fi?

Two things

a) First more bandwidth. Whatever spectrum you have at 2.4 and 5GHz now you add multiples of 6-8Mhz of UHF spectrum.

b) Also, propagation. White Space signals carry further so Wi-Fi range is extended and where a weak signal would mean low bandwidth you would now get more bandwidth.

The concepts are interesting i.e. in the home, at a venue etc – if spectrum is seen not as ‘spectrum types’ (LTE, Wi-Fi, White space etc) – but rather holistically as ‘channels’ which may be ‘harvested’ by a service

Analysis

- The uptake of LTE is more sober – although Operators are deploying LTE, many challenges remain – such as spectrum harmonization etc

- The '50 billion sensor devices' present an opportunity but as of this conference – not on the Radar! (i.e. LTE is still mostly about mobile broadband)

- White Space networks have potential to unleash innovation by creating a new class of applications based on deploying networks in areas where traditional networks cannot be easily deployed(rural deployments, M2M etc)

- LTE needs friends to tap the real M2M opportunity

- We need to rethink the old ideas of spectrum allocation and consider a more dynamic spectrum allocation.

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PhD research on resilience in sensor networks on white space networks. Contact me to learn more