LTE Mobile Offload using DVB-T2

LS Telcom Summit 2015
10th June 2015 Lichtenau, Germany
About Gatesair

- GatesAir is former Harris Broadcast
- US based company with unparalleled reliability for nearly 100 years
- provides world-wide complete over-the-air Radio and Television solution supporting all TV & Radio Standards
- High efficient, reliable, easy to serve premium quality for long term operation
- Actively defining future of broadcasting as member of all large broadcast organization
- www.gatesair.com

TV - ------------ Transmitter - ------------ Radio

- DVB
- ISDB-T
- DTMB

Audio over IP

- DAB+
- HD Radio
- DRM
- FM, AM
- CDR

Studio

Connecting What’s Next
About Technische Universität Braunschweig

- The Technische Universität Braunschweig’s Institute for Communications Technology specializes in System Theory and Technology of Electronic Media; Mobile Radio Systems and Digital Signal Processing
- A combination of teaching and research is performed in Electrical and Electronic Engineering; Industrial, Electrical and Electronic Engineering; Computer Sciences; Computer Systems Engineering; Media Studies and Mobility and Traffic Engineering
- The Institute currently employs 65 professors and staff, including 35 research assistants, many of which are financed via cooperative contracts with third parties spanning the globe.

www.ifn.ing.tu-bs.de/en/ifn/
Forecast for mobile data traffic

- Increasing use of bandwidth from mobile phones
  - Studies from Ericsson and Cisco predict exponential growth of bandwidth need, driven largely from video consumption
- Drivers i.e. are TV Anywhere and widely usage of tablet PC & smart phones
- For Tablet PC using HEVC 1.4 Mbit/s required (1MB Video+ 0.4MB Audio)
- 1 hour requires 630 Mbyte
- 1h every day requires 18.9 Gbyte/ month

If it comes to mobile & portable reception – which networks cando the job?

**UMTS / LTE**
- Long Term Evolution (LTE) in Unicast mode
- Not with moderate costs

**Terrestrial DTV**
- **Limited success** to include broadcast tuners in mobile devices failed
- Remember MediaFLO and DVB-H
- Experience shows that a separate DTV tuner seems to be “hard to do“!
- The world of 3GPP and the world of broadcast still exist on different planets

**WiFi**
- WiFi experiences congestion in many built-up areas, especially indoor
- Cisco: ~ 30 % Wifi offloading today, ~ 50 % in 2018 → important delivery technology
- no predictable network with limited and fragmented coverage
Is LTE eMBMS ready for this challenge?

- eMBMS = evolved Multimedia Broadcast Multicast Services
- Point to Multi Point (P2M) broadcast and multicast in 4G LTE networks
- **Only 60% of LTE cell data rate** can be used for eMBMS (6 of 10 Sub-Frames) because Unicast needs to be present too (fixed in the standard)
- **Bounded to cellular network structure** (max. 10km cell size supported)

- Allows Single Frequency Network (MBSFN) of multiple cells to cover larger areas
- Carrier Aggregation up to 20MHz bandwidth for increased data rate
- **Interference protection needed on border of MBSFN area**
- For large areas it may become inefficient

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LTE Radio frame

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MBSFN
Cellular networks will probably not be able to cope with the growing demand for data like live video and will not be efficient to distribute live video and audio @ 1.4 Mbit/s or more in thousands of networks cells and possibly by several mobile network operators in parallel.

Let's define a LTE Megacell overlaying the cellular network and broadcast high power from high tower to mobile receiver.
What is LTE Mobile Offload (LMO)?

- Technology envisioned / created by the Technical University of Braunschweig. Also known as “Tower Overlay”
- GatesAir has partnered with TUB to commercialize
- Basic idea is to offload popular services, especially live video, from cellular networks
- Utilizes High Tower, High Power (HTHP) transmitter sites so that...
  - HTHP transmitter coverage “over-lays” the many existing cellular towers
  - HTHP transmitters are typically operated by network operators or broadcasters
  - Provide native (i.e. LTE signal) to existing mobile receiver

Can we use existing broadcast infrastructure i.e. DVB-T2 broadcast sites?
Connecting What's Next

Technical Fundamentals

Tower Overlay with DVB-T2 using Future Extension Frames (FEF)

- **DVB-T2 Future Extension Frames** (FEF, defined in the DVB-T2 Standard) enable time domain spectrum sharing with other wireless networks, e.g. a mobile access network.
- Re-use of DVB-T2 as existing wireless carrier.
A **hybrid modulator** / exciter can therefore be realized that broadcast DVB-T2 to fixed (home) receivers while video over LTE can be broadcast to mobile receiver.

**Technical Fundamentals – Hybrid Modulator**

- **Standard DVB-T2 content**
- **Time multiplexed DVB-T2 and LTE-A+ signal**
- **LTE-A+ formatted content is inserted into a broadcast DVB-T2 multiplex using the FEF, in a format that is *native* to the LTE device.**
Hybrid Modulator

The LTE in-band signaling (via unicast network) instructs the LTE receiver that a P2MP LTE carrier exists that it can receive and decode at the broadcast frequency being used.
The carrier aggregation concept of LTE enables a solution for sharing of resources by multiple network operators to gain the most benefit out of the LTE Mobile Offload Tower Overlay.

Users from different network operators access the same content through proper signaling.
- Time Multiplex of DVB-T2 and LTE content over one transmitter

8 MHz (DVB-T2)

5 MHz (LTE-A+)

554 MHz
Receive Devices Operate Normally

DVB-T2 reception unaffected by LTE-A+ Signal!

Standard DVB-T2 TV

LTE-A+ reception unaffected by DVB-T2 Signal!

Modified LTE-A+ Device

Hybrid Modulator/Tx

Transmission Path

DVB-T2 Modulator

DVB-T2 Data

MUX/Transmitter

LTE-A+ Modulator

FEF LTE-A+

LTE-A

Benefits for Mobile Network Operators

- Reduces significant the potential capacity gap
- No new network build-out required.
- No (or less) spectrum to pursue at auctions.
- Relieve network congestion, especially in dense populated areas.
- Pay-as-you-go or pay-per-use.
- Launch new services
- Mobile network operator still gets revenue from customer even though content is delivered “out of band”. The experience should be seamless to the user.
Benefits for Broadcast Network Operators

- New revenue stream via capacity lease / rent.
  - On demand or bits per unit time
- Similar to datacasting business models
- Expand reach to ever-growing nomadic viewing public with existing standards technology.
- Create synergistic partnerships with mobile network operators.
- Coverage within dense metro areas may be most important since there are fewer users outside of that where the broadcast signal strength is diminished and the LTE network may handle the load with ease.
Connecting What's Next

**Milestones to LTE-Mobile Offload with DVB-T2**

- **2013**: Demonstrator Future Zone
- **2014**: Demonstrator Gatesair Booth
- **2015**: Prototype Hybrid Modulator Gatesair Booth
- **Since 2015-04**: Live Test Paris

**Connecting What’s Next**
LTE- MO with DVB-T2 tests in Paris

- On Eiffel Tower transmission of LTE-MO with DVB-T2
- UHF Channel 54 (738 MHz, 8MHz)
- Gatesair Transmitter 500W (2.7kW ERP)

- LTE-MO reception to mobile & portable receiver (tablets, cars)
- LTE-MO mobile coverage
- Different modulation parameter for both T2 and LTE-MO
- Different bandwidth share between T2 and LTE-MO (i.e. 50/50)
Summary

- The Concept of High Power High Tower Megacell has been developed at the Technische Universität Braunschweig in their Institute of Communications Technology (IfN).

- The GatesAir and Technische Universität Braunschweig solution modulates the DVB-T2 and LTE-A+ signals, using a hybrid exciter platform and over-the-air transmitters to deliver simultaneous digital TV and LTE content to all devices from a traditional broadcast tower.

- This potentially eliminates cellular network congestion from multiple peer-to-peer connections, and instead uses the broadcaster's signal to deliver multi-user requested content — a win-win for broadcasters and mobile network operators!
Summary

- The LTE Mobile Offload model is proven to work using the DVB-T2 broadcast standard today.
- Similar possibilities exist for incorporation into ATSC 3.0.
- Mobile operators can reduce costs while expanding reach and conserving bandwidth.
- Broadcast operators can leverage existing infrastructure and spectrum and cultivate new revenue models and business relationships.
- Consumers and the public benefit from optimal spectrum utilization and optimized services.
- LMO maximizes the use of existing spectrum and revenue opportunities for both broadcasters (network operators) and telecom operators.
Thank you very much!

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