



LTE Mobile Offload

*Supplementing Capacity for Live Services over
Bandwidth-Constrained Mobile Networks*

June 2, 2015

Broadcast Asia 2015

Featuring
GatesAir's



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LTE Mobile Offload

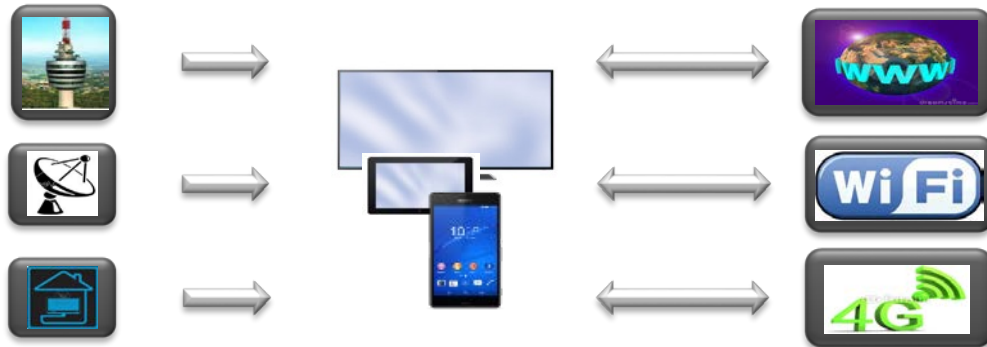
Supplementing Capacity for Live Services over Bandwidth-Constrained Mobile Networks

The background of the slide is a scenic photograph of a mountain landscape. In the foreground, a dark, rocky cliff edge is visible. To the right, a tall, metal communication tower with several satellite dishes and antennas stands on a grassy slope. The background shows a vast valley with green fields, a blue lake, and distant, snow-capped mountains under a cloudy sky.

Martyn Horspool
Product Manager, TV Transmission
GatesAir, USA

Situation for TV and Video Delivery

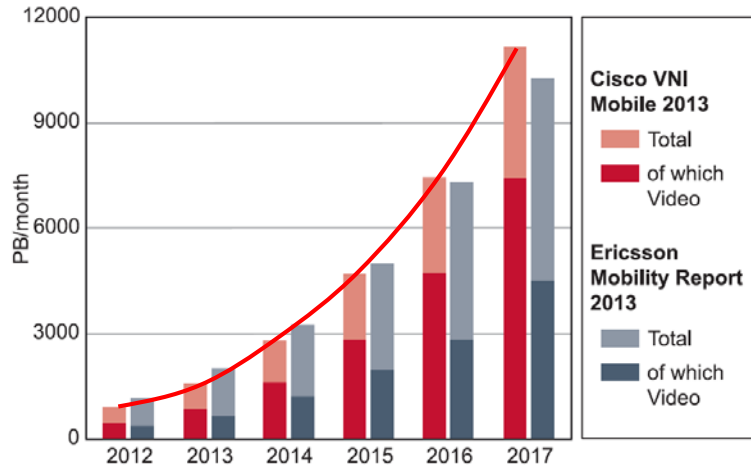
- DVB-T/T2 is today the most used terrestrial digital TV standard for fixed reception
- There are many ways to deliver TV content to different kinds of receivers
- Increasing competition for terrestrial distribution



Forecast for Mobile Data Traffic

- Increasing use of bandwidth from mobile phones
 - Studies from Ericsson and Cisco predict exponential growth of bandwidth needed, driven largely from video consumption
- Drivers are TV Anywhere and increasing usage of tablet PC's & Smart Phones
- For Tablet PC - 1.4 Mbit/s required (Video+Audio) using HEVC:
 - 1 hour requires 630 Mbytes
 - **1 hour every day requires 18.9 Gbyte/ month**

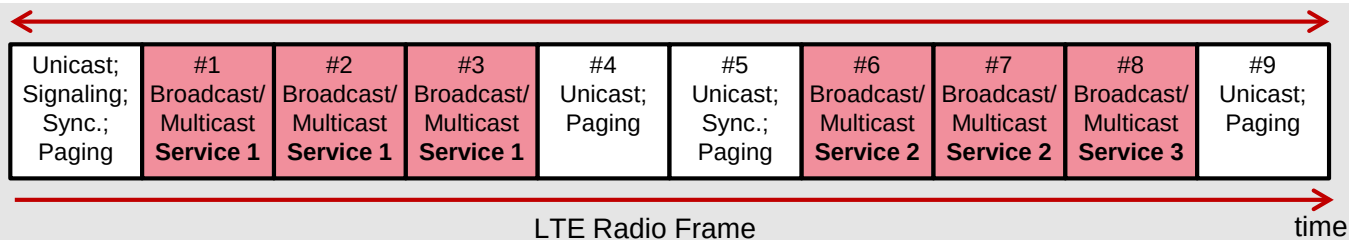
Growth of Mobile Data Traffic



Is LTE eMBMS Ready For This Challenge?



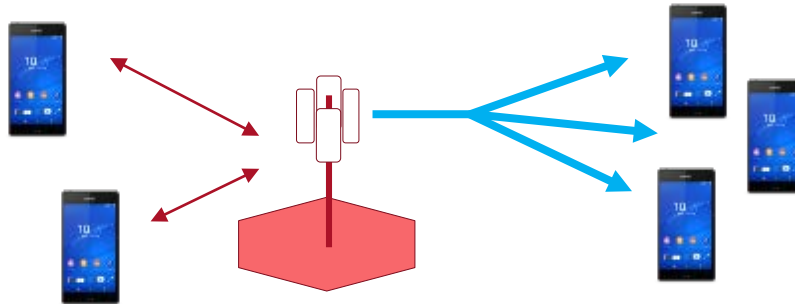
- eMBMS = **Evolved Multimedia Broadcast Multicast Services**
- Enables Point to Multipoint (P2M) broadcast and multicast
- Up to 8 different eMBMS channels per network (8 different “programs”)
- Carrier aggregation up to 20MHz bandwidth for increased data rate
- Single Frequency Network (MBSFN) of multiple cells to cover larger areas



- Only 60% of LTE cell data rate can be used for eMBMS (6 of 10 Sub-Frames)
- Bounded to cellular network structure (max. 10km cell size supported)
- For large areas it may become inefficient
- Content only accessible inside same network ID (same Mobile Network Operator MNO)



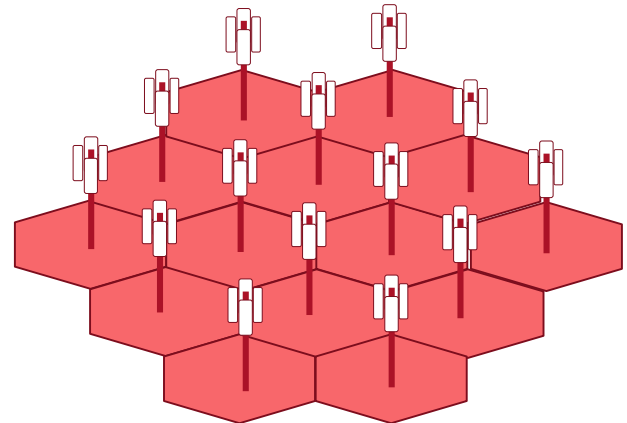
LTE - Unicast and eMBMS



↔ LTE cell with P2P Unicast

➡ P2MP eMBMS

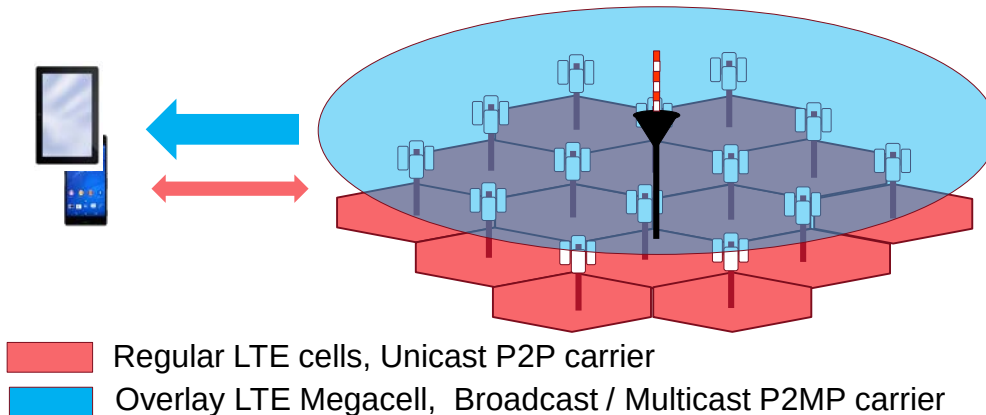
MBSFN Multicast-broadcast
single-frequency
network



LTE Radio Frame

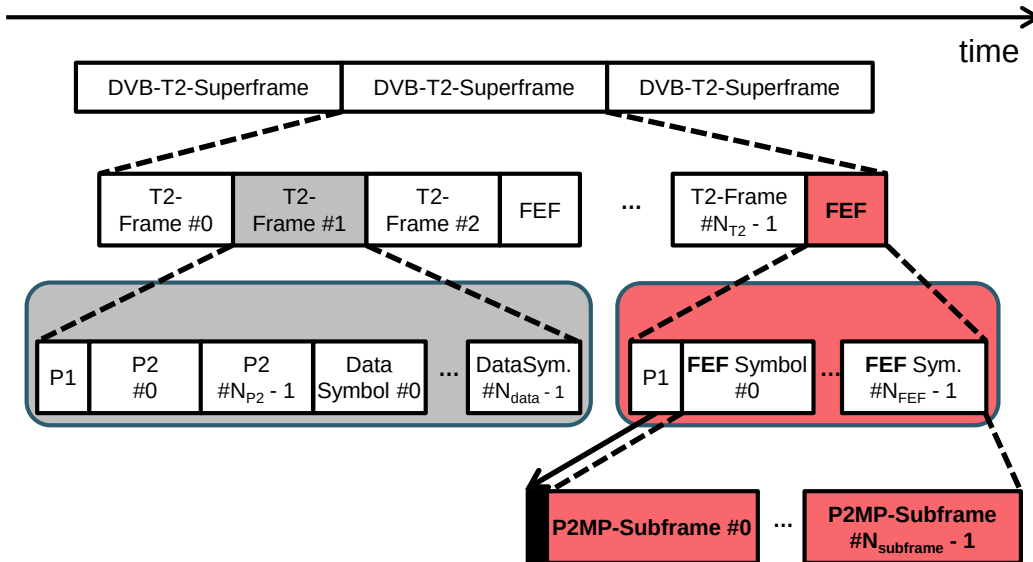


- Cellular networks will probably not be able to cope with the growing demand for data like live video and will not be efficient to distribute live video and audio @ 1.4 Mbit/s or more in thousands of networks cells and possibly by several mobile network operators in parallel
- LTE Megacell Overlay - Defines a LTE Megacell to broadcast high power from a high tower to mobile receiver based on LTE specifications**
- Can we use the existing broadcast infrastructure? - i.e. DVB-T2 high power, high tower broadcast sites**



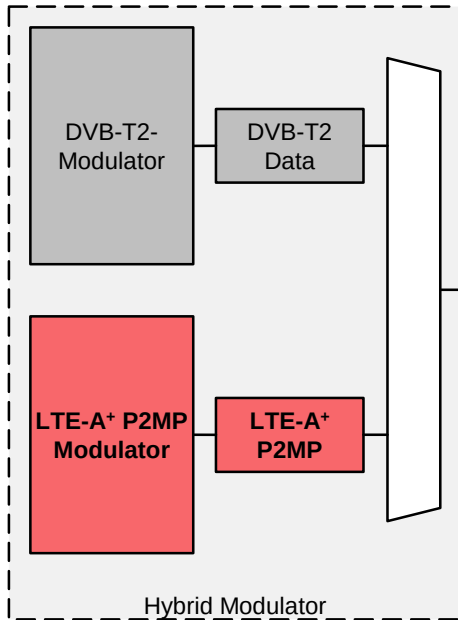
Tower Overlay Using DVB-T2 FEF

- **DVB-T2 Future Extension Frames (FEF)** enable time domain spectrum sharing with other wireless networks, e.g. a mobile access network
- Re-use of DVB-T2 as existing wireless carrier

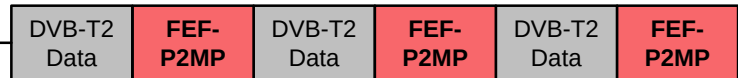


Tower Overlay Using DVB-T2 FEF

- A **hybrid modulator** / exciter can be realized that broadcasts DVB-T2 to fixed (home) receivers while video/audio over LTE can be broadcast to mobile receiver



- LTE-A formatted content is inserted into a broadcast DVB-T2 multiplex using the FEF
- LTE in-band signaling (via mobile network) instructs the LTE receiver that a LTE carrier



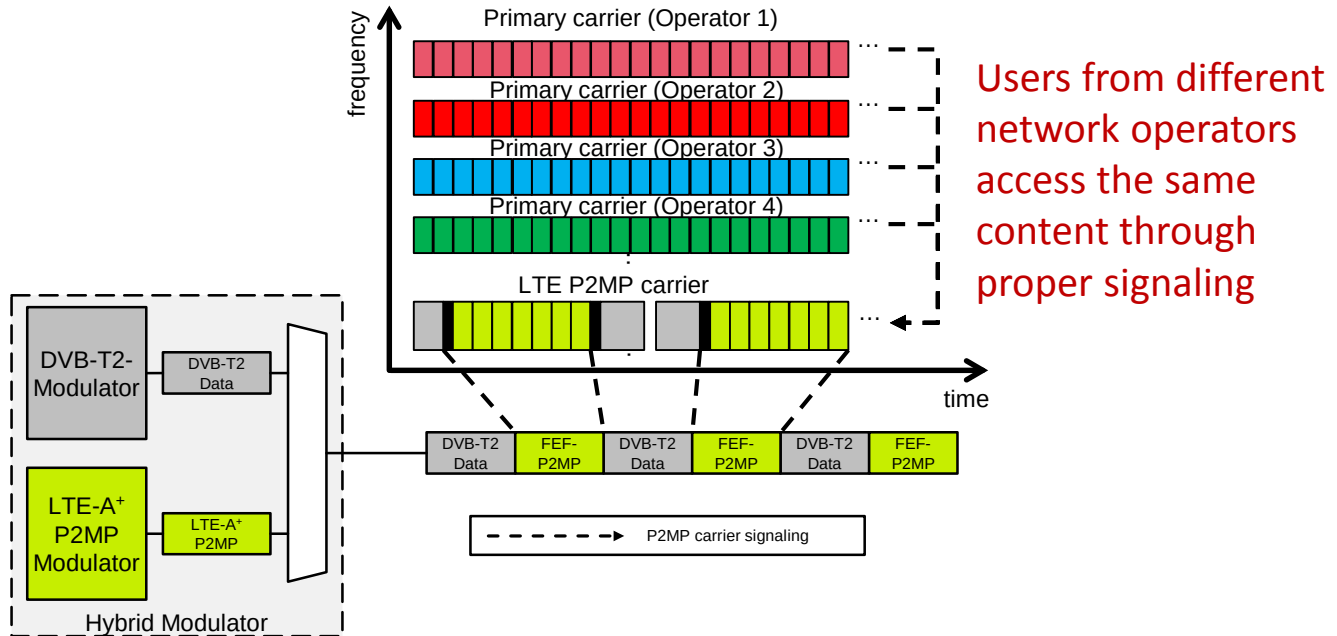
exists that it can receive and decode at the broadcast frequency being used

- Received in a format that is *native* to the LTE device



Tower Overlay Using DVB-T2 FEF

- 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 Megacell Offload Tower Overlay



- No new network build-out required
- No (or less) spectrum to pursue at auctions
- Relieve network congestion, especially in densely populated areas
- Pay-as-you-go or pay-per-use
- Launch new revenue services:
 - e-book, e-magazine, or e-newspaper downloads
- Mobile network operator still gets revenue from customer even though content is delivered “out-of-band”
- Seamless to the end-user.



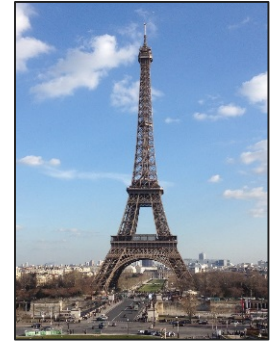
Broadcast Network Operator Benefits



- 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.



Milestones: LTE-Mobile Offload w/DVB-T2



Demonstration
Future Zone



Demonstration
GatesAir Booth



Prototype Hybrid
Modulator
GatesAir Booth



**April 8th
2015**

Live Tests Paris
(France) & Aosta (Italy)



Proprietary and confidential. | 12



News Release – April, 8th 2015



- *Paris, France / Aosta, Italy, April 08, 2015*
- World's first trials of LTE-A+ Broadcast from High Power High Towers starts simultaneously in Aosta and Paris



Today TDF and Rai launched the first field trials of LTE-A+[†] Broadcast from high-power television stations, in Paris and Aosta. The joint project, based on the original “Tower Overlay” idea developed and implemented by Technische Universitaet Braunschweig (Germany) in 2013, involves contributions by GatesAir (USA) and is supported by IRT (Germany) and Expway (France).

Proprietary and confidential. | 13



LMO with DVB-T2 Tests in Paris

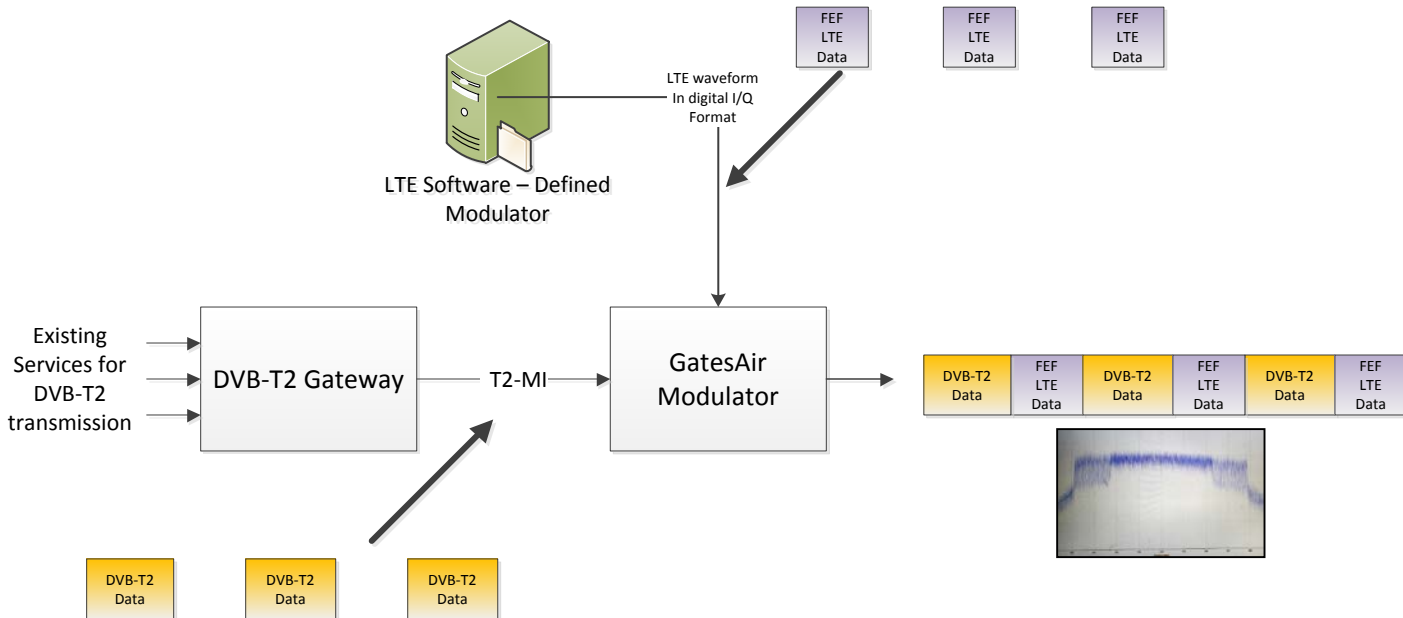


- Tx site Eiffel Tower - Transmission of LTE-MO with DVB-T2
- UHF Channel 54 (738 MHz, 8MHz)
- Gatesair Transmitter 500W (2,7kW ERP)
- LTE-MO reception to mobile & portable receivers (tablets, cars)
- LTE-MO mobile coverage
- Different modulation parameters for both T2 and LTE-MO
- Different bandwidth shared between T2 and LTE-MO (i.e. 50/50)

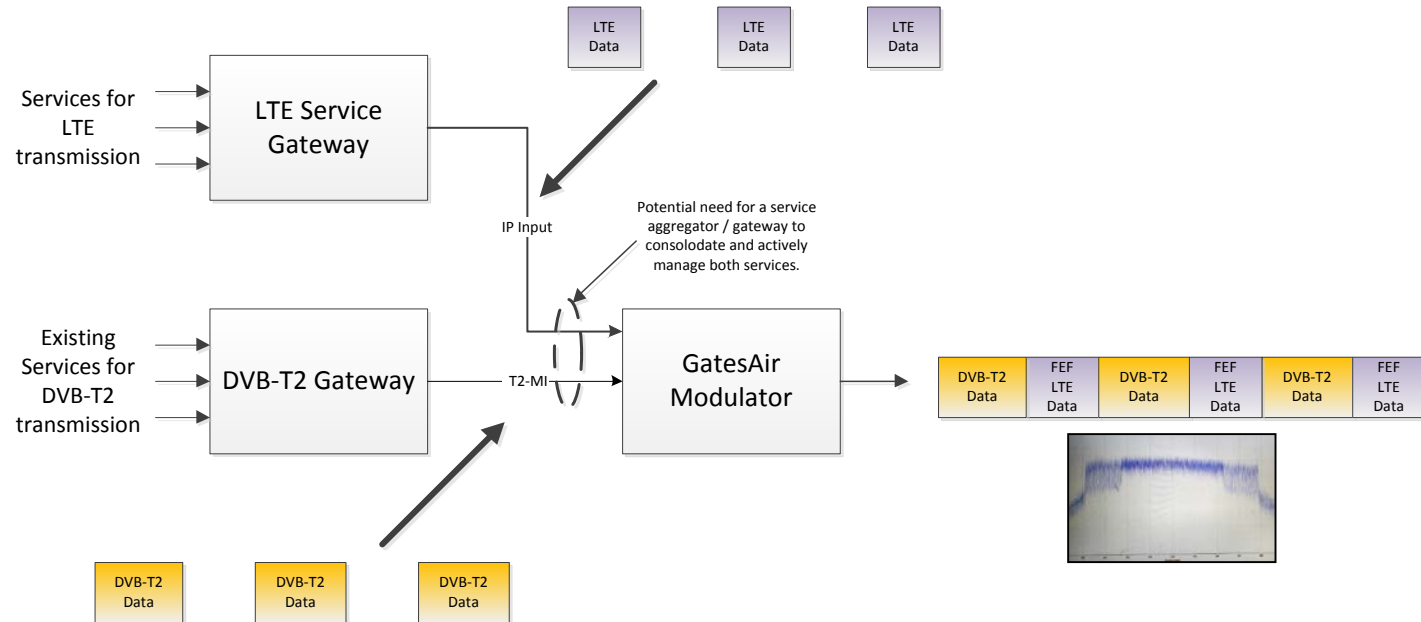


Current Demonstration System

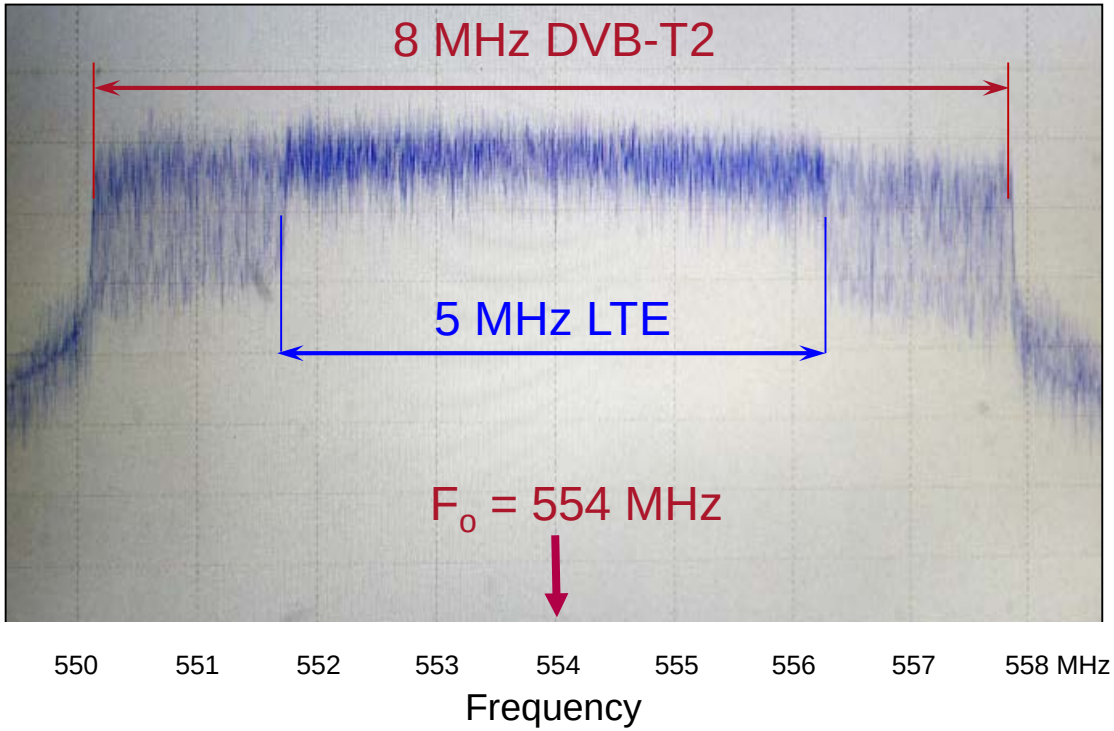
LTE Mobile Offload System used in the field test in Paris in March 2015



Future Implementation

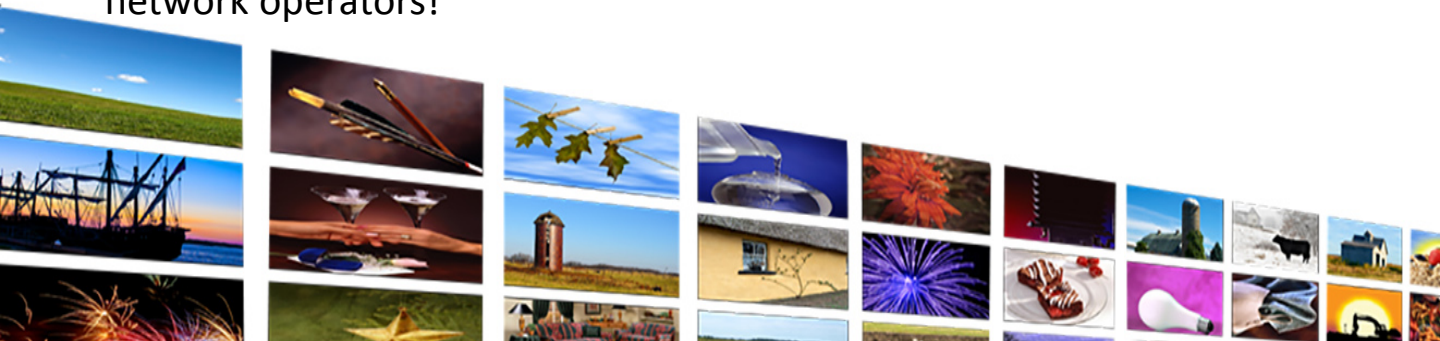


RF Spectrum – 8MHz T2 + 5MHz LTE



Summary - Technical

- 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 - Business Potential

- The LTE Megacell Overlay model has been proven to work using the DVB-T2 broadcast standard today
- Similar possibilities exist for incorporation into other advanced modulations (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.



Thank You!

Martyn Horspool
Product Manager, TV Transmission
GatesAir

