LTE Mobile Offload

Technology and Business Model for off-loading payload from Low Tower, Low Power networks to High Tower, High Power networks

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Featuring GatesAir's

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Connecting What's Next

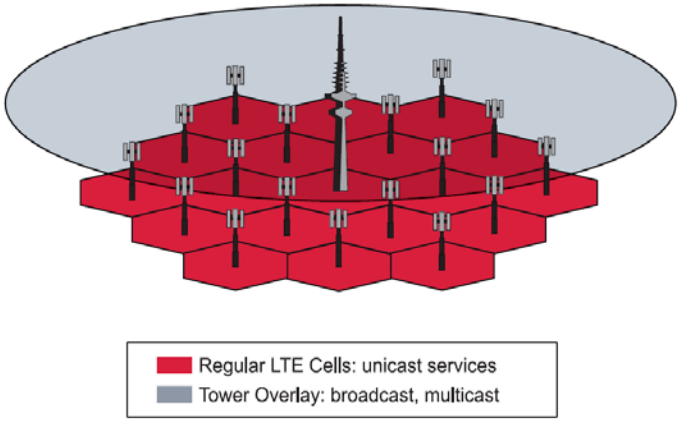
LTE Mobile Offload

Technology and Business Model for off-loading payload from Low Tower, Low Power networks to High Tower, High Power networks

Martyn Horspool
Product Manager, TV Transmission
GatesAir, USA

What is LTE Mobile Offload (LMO)?

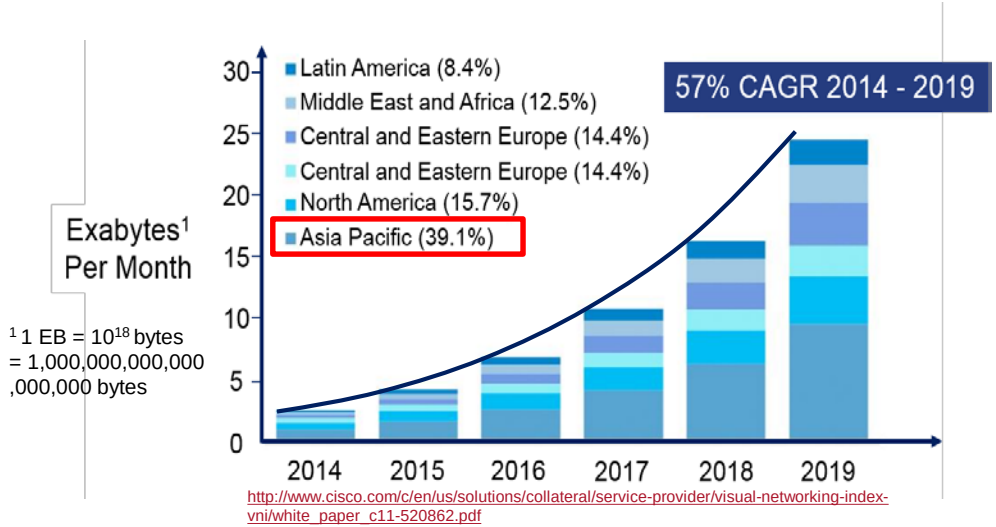
- Technology envisioned / created by the Technical University of Braunschweig. Also known as "Tower Overlay"
- GatesAir has partnered with TUB to commercialize
- Basic idea is to offload popular services, especially live video, from cellular networks
- Utilizes High Tower, High Power (HTHP) transmitter sites so that…



- HTHP transmitter coverage "over-lays" the many existing cellular towers
- HTHP transmitters are typically operated by network operators or broadcasters
  - There are cases where the broadcast network operators and the mobile network operators may have common ownership

Why is LMO Useful? (1)

Cisco Global Mobile Data Forecast 2014-2019



[1] 1 EB = 10^{18} bytes = 1,000,000,000,000,000,000 bytes

http://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/white_paper_c11-520862.pdf

- Mobile phone bandwidth:
  - Ericsson and Cisco predict exponential growth of bandwidth needed - driven largely by video consumption
- Placing popular content on an HTHP network would reduce LTE network load
- LMO maximizes the use of existing spectrum and revenue opportunities for both broadcasters (network operators) and telecom operators

Why is LMO Useful? (2)

"Insatiable demand for bandwidth fuels mobile network capacity issues… despite efficiency improvements"

Alan Solheim, DragonWave | *Mobile Dev Design* Feb 4, 2013

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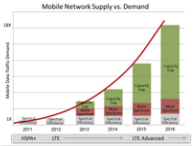
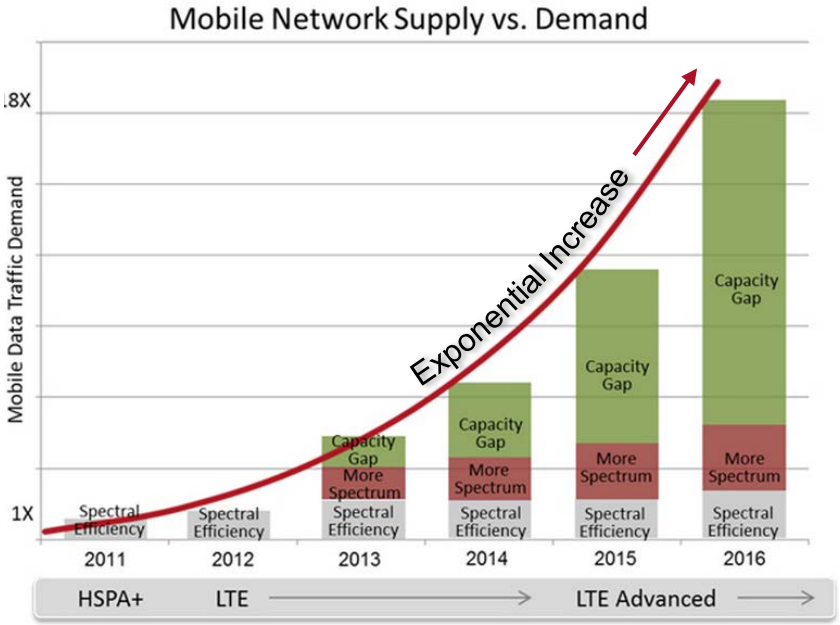
Alan Solheim, vice president of corporate development at DragonWave, holds a PhD in electrical engineering from the University of Waterloo. With more than 25 years of industry experience in telecommunications, he heads up business development and strategic marketing for DragonWave with a strong emphasis upon the development of overall value proposition for its different customers and partners. Previously, he was VP of product management, where he was responsible for the introduction of DragonWave's award winning Horizon packet microwave product line.

Smart phones and tablets are driving the insatiable demand for bandwidth in mobile networks. End users expect content-rich applications such as Web browsing, gaming, video streaming, and interactive maps to be available on any wireless device, transforming and often overwhelming today's mobile networks.



The mobile network capacity gap keeps increasing despite the adoption of LTE with more bandwidth and improved spectral efficiency.

Much of the industry's focus has been on radio access technology, with the expectation that the evolution from 3G to HSPA+ to LTE will satisfy the demand. But advances in spectral efficiency, coupled with aggressive liberalization of new spectrum for mobile applications, still fall short of meeting capacity demands *(Fig. 1)*.



The Global Spectrum Crunch

- UHF spectrum is being sought worldwide
  - **EU:**
    - 1st digital dividend in EU reduced the broadcast spectrum down from 862 MHz to 790 MHz
    - ITU is now considering other spectrum uses for 694-790 MHz
    - If this happens, it represents a 43% reduction in broadcast spectrum
  - **USA:**
    - Digital TV transition that completed on June 12, 2009 recovered 108 MHz from broadcast spectrum for other services
    - The National Broadband Plan / Incentive Auction aims to recover 120 MHz more spectrum from broadcast
    - In total, this is a 68% reduction in broadcast spectrum
  - **Asia:**
    - High likelihood of spectrum re-allocation in the future

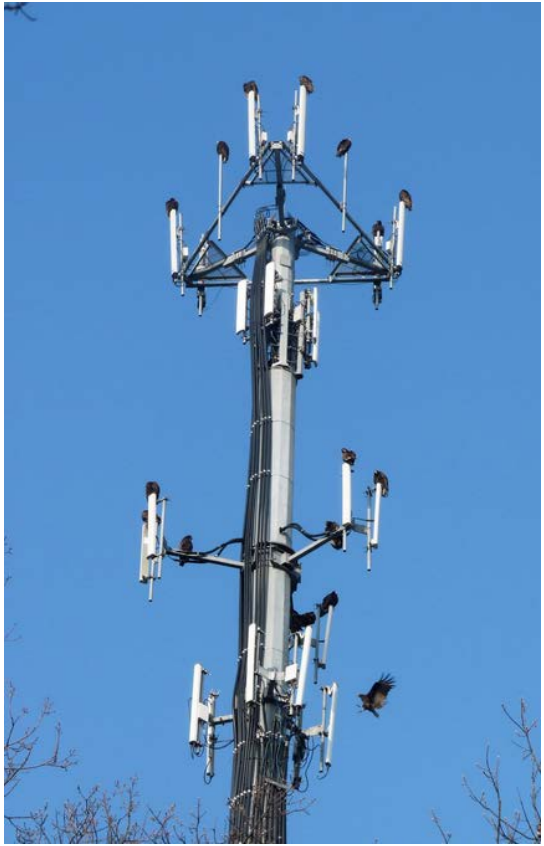
The Spectrum Crunch - What it Means

- Given that UHF spectrum is being sought for wireless broadband use and predictions are that the bulk of this bandwidth demand will be consumed by video traffic…
  - LMO is a natural augmentation to the UHF offering
- If a broadcast network operator owns or controls two channels in a given market, one channel could be dedicated for fixed services while the other channel is mostly dedicated to mobile services via LMO
- Or… partner with another broadcast network operator to offer fixed services in one channel and LMO mobile services in another channel

UHF Broadcast spectrum is highly sought after - Auctions / digital dividends are inevitable. LMO offers a new way to monetize spectrum for broadcasters.

Mobile Network Operator Benefits

- 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 time unit.
- 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.

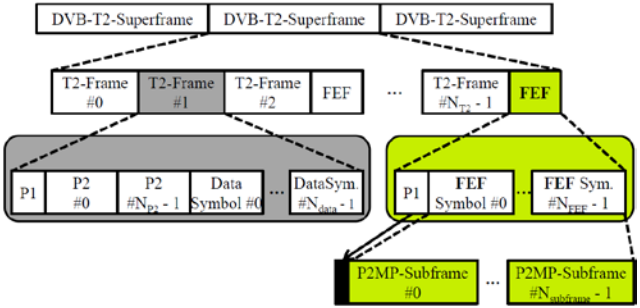
What About eMBMS?

- **eMBMS** = **e**volved **M**ultimedia **B**roadcast **M**ulticast **S**ervice
- eMBMS is often described as a broadcast channel, or capability over LTE-A
- Consider:
  - A quality HD video experience using HEVC to a tablet requires data on the order of 1.4 Mb/s
  - If the content is very popular, expanding to many cells and perhaps spanning multiple cellular network operators, eMBMS becomes inefficient
  - eMBMS, as currently architected, is limited to relatively small maximum cell sizes (10 km)

LTE Mobile Offload overcomes these limitations

Fundamental Technical Concepts

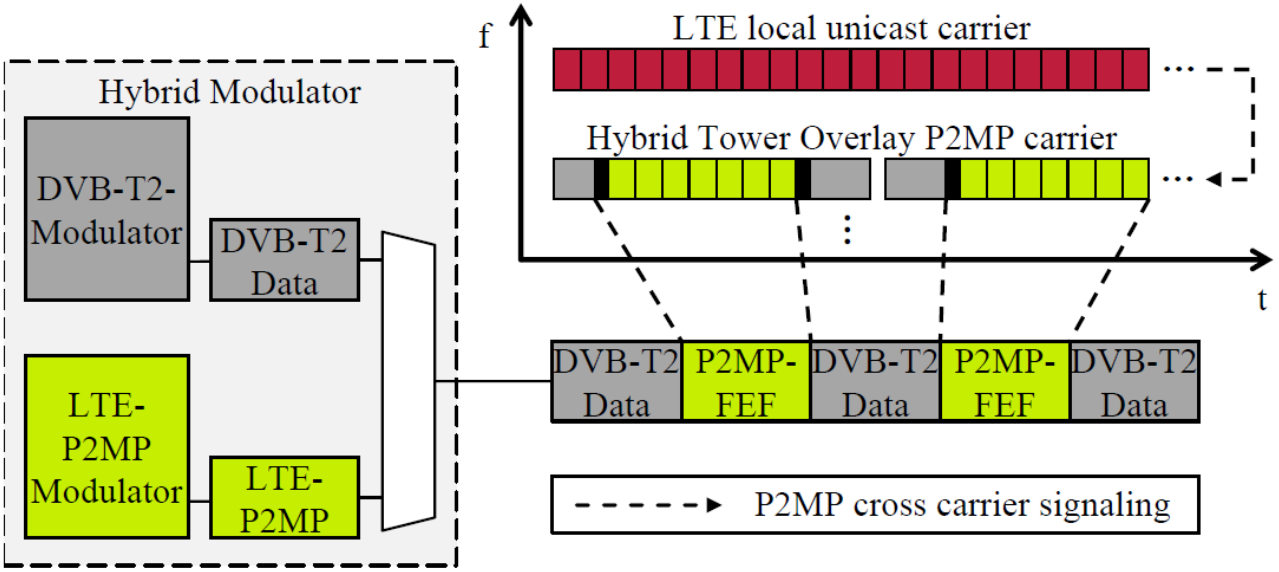
- Key system attributes from modern digital TV systems, e.g. DVB-T2 and LTE-Advanced are exploited to realize LMO*
  - From DVB-T2: Future Extension Frames (FEF)
  - From LTE-A: Carrier Aggregation (CA)
- Example:
  - LTE-A formatted content is inserted into a broadcast DVB-T2 multiplex using the FEF
  - 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



Integration of an LTE P2MP carrier into DVB-T2 Future Extension Frames

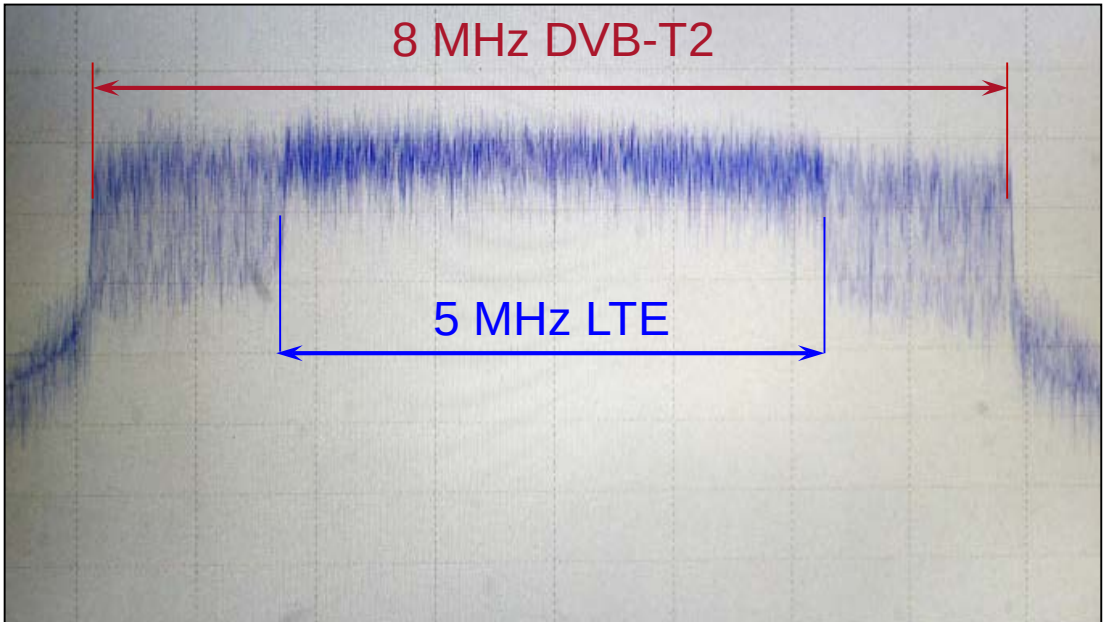
** 3GPP specification revisions are needed to fully realize the system.*

LMO Modulator/Transmitter

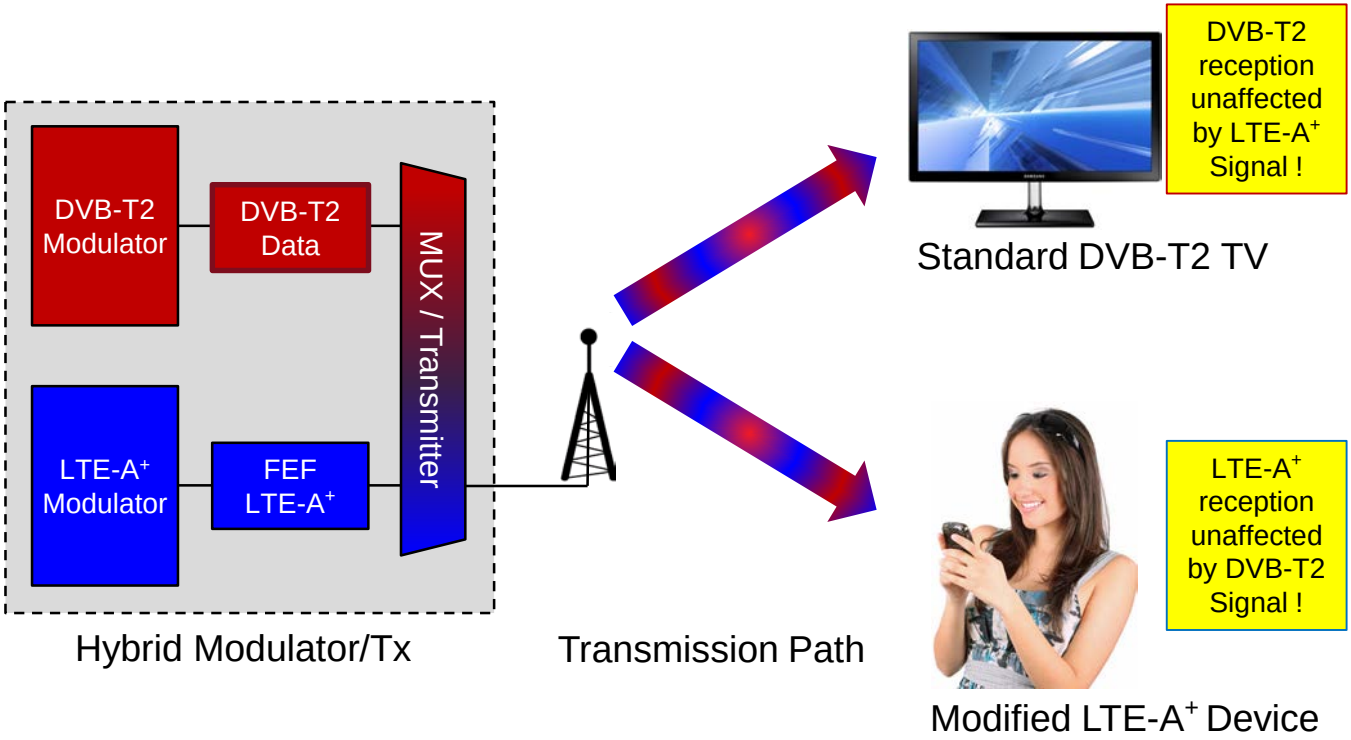


Reference: Point-To-MultiPoint-Overlay (P2MP) for LTE-Advanced using DVB-T2 Future Extension Frames, Dipl.-Ing. Frieder Juretzek & Prof. Dr.-Ing. Ulrich Reimers Institute for Communications Technology,Technische Universitaet Braunschweig

RF Spectrum – 8MHz T2 + 5MHz LTE



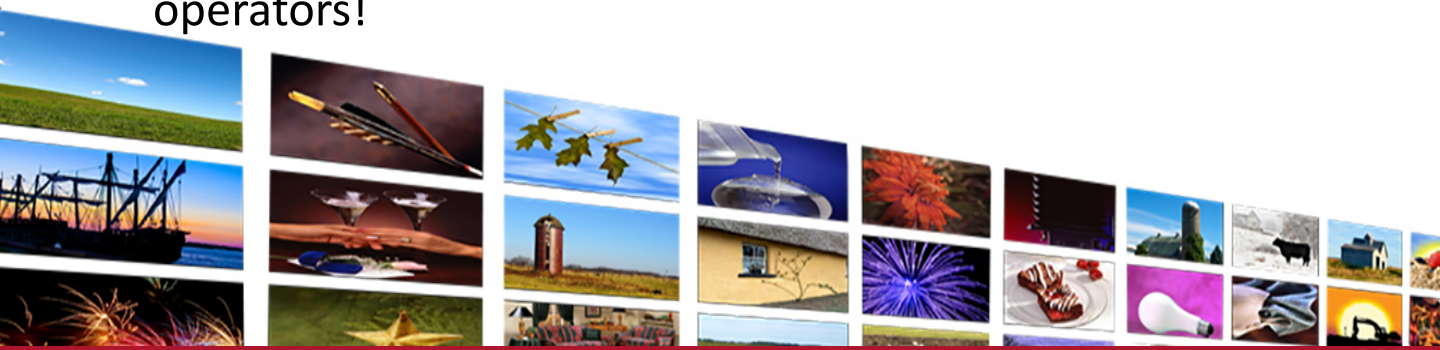
Receive Devices Operate Normally



Reference: A Software Defined Radio based Implementation of the "Tower Overlay over LTE-A+" System, Daniel Rother, Stefan Ilsen, Frieder Juretzek - Institute for Communications Technology (IfN) Technische Universitaet Braunschweig

Summary - Technical

- This solution combines 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
- Reduces, or 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.

Ongoing Activities / Next Steps

- TDF trial, Paris, France
  - GatesAir provided UHF Transmitter
  - Interested parties include (so far):
    - Technical University of Braunschweig, Germany
    - TDF, France
    - RAI, Italy
    - Sequans, France (*LTE Chipset manufacturer*)
    - IRT (Germany)
    - Expway (France)
- Next steps
  - Work with all interested parties
  - Publicize the trial to engage 3GPP for success

GATESAIR

Connecting What's Next

Thank You!

Martyn Horspool

Product Manager, TV Transmission

GatesAir