LTE Broadcast: Evolving and going beyond mobile

QUALCOMM®

Mobile data traffic growth—industry preparing for 1000x

Industry preparing for

1000x

data traffic growth*

Richer Content

more video

~2/3 of mobile traffic will be video by 2017[3]

Bestse

5.93 GB
Movie (High Definit

1.8 GB
Game for Android

0.14 GB
Soundtrack

0.00091 GB
Book

Multiple Solutions needed to address video demand

More devices

everything connected

~25 Billion Interconnected device forecast in 2020[2]

Billion Cumulative smartphone forecast between 2014-2018[1]

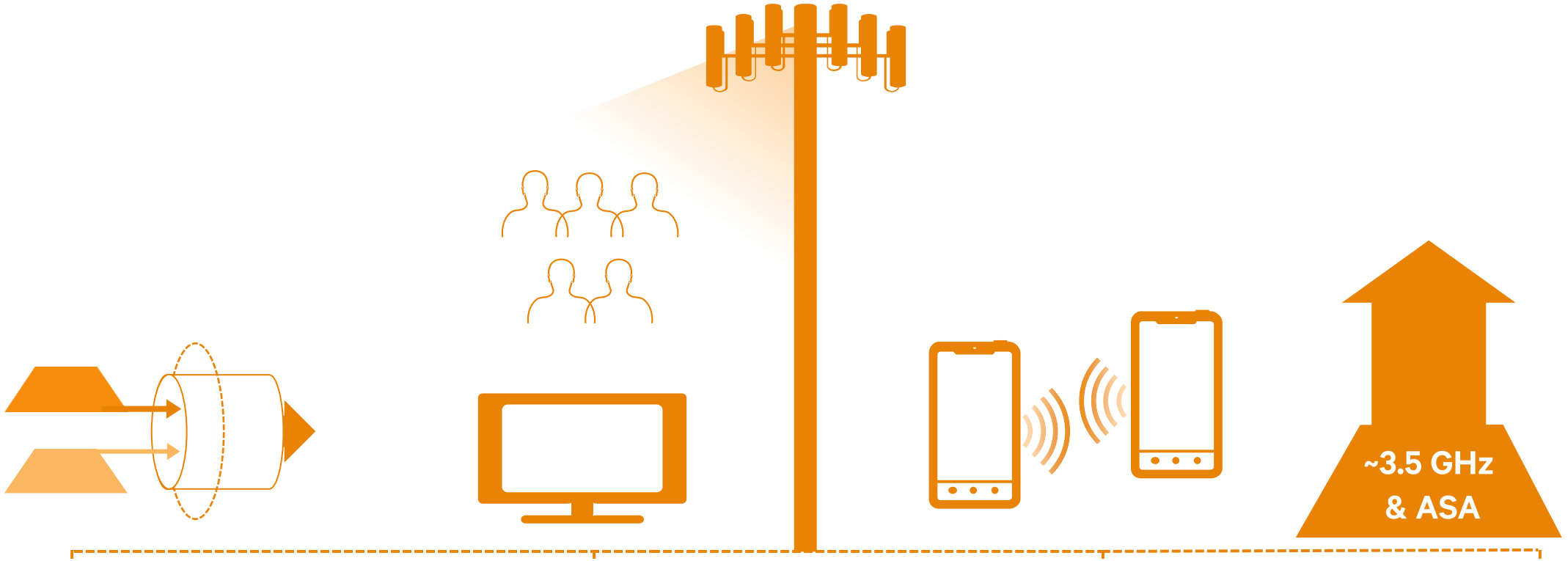
[1] Gartner, Mar '14

[2] Machina Research/GSMA, Dec. '12

[3] Cisco, Feb. '13

One example of reaching 1000x would be if mobile data traffic doubled ten times, but Qualcomm does not make predictions when 1000x will happen, Qualcomm and its subsidiaries work on the solutions to enable 1000x

LTE Advanced is evolving and expanding into new frontiers



Extending LTE Advanced to unlicensed spectrum

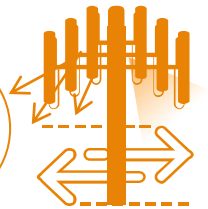
Dynamic LTE broadcast. Being considered for beyond mobile for terrestrial TV

LTE Direct for “always-on”, autonomous device-to-device proximity awareness

Higher spectrum bands new licensing models—authorized shared access

LTE Broadcast is evolving and going beyond mobile

1. 
Efficient delivery of mass media content, with opportunities far beyond just venues

2. 
The evolution makes it dynamic and more useful – on demand, more scalable, more applications

3. 
Small cells enhance venue casting, with opportunity for unlicensed spectrum

4. 
Candidate for next-generation converged terrestrial TV services in Europe

1000x mobile data challenge enabler

Video - Major contributor to the global traffic growth

Multiple solutions needed to address video demand

~70% **mobile data will be video in 2018[1]**

Trend toward watching long and live video content on mobile devices

- More than half (53%) of mobile viewers' time was spent watching videos longer than 30 minutes[2].
- Video time per play for live video was 5x that of video-on-demand for mobile devices[2].

Video traffic compelling operators for network upgrade

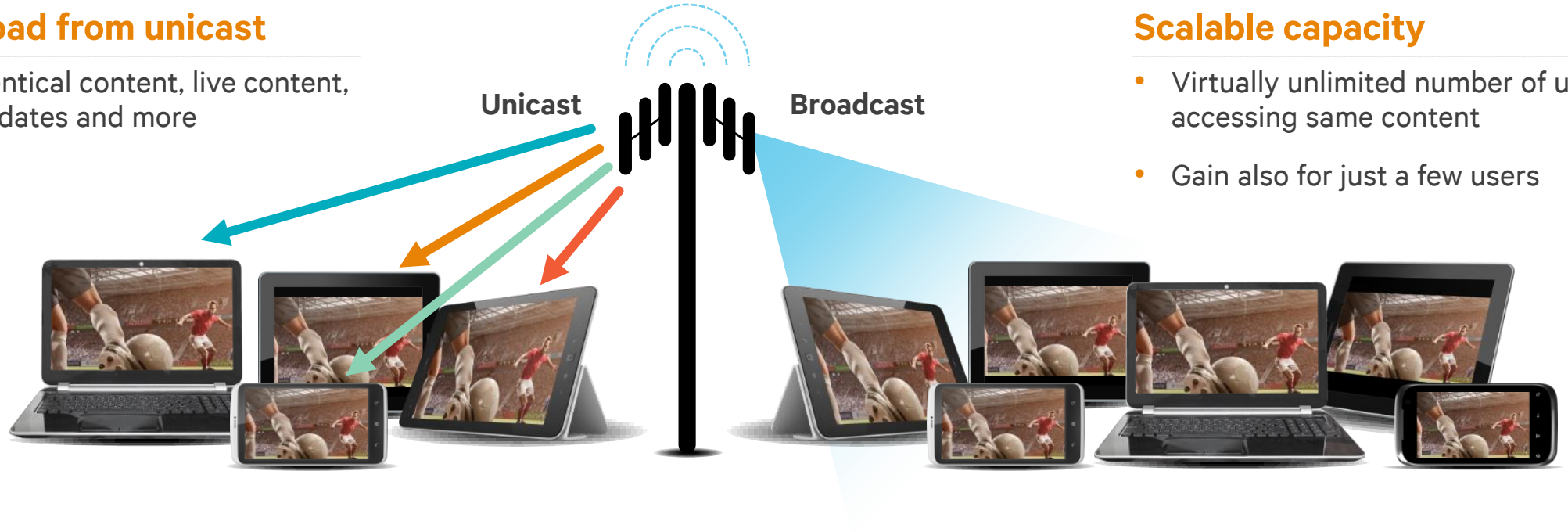
"...Video boom forces Verizon to Upgrade Network...."
– Wall St. Journal, Dec 15, 2013[3]

Source: [1]Cisco VNI Mobile, 2014. [2]Ooyala, Mar. '14; [3]http://online.wsj.com/news/articles/SB10001424052702304173704579260354018157042

LTE Broadcast for efficient delivery of mass media content

Traffic offload from unicast

- Offloads identical content, live content, software updates and more



Scalable capacity

- Virtually unlimited number of users accessing same content
- Gain also for just a few users

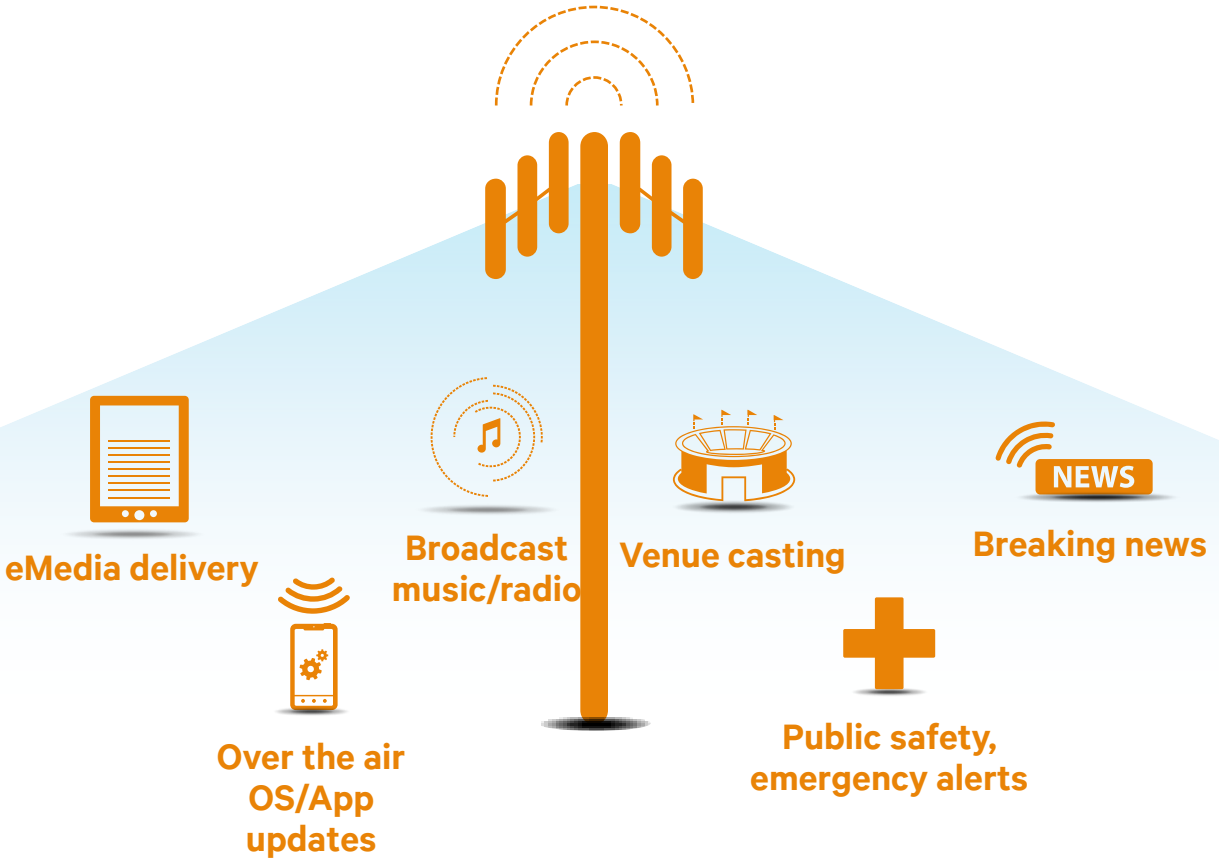
Integral part of LTE—no separate spectrum/network

- Uses LTE infrastructure and devices
- Supported in 3GPP Rel. 9, becoming even more useful with the evolution

Leading operators already embracing LTE Broadcast

- World's 1st LTE Broadcast launch Jan. 2014 powered by Qualcomm® Snapdragon™ processors
- Supported across Snapdragon tiers and Qualcomm® Gobi™ LTE modems

LTE Broadcast opportunities extend beyond venues

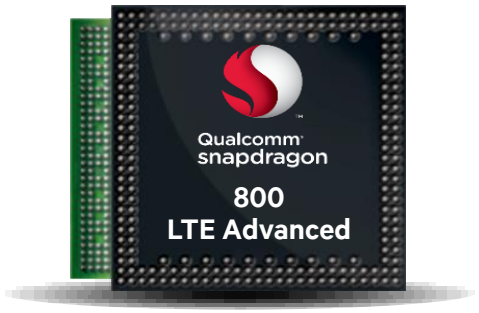


Significant data offload

Enhanced user experience

More revenue opportunities

LTE broadcast is commercial – Powered by Qualcomm® Snapdragon™ processors



- World's **first** LTE Broadcast solution
- KT Corp launches world's **first** commercial LTE Broadcast service – Jan '14

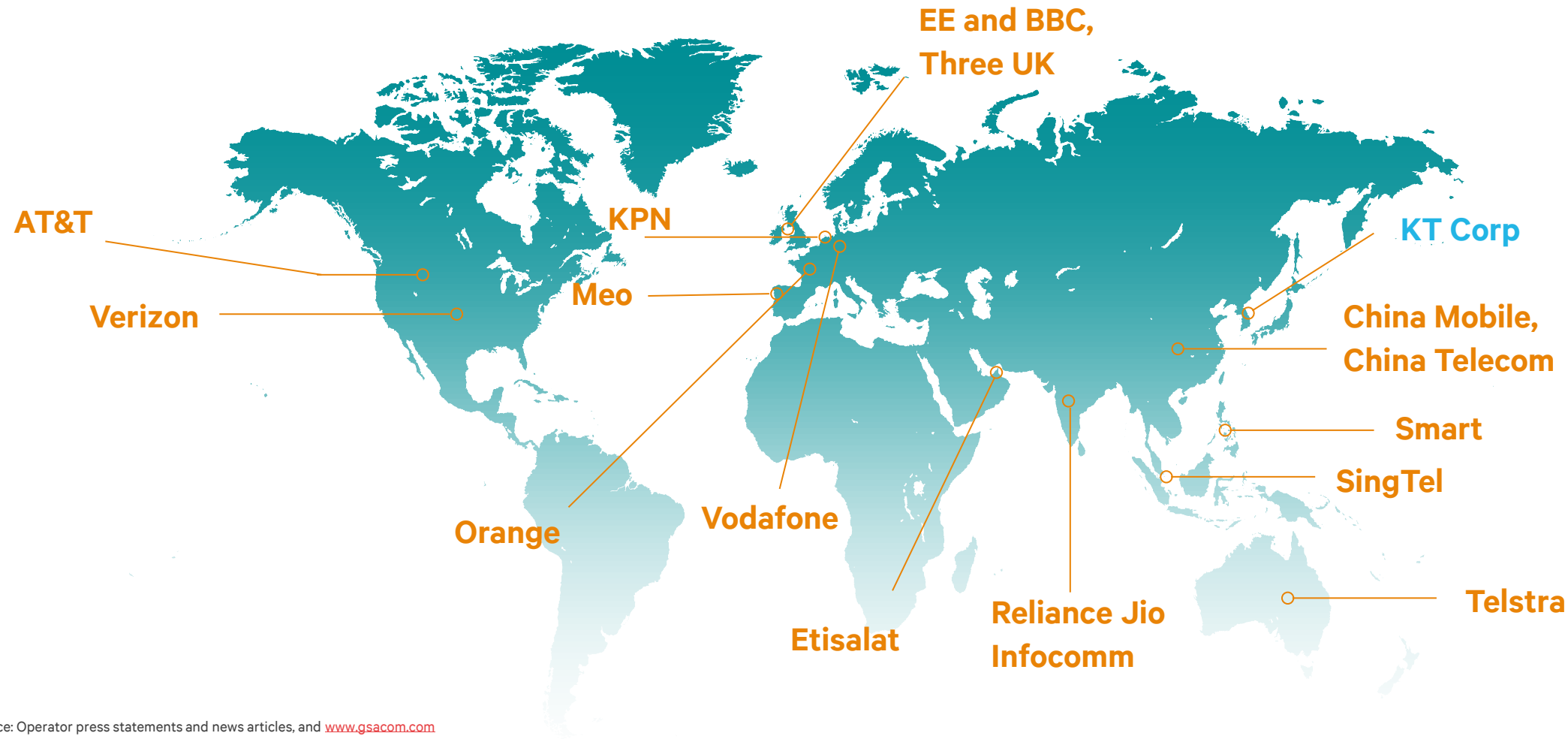
Two videos streaming channels

Easy software upgrade to Samsung Galaxy Note 3 devices

Qualcomm Snapdragon is the products of Qualcomm Technologies, Inc. Source: http://www.totaltele.com/view.aspx?ID=485128

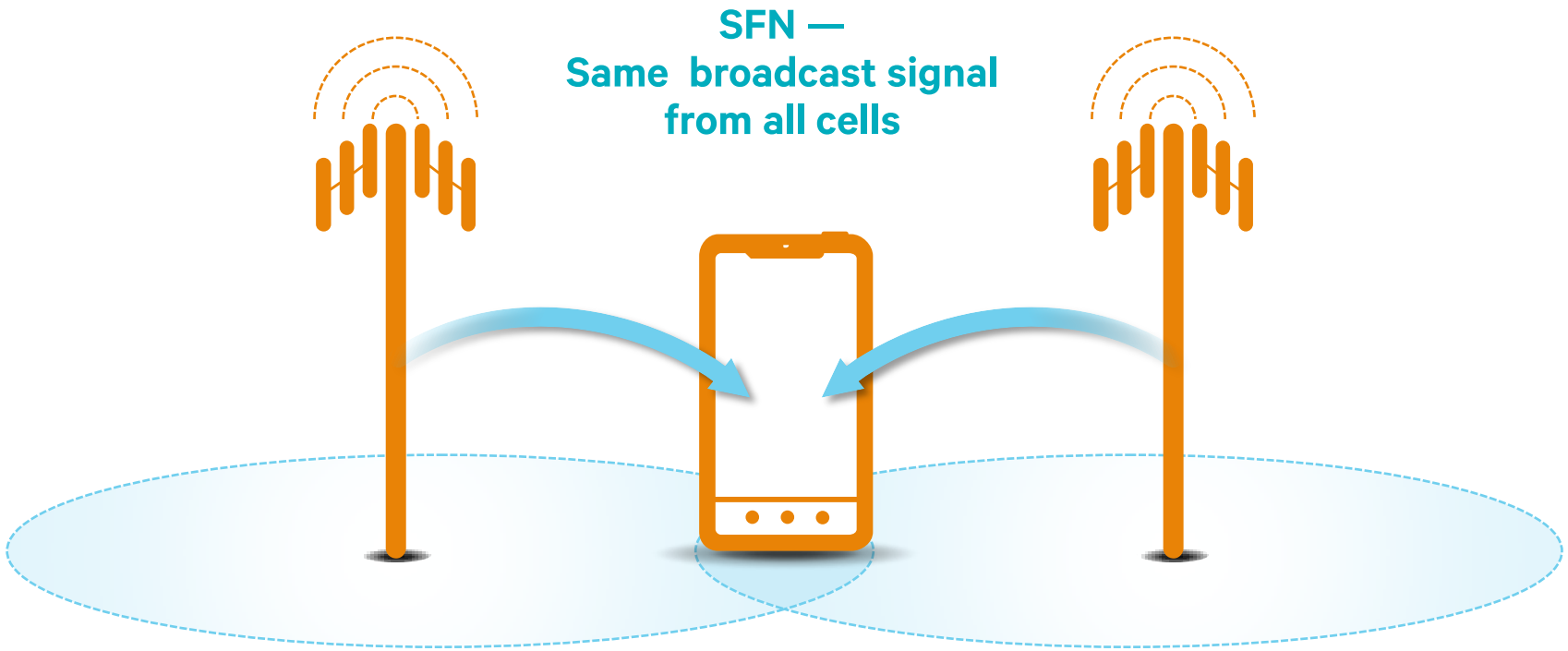
Leading operators already embracing LTE Broadcast

Commercial launch, launch plans, trails, demos, and commitments



Source: Operator press statements and news articles, and www.gsacom.com

LTE Broadcast creates a Single Frequency Network (SFN)



More consistent user experience

The whole network behaves
as a “single cell” – no interference

Better cell-edge performance

By combining same broadcast signal
from multiple cells at cell-edge

Higher overall efficiency

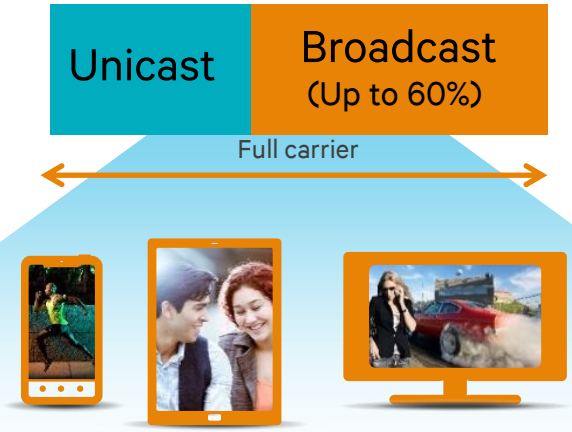
Cell-edge performance dictates
network design and efficiency

Capacity tailored to screen size, content & assigned spectrum

Screen size (video quality), type of content & coding decides bit rate per stream

HEVC/ H.265

Spectrum resources assigned to LTE Broadcast



Videos for **mobile** devices[1]	Videos for **public** TV service[1]
~0.5 Mbps Typical bit rate for sporting event, 540p, HEVC (H.265) coding	**~16 Mbps** Typical bit rate for sports event, 4K (UHD), HEVC (H.265) coding
~2 bps/Hz* LTE Broadcast spectral efficiency (Venue/dense urban scenario, with a cluster of cells using LTE Broadcast)	**~2 bps/Hz*** LTE Broadcast spectral efficiency (Mix of dense urban, rural scenarios, with rooftop directional antenna for latter)
~24 Streams For **10 MHz** spectrum, utilizing **60%** of resources for LTE Broadcast	**~5 Streams** For **40 MHz** spectrum, utilizing full carrier (**100%**) for LTE Broadcast

*2bps/Hz achieved under specific assumptions. The exact spectrum efficiency achieved depends on several parameters including, among other, network topology, receiver installation and coverage requirements.

[1]All the numbers mentioned here are for illustration purpose only, and are based on Qualcomm Technologies' simulations. The actual numbers will vary based on type of deployment, type of coverage, spectrum used etc.

Qualcomm Technologies' optimized LTE Broadcast solution

Snapdragon processors & Gobi LTE modems coupled with service layer middleware

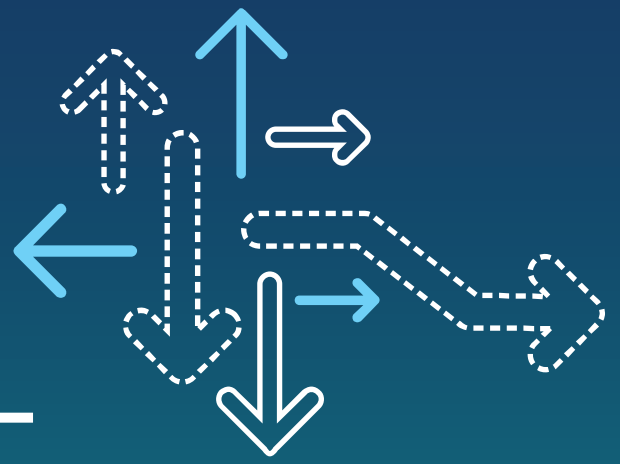
Advantages of middle-ware

- Interoperable with major infra vendors
- DASH and HEVC support
- Multiband and mobility support
- Performance and power optimized
- Proven SDK

Snapdragon 800
World's first commercial LTE Broadcast-enabled chipset

Supported across Qualcomm® Snapdragon™ tiers and Qualcomm® Gobi™ LTE modems

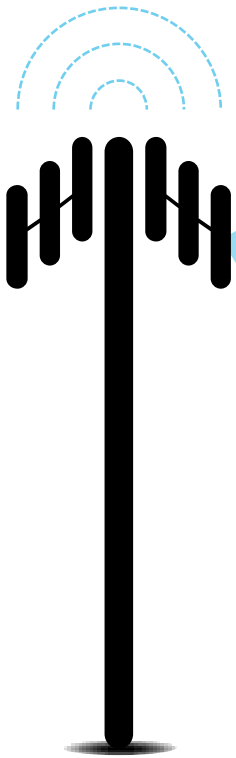
Qualcomm Snapdragon and RaptorQ are products of Qualcomm Technologies, Inc.



LTE broadcast Evolution - dynamic, more use cases, more utility

The LTE Broadcast evolution makes it dynamic and more useful

Increased performance to become viable at more places and for more applications



Long term

Dynamic switching between unicast and broadcast

Higher efficiency than unicast for as few as 1-2 users per cell[1]

Small cell optimizations & leveraging unlicensed spectrum

Flexibility to use dedicated carrier

Full Carrier

Longer range[2] up to 15 km, and higher capacity

MIMO/256QAM

More content using LTE Broadcast across the network, not just venues

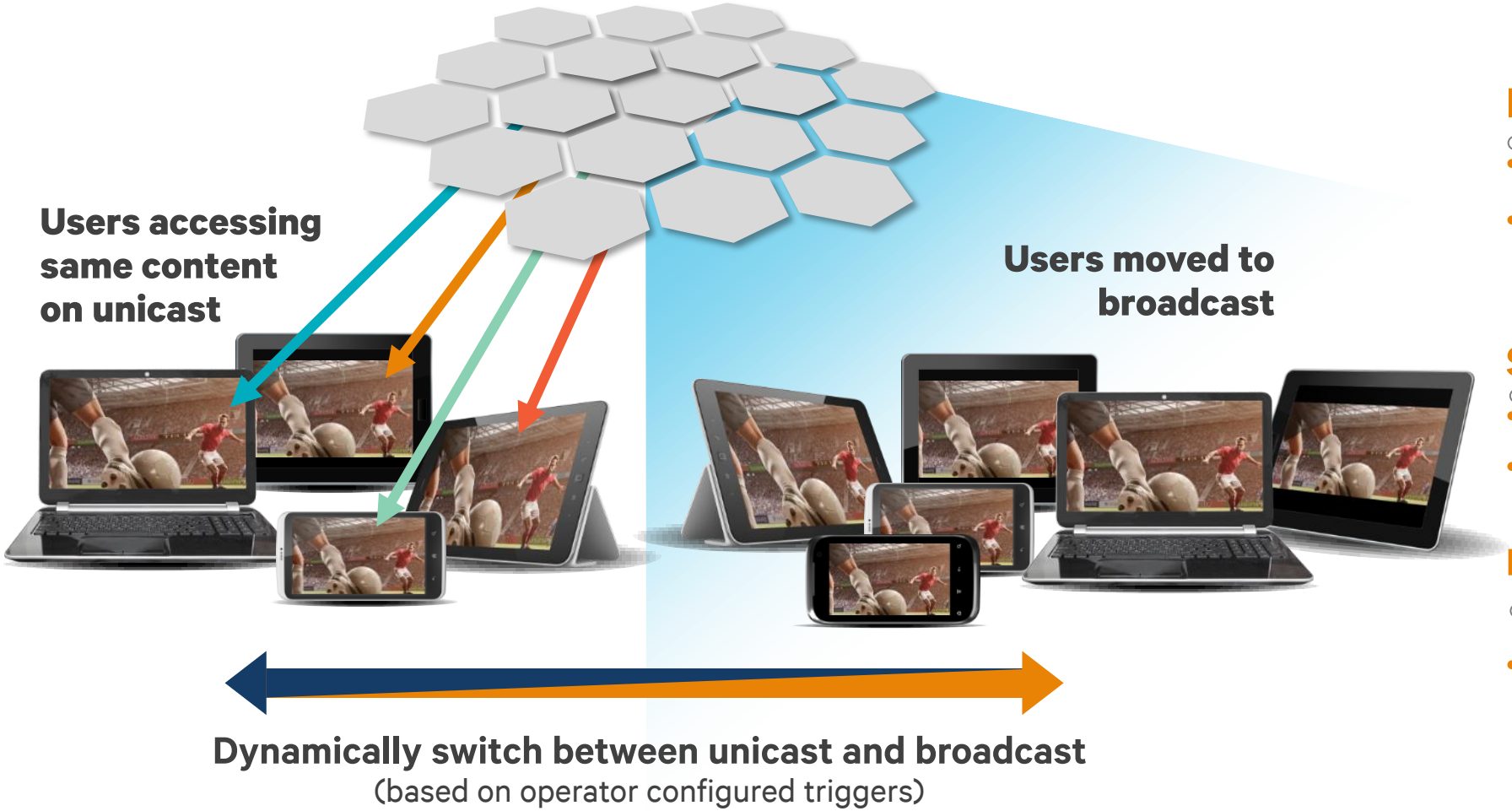
New use cases such as public safety

Enhancing venue casting performance and beyond with small cells

Converged TV services using LTE Broadcast

[1]In a cluster of cells consuming identical content. This is possible even with Rel 9, but more useful with dynamic switching; [2]10km using a cyclic prefix of 33us

Dynamic switching enables broadcast on demand



Demand or event driven

- Based on demand, e.g. breaking news
- Pre-scheduled, e.g. at stadiums during games

Seamless transition

- Make-before–break connection
- Fully transparent to users

Part of Rel. 12[1]

- Called as MooD (Multicast operation on demand)

[1]This feature is called Mood (Multicast operation on Demand) in Rel. 12

Dynamic switching offers scalability

LTE broadcast – Higher capacity even with few users

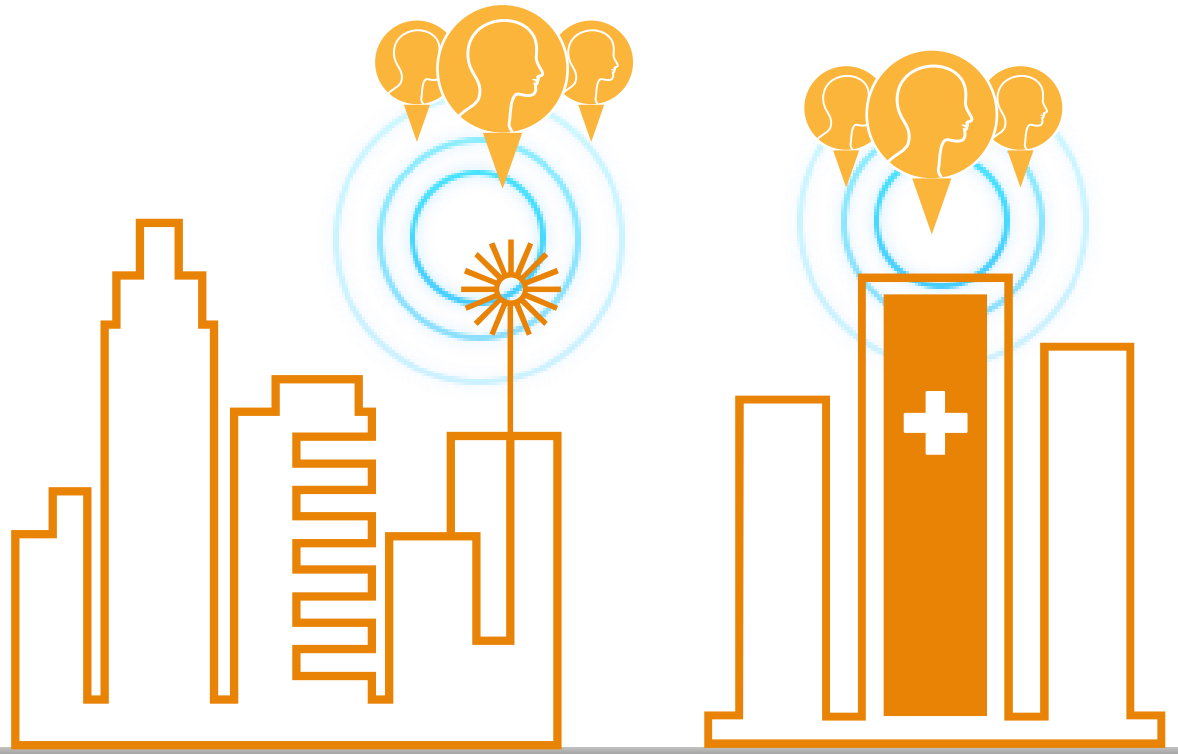
Makes dynamic switching even more useful

1.7x* ▶ **3x** ▶ **7x** ▶

1* 2 5

* Throughput gain vs. unicast

* Avg. users per site in network with same content



Source: Qualcomm Research. 2GHz carrier frequency, site-to-site distance is 500meter, cluster eMBMS deployment (19 sites in single frequency network), comparison with unicast is based on the same amount of resource allocation.

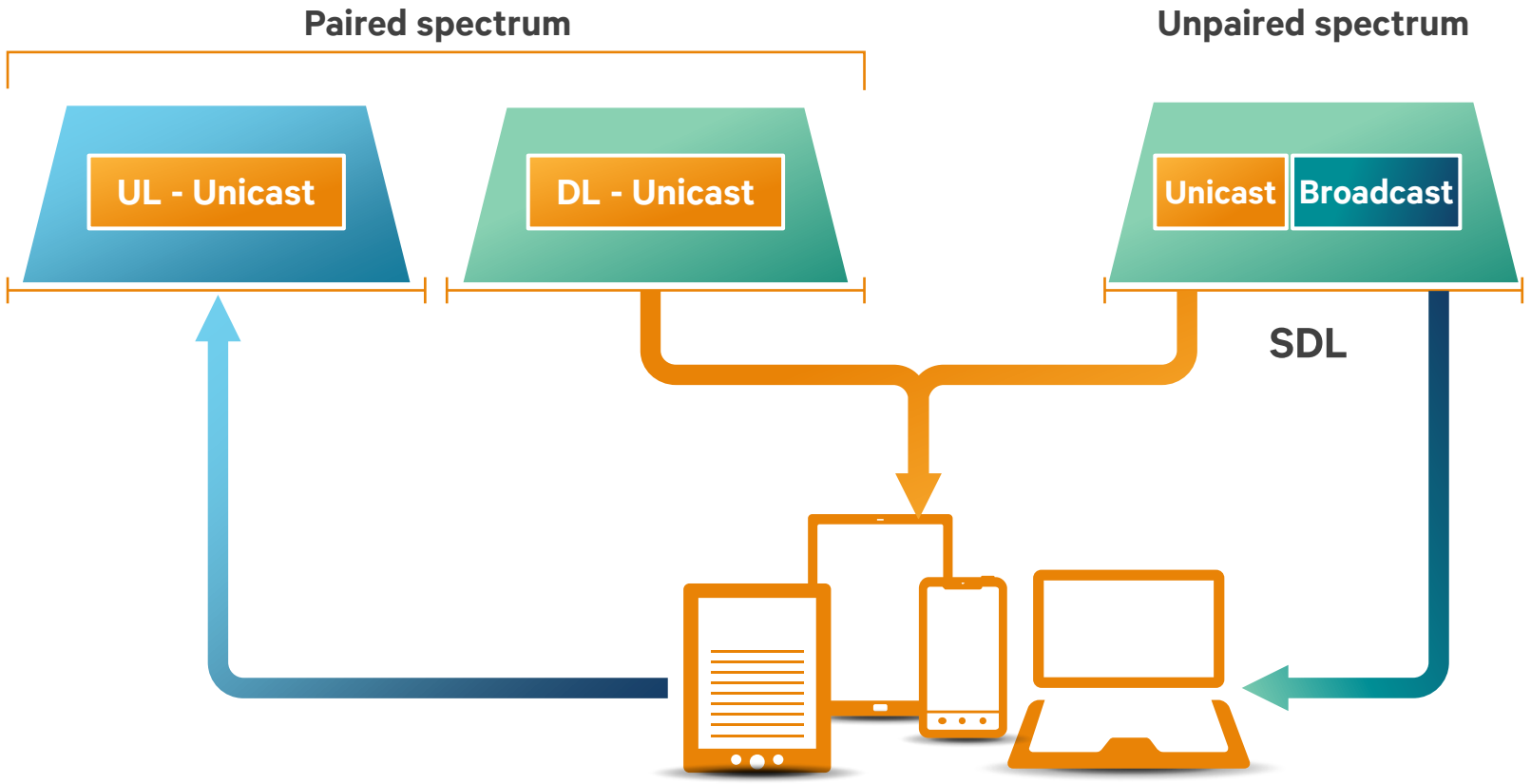
Ability to use unpaired spectrum for mass media/content

Supplemental Downlink (SDL) boosts the downlink

- By aggregating unpaired spectrum with typically paired spectrum
- L-Band standardized as band 32 in 3GPP and harmonized in Europe[1]
- Band 29 in the US

Opportunity for LTE Broadcast

- Flexibility to allocate part of unpaired spectrum for downlink broadcast services



Better utilizing unpaired spectrum for downlink intensive traffic

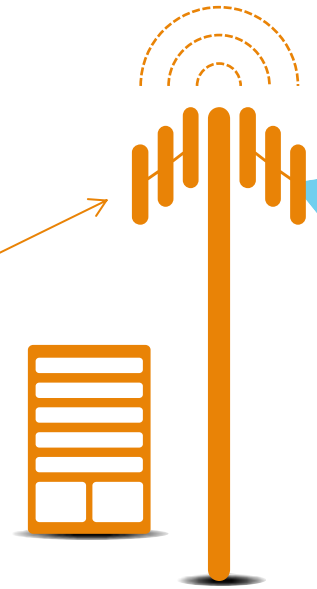
This feature is supported in Rel 11

[1]L-Band in Europe: 1452 MHz to 1492 MHz, sometimes referred to as 1.4GHz or 1.5GHz spectrum, has 40 MHz of idle unpaired spectrum available

LTE Broadcast for public safety

Bringing efficiency when needed most

Push-to-Voice/Data/Text



Recipients dynamically moved between broadcast and unicast

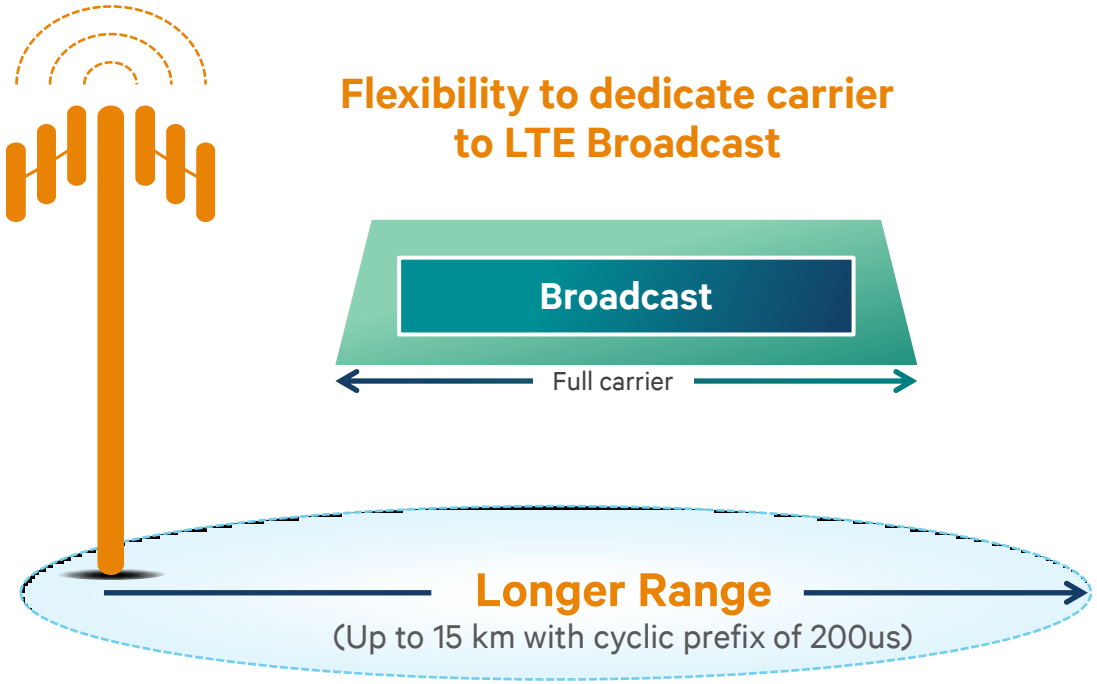
User groups preconfigured or formed on the fly

Targeted to meet stringent public safety requirements

- <300ms end-to-end set-up time and <150ms end-to-end transport delay
- Standardization started in Rel 12

This feature in Rel 12 is called as Group Communication System Enabler (GCSE)

Long-term evolution brings increased range, capacity & flexibility



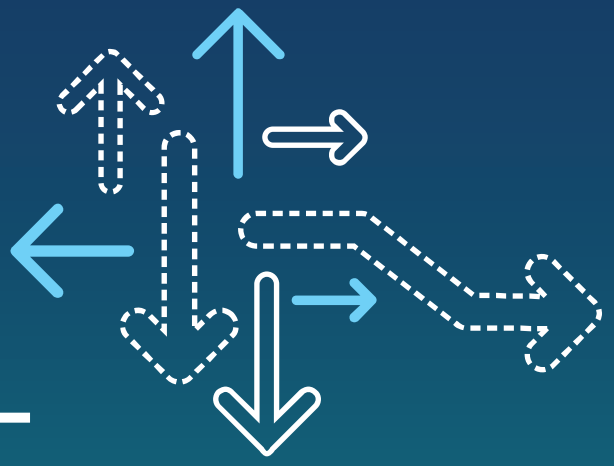
Needed to use LTE Broadcast for converged TV services

Higher capacity

Enhancements to increase robustness and utility[2]

- Improved error correction, lower latency, improved battery life[1]
- Ability to insert customized ads

[1]MIMO and 256QAM are being proposed for 3GPP Rel 13; [2]The features include unified MPD or called DASH transport indicator, datacasting services, multiple FLUTE sessions, file repair without FDT, FLUTE enhancement



Small cells with LTE Broadcast for venue casting and beyond

Small cells enhance venue casting performance

Venue SFN comprised of small cells and near-by macros

Robust coverage across the venue

- More overlapping cells maximize SFN gain
- Cover back stage and other areas not reachable by macros

Higher capacity and more channels

- Better coverage also enables higher order modulation/coding
- Offload traffic from nearby macro cells

Opportunity to localize broadcast

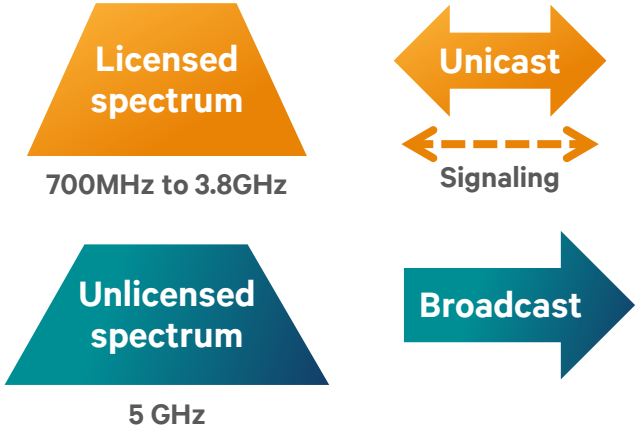
- Only small cells could broadcast, freeing up macros for unicast

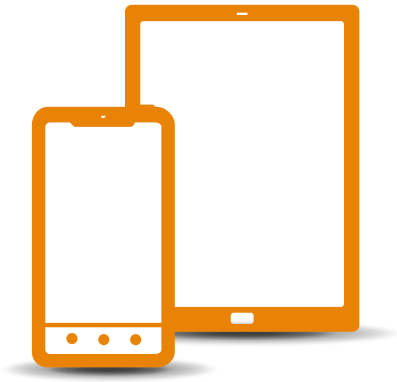
Enhanced user experience

- Better streaming experience, more channels/content
- Better user experience for users on macro network and non-venue users

Opportunity for LTE Broadcast in unlicensed spectrum

Combining higher efficiency of LTE Broadcast with bandwidth-rich unlicensed spectrum





Utilize bandwidth-rich 5 GHz band

~500 MHz potential availability

Offload traffic from licensed spectrum

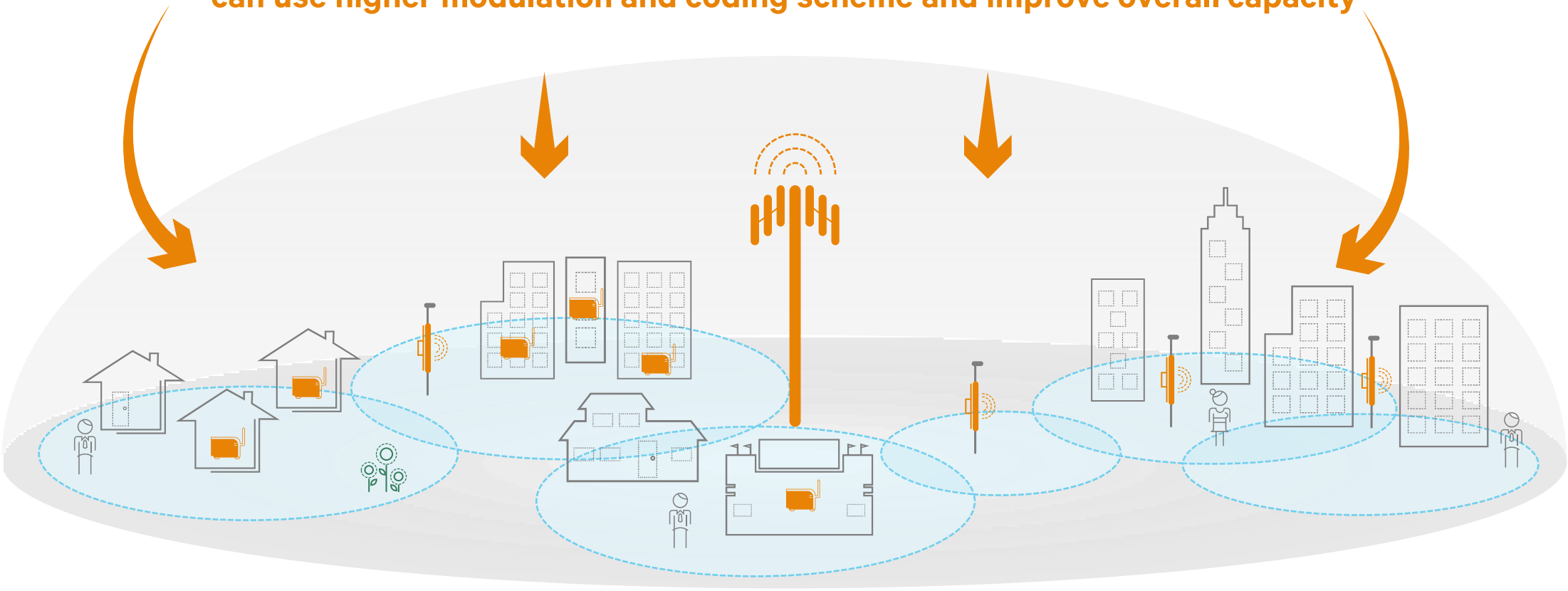
More available capacity for broadcast and unicast traffic

Better user experience than venue Wi-Fi

Because of SFN gain and mandatory anchor in licensed spectrum

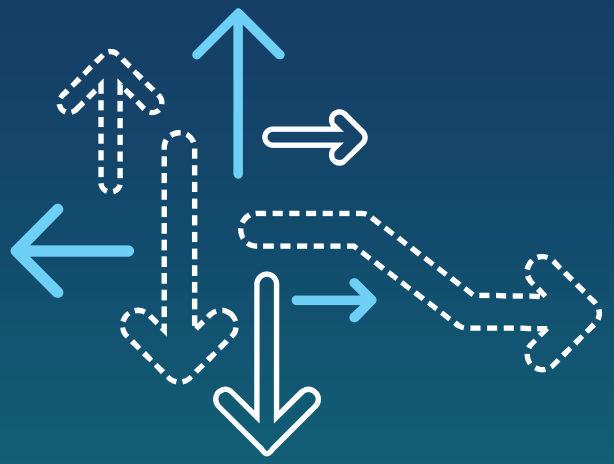
Small cells boost LTE Broadcast coverage and capacity

Small cells ensure good indoor and overall coverage so that LTE Broadcast can use higher modulation and coding scheme and improve overall capacity



Network dimensioned for worst-case scenario—users in bad coverage area dictate overall efficiency

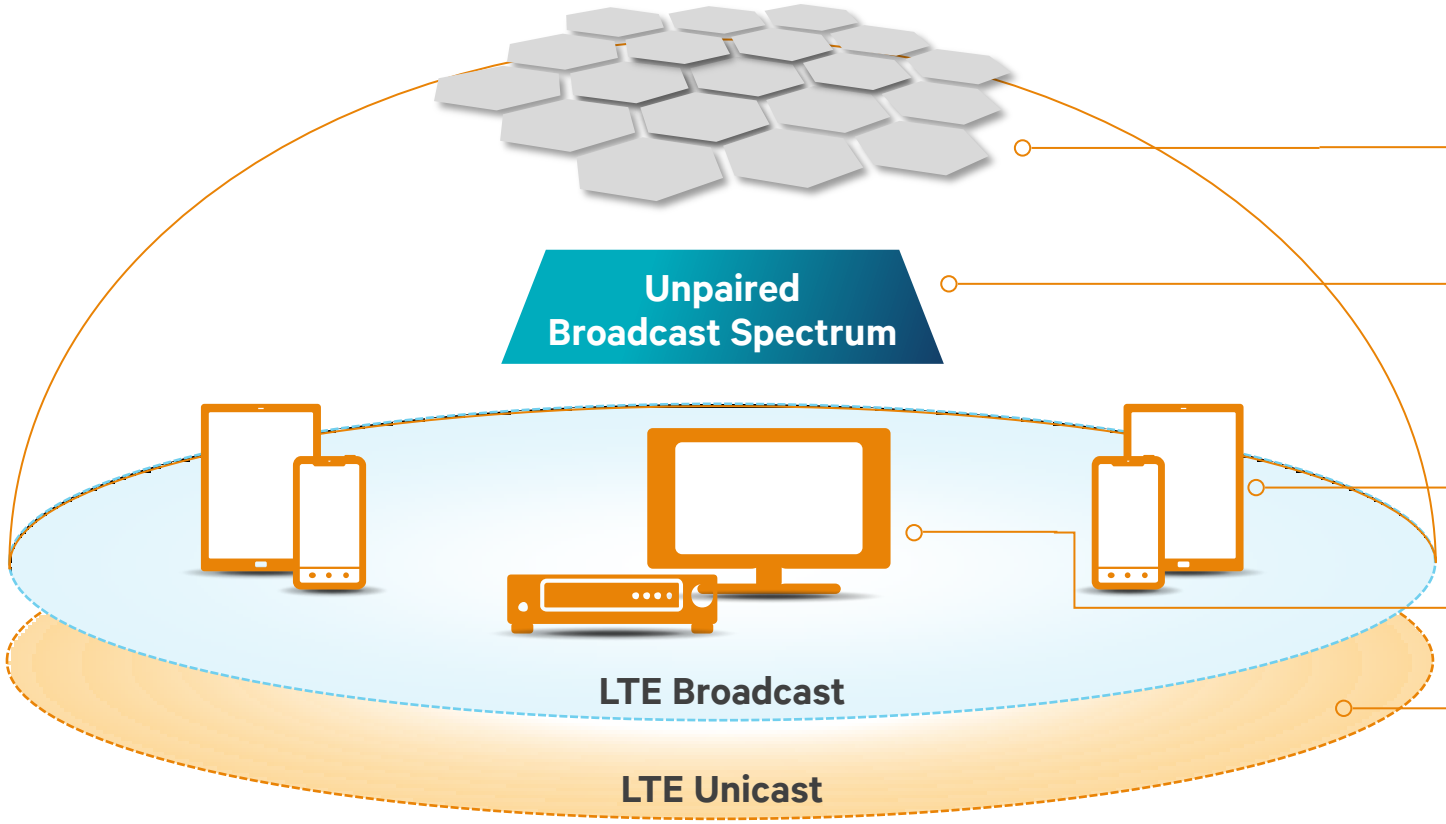
– No link quality feed back, no adaptive modulation, no HARQ etc.



Extending LTE broadcast to converged TV services

LTE Broadcast for converged TV service, beyond mobile

Next-gen TV content for the Internet age



Overlay broadcast network leveraging LTE assets
(sites, transport, core network)

Offering TV service on a dedicated spectrum

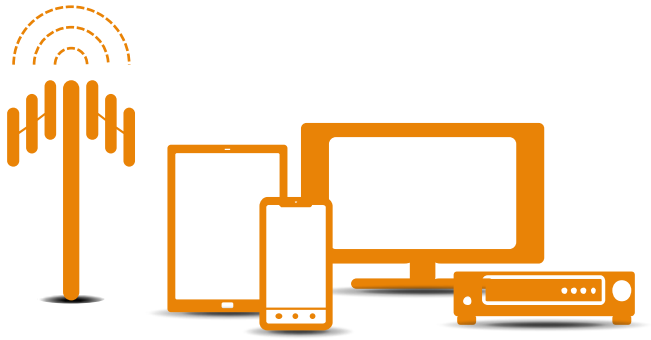
Exploiting LTE devices with Inherent LTE Broadcast support
Other devices, such as regular TV, will need to add LTE Broadcast capability

Devices access both unicast and broadcast or broadcast only based on service/type

LTE Broadcast based TV service has many benefits

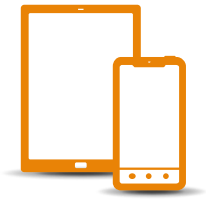
Anytime, anywhere, across all devices

Single network for mobile and fixed devices



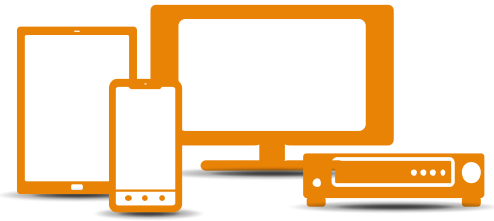
- Uses the same network/ assets for all devices and TVs
- Easier to manage single network, content and assets

Most effective way to deliver TV content to mobiles



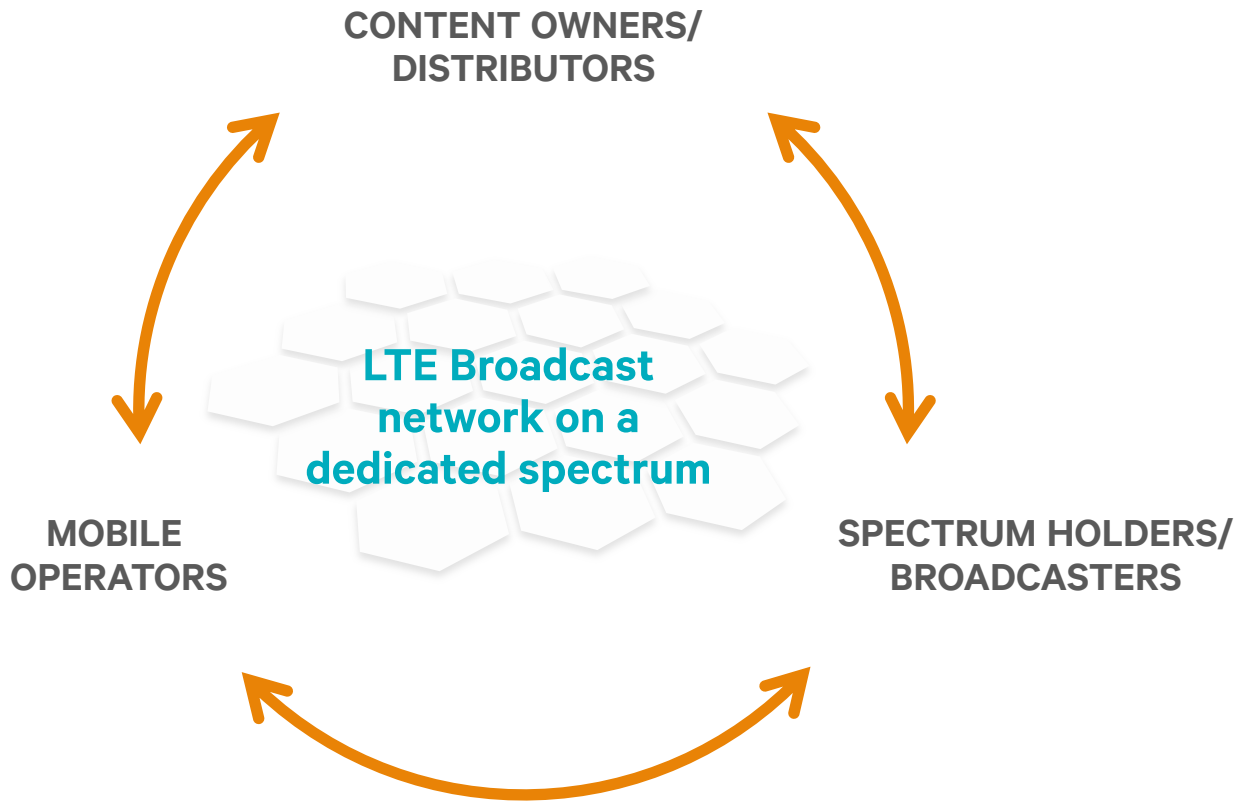
- Utilizes inherent LTE Broadcast support in devices—no new modem
- Provides interactivity to broadcast content through unicast
- Expands the reach of live TV content with higher advertising revenue potential

Uniform user experience across multiple devices/screens



- Better streaming experience by eliminating unicast congestion constraints
- Opportunity for more cost-effective data plans for mobile TV (bundled plans)

Opens up new business opportunities



New class of services

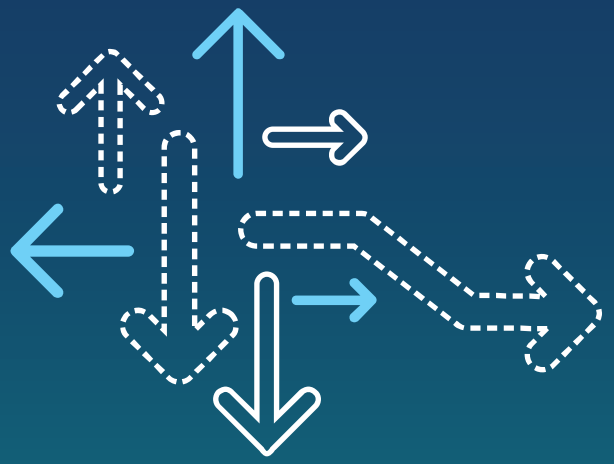
Interactive and personalized TV services with cost-efficiency

New partnerships

Between operators, content owners, spectrum holders & advertisers

New business models

Revenue share, leased/hosted network model and others



LTE broadcast - candidate for converged terrestrial TV in Europe

Europe defining next-gen terrestrial broadcasting

Led by CEPT and European Commission, supported by mobile and broadcast industries

CEPT ECC
Electronic Communications Committee

Task Group 6 (TG 6)

- National regulators
- Mobile Industry
- Broadcast Industry

Nov '14

ECC Report 224

Long-term vision for UHF

Identifying scenarios, technical aspects, and spectrum coordination

European Commission

High Level Group on the future use of the UHF band

- C-level representatives from mobile & broadcast Industry
- Digital Europe

Sep '14

Vision Docu--ment

Future of UHF

Economic and spectrum solutions

Plum consulting /Farncombe

- Open to all (Public)

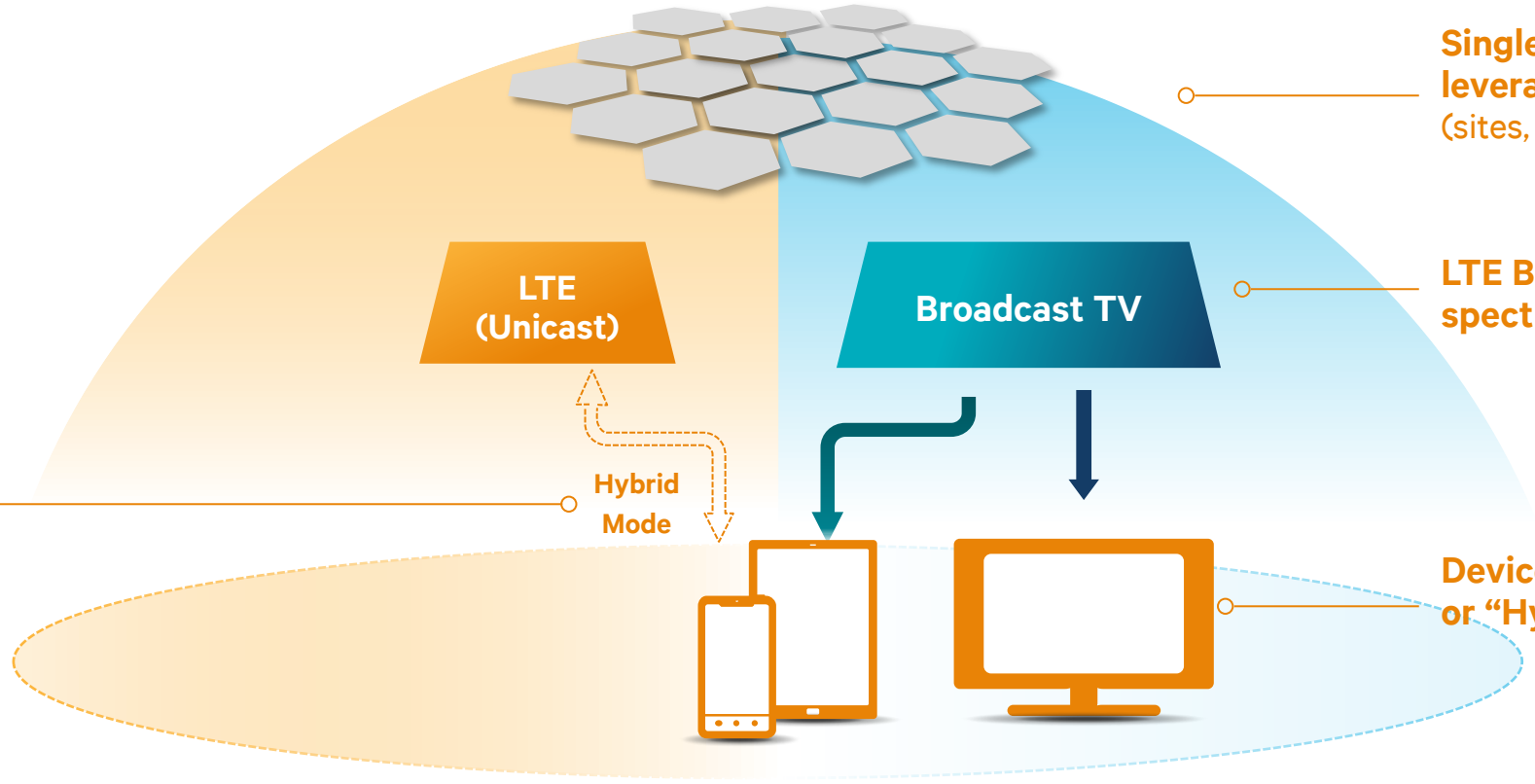
Dec '14

Report

Convergence of broadcast & broadband

Socioeconomic analysis

Proposed LTE Broadcast set-up for converged TV services



Single nationwide network leveraging existing LTE assets (sites, transport, core network)

LTE Broadcast on a dedicated spectrum

Enhanced user experience in the "Hybrid Mode" (e.g. On-demand content, interactivity)

Devices in "Stand-alone" or "Hybrid" mode

2x more efficient than today's DVB-T/ATSC

Allows broadcasters to reach lucrative mobile market

Opportunity for converged broadcast-unicast services

Current broadcast technology operates in Multi Frequency Network (MFN) mode with a frequency reuse of at least 4 with a spectrum efficiency of up to 4 bps/Hz inside each cell. This corresponds to an overall spectrum efficiency of approx. 1bps/Hz. Whereas LTE-B operates in SFN over the entire coverage area with a spectrum efficiency of up to 2bps/Hz.

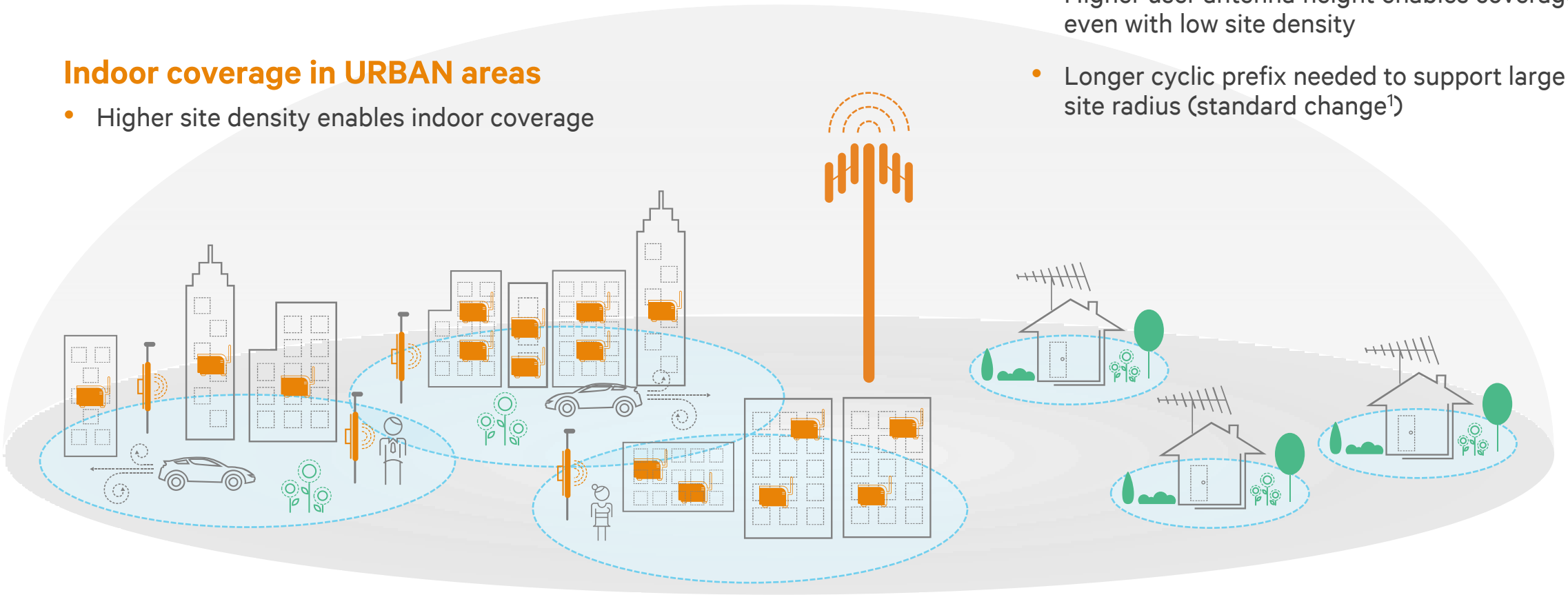
Existing LTE sites can provide wide area broadcast coverage

Indoor coverage in URBAN areas

- Higher site density enables indoor coverage

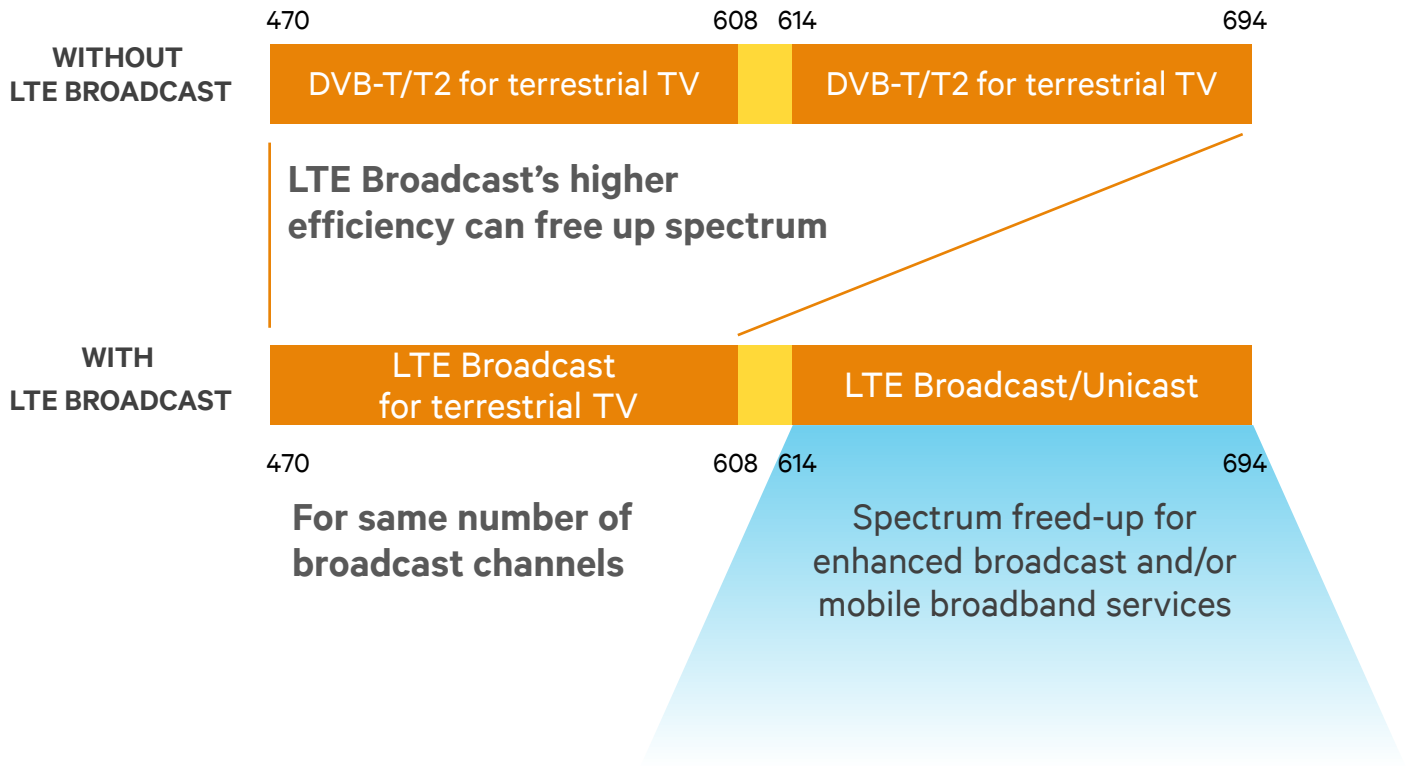
“Roof-top” reception in RURAL areas

- Higher user antenna height enables coverage even with low site density
- Longer cyclic prefix needed to support large site radius (standard change[1])



LTE Broadcast offers higher efficiency

Can free-up spectrum for more content and services



Potential to free-up up to 100 MHz of spectrum

- Support enhanced broadcast and mobile broadband services

Incentive for wireless operators

- Provide customers with high quality video content.
- Regain position in value chain by unlocking new value through billing and interactivity features
- Spectrum opportunity cost far outweighs network upgrade cost

Note: Example shown for typical European spectrum allocation

LTE Broadcast – a 1000x data challenge enabler

- Efficient way to offload mass media and live content
- Dynamic switching makes it ideal when and where needed, with even fewer users

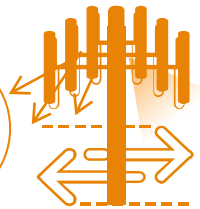
- Efficient use also of unpaired spectrum
- Better utilizes unlicensed spectrum

- Small cells improve coverage and thereby capacity everywhere
- Especially enhances venue casting performance

More Small Cells is Key to 1000x

Summary: LTE Broadcast is evolving and going beyond mobile

1. 
Efficient delivery of mass media content, with opportunities far beyond just venues

2. 
The evolution makes it dynamic and more useful – on demand, more scalable, more applications

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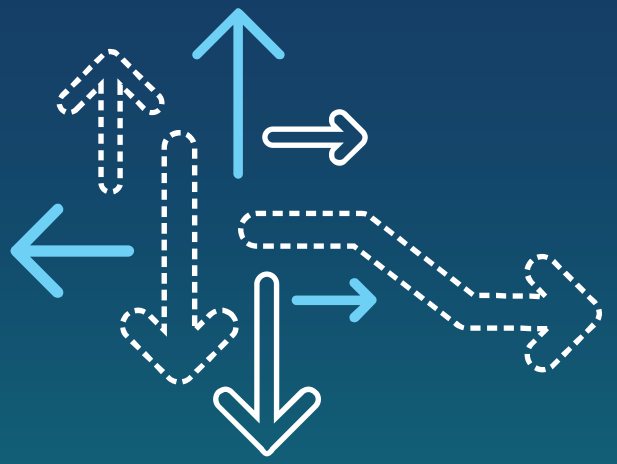
Candidate for next-generation converged terrestrial TV services in Europe

1000x mobile data challenge enabler

Questions? - Connect with Us



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