Optimizing Spectrum Usage for 2020 and beyond

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Spectrum
“is the lifeblood of this industry”
(Vittorio Colao)

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Spectrum = the real estate for Mobile Broadband

A proper network deployment goes hand in hand with a sound spectrum strategy

800/850, 900, 700, UHF
FDD, ~10MHz BW
Macro

Coverage

1800/1900, 2100, 2600
FDD, ~20MHz BW
Macro + light HetNets

Capacity

2300: LSA
3500: Co-primary
ISM, 5000+: Unlicensed

Complementary

2600, 3500, 2300
TDD, ~20MHz BW
dense HetNets

Densification

We cannot generate new spectrum, but we can optimize its use!

Overall Efficiency

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Complex processes towards new spectrum for exclusive Mobile Broadband

All attractive spectrum is assigned to some service today

"new" spectrum means re-purposing of bands by relocating existing services

Harmonization is key and spans countries and regions

Lengthy process in identifying potentially suited bands in national and regional World Radiocommunications Conference (WRC) preparatory work, currently under way for WRC-15 until November 2014

WRC agreements need to be mirrored on regional and national levels

e.g. 700 MHz band plan definition work in CEPT for 700 MHz
e.g. 700 MHz national spectrum assignments like Finland and Sweden announcements to re-purpose 700 MHz band from Broadcast to MBB in 2017

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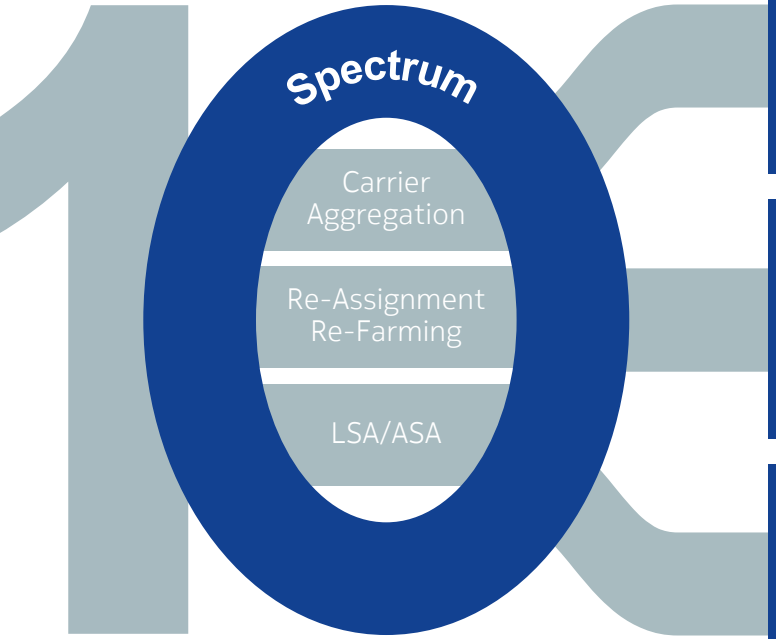
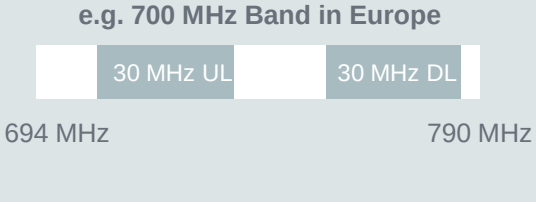
Main levers to optimize spectrum utilization for Mobile Broadband
in bands below 6 GHz



Dynamic combination of fragmented spectrum

Additional harmonized spectrum for LTE by re-farming & re-assignment



Unlock more spectrum by Licensed Shared Access with predictable QoS

UHF “goldmine” for coverage and capacity

2020+ Longer term vision: Convergence of DTT & MBB?
Requires further work on technology, regulatory and business models

470-694 MHz

2015+ Near term opportunity: 700 MHz band for LTE (3GPP band 28)
700 MHz can substantially contribute to broadband / Digital Agenda targets

700 MHz

470	Linear Broadcast ⟷ Unicast via SDL	694	700 MHz Band starting 2015/16	790	Digital Dividend since 2010	862

Supplemental Downlink as a lever towards more UHF spectrum for MBB

- Stepwise introduction of SDL where need for DTT bandwidth decreases
- Complementing DTT with macro cellular eMBMS for true mobile delivery
- Flexibility of mobile technology supports migration paths and different pace in different countries within Geneva-06 DTT plan

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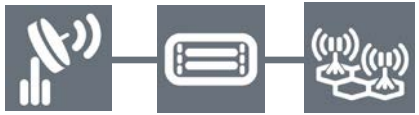
Spectrum usage models

Harmonization and global standards drive economies of scale

Mainstream Approach
Auctions
of Cleared Spectrum

Exclusive Use
Ensures
Quality of Service



Complementary
License Model
Licensed Shared Access

Exclusive Shared Use
Exclusive use on a *shared* and *binary*
basis in Time, Location, and/or Frequency
with Incumbent (government, defense, etc.)
Predictable
Quality of Service

Shared Approach
Unlicensed
(Wi-Fi, LTE-U, …)

Shared Use
Unpredictable
Quality of Service

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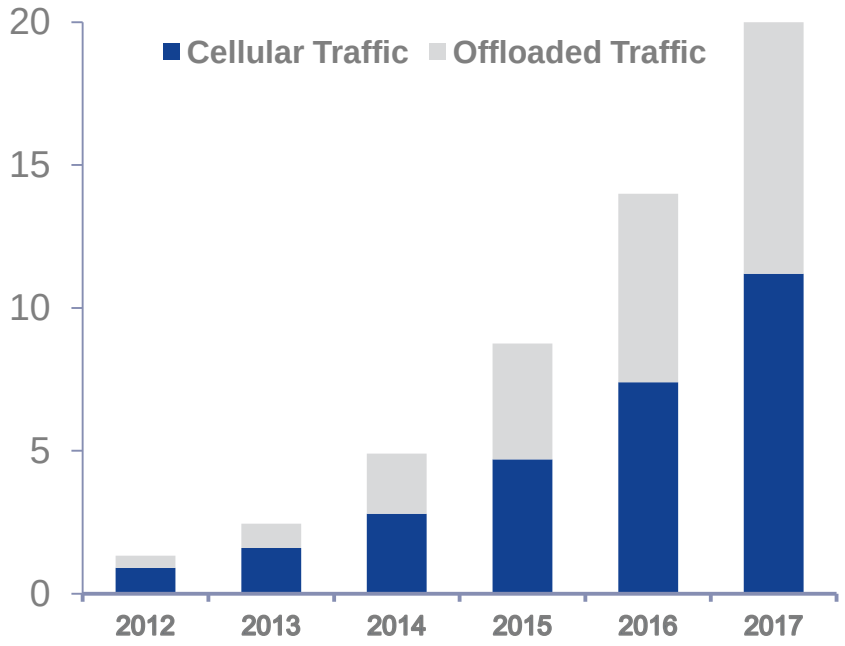
Offload via complementary unlicensed spectrum



Source: Cisco VNI Mobile Forecast 2013

Wi-Fi needs more spectrum, too, in high bands e.g. 5 and 60 GHz

Wi-Fi

LTE on unlicensed spectrum will open new opportunities for local area traffic offload

LTE-U

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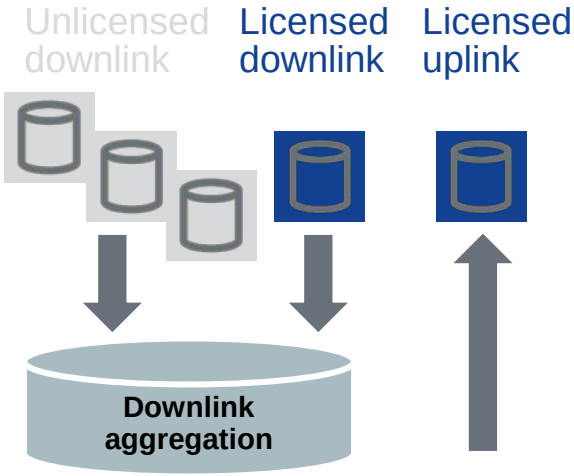
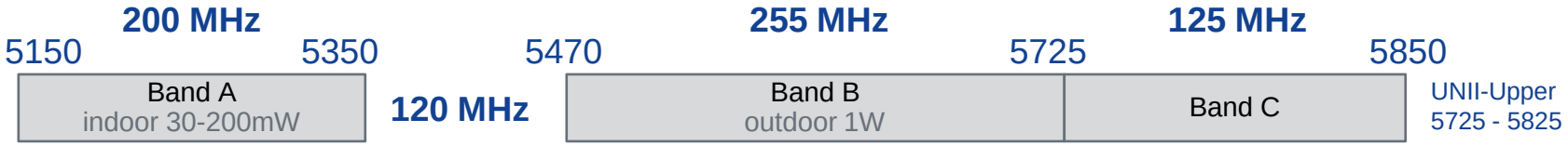
LTE for Unlicensed Bands (aka LTE-U)

Licensed-Assisted Access using LTE



- Unique combination of licensed + unlicensed bands
- Licensed band provides reliable connection and quality of service for mobility, signaling, voice and data
- Unlicensed band boosts data rates – ”Opportunistic use”
- LTE-U to be integrated into small cells beside Wi-Fi
- Note: downlink: uplink asymmetry 10:1 in LTE networks

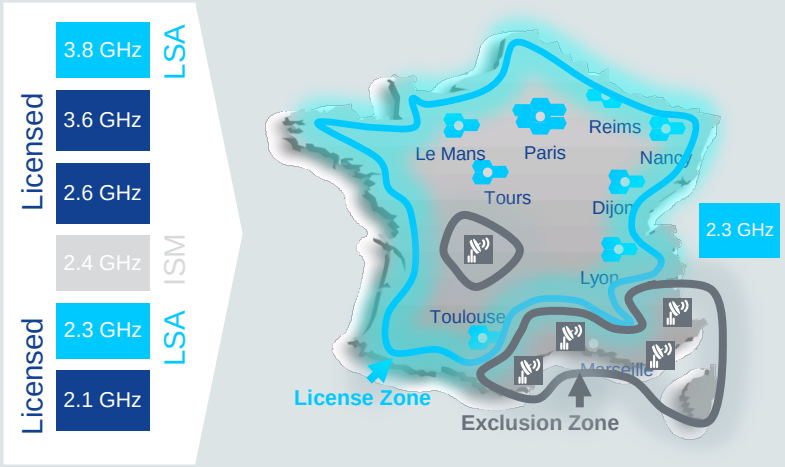


Licensed Shared Access

Unlock more spectrum with predictable QoS

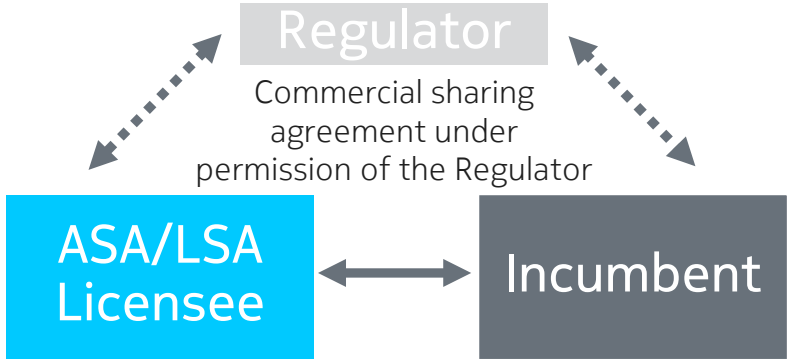
Approach

- Enables timely availability and licensed use of harmonized spectrum with predictable QoS



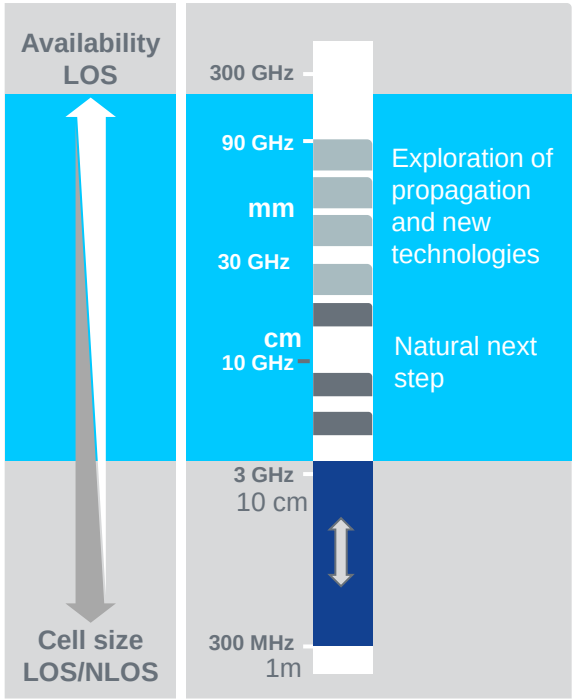
Operator benefits

- Accelerates spectrum harmonization
- Leverages available LTE technologies to ensure early use and Economy of Scale
- Opportunity for lower cost and high quality licensed spectrum



Bridging the spectrum gap to deliver extreme capacity

High hope, high risk: exploring frequencies above 6 GHz



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And a practical proposal to take things forward

One potential technology enabler
is new spectrum above 10 GHz.

We propose to set up a forum to
share plans and results of
mm wave propagation studies
and offer to facilitate it.

Johannesberg Summit, Lauri Oksanen 20th of May 2013

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Brooklyn 5G Summit – Focus on antennas, propagation & channel modeling
Preliminary Conclusions

- Millimeter wave band communication is already proven suitable for backhaul and no show stoppers were identified for use in small cell mobile access
- Preliminary conclusions from channel measurements (Indoor and outdoor) for 28 GHz- 100 GHz bands:
  - Pathloss exponent : LOS ~ 2.0 , NLOS ~ 3.4-3.5 (Reference distance based model) - similar as for lower frequency bands
  - Modeling of blockage is important at mmWave band
  - mmWave frequencies have similar reflection loss as lower frequency bands but much higher diffraction loss
  - Rain/Oxygen no problem for ISD < 200 meters
  - Further work needed to clarify whether mmWave systems are noise or interference limited
- Channel modeling options: based on 3GPP or do we need a more complex model?
- Antenna opportunities
  - Additional pathloss at higher frequency bands can be compensated by increasing size of antenna arrays for additional beamforming gain while keeping the aperture size the same.
- Common sense: more extensive measurements needed

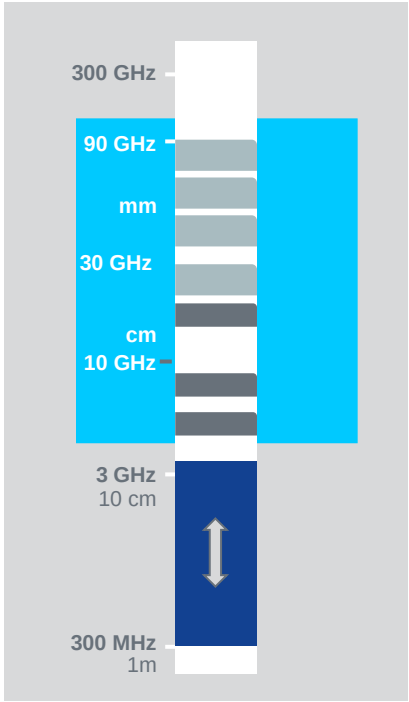
Necessary steps to unlock bands above 6 GHz

Top level actions

1 WRC-15 to agree agenda item for WRC-18/19 related to IMT in frequency bands **>6GHz**

2 Suitable bands above 6GHz to be allocated to **Mobile** on primary/co-primary basis + identified for **IMT**. If a suitable band is already allocated to Mobile, it should then be identified for IMT.

3 IMT 'federation' = {IMT-2000, IMT-A, **IMT-2020**} All IMT families to have access to all IMT bands below and above 6 GHz



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Optimizing spectrum usage for 2020 and beyond
Conclusions

- Exclusive spectrum access is preferred as MBB requires predictable conditions
- Maximize spectrum harmonization for global economies of scale, ease of border co-ordination and international roaming capabilities
- LSA as a valuable additional tool for spectrum optimization where exclusive use is not feasible
- Unlock UHF bands via new primary allocations and convergence between Broadcast and Broadband
- WRC-15 to agree agenda item for WRC-18/19 related to IMT in frequency bands above 6GHz
- Suitable bands above 6GHz to be allocated to Mobile on primary/co-primary basis as well as identified for IMT
- Continue joint global collaborative efforts on de-risking the new frontiers of cm and mm-wave e.g. add measurements, pre-3GPP harmonization of propagation and channel models etc.


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