

HSPA+ LTE Carrier Aggregation

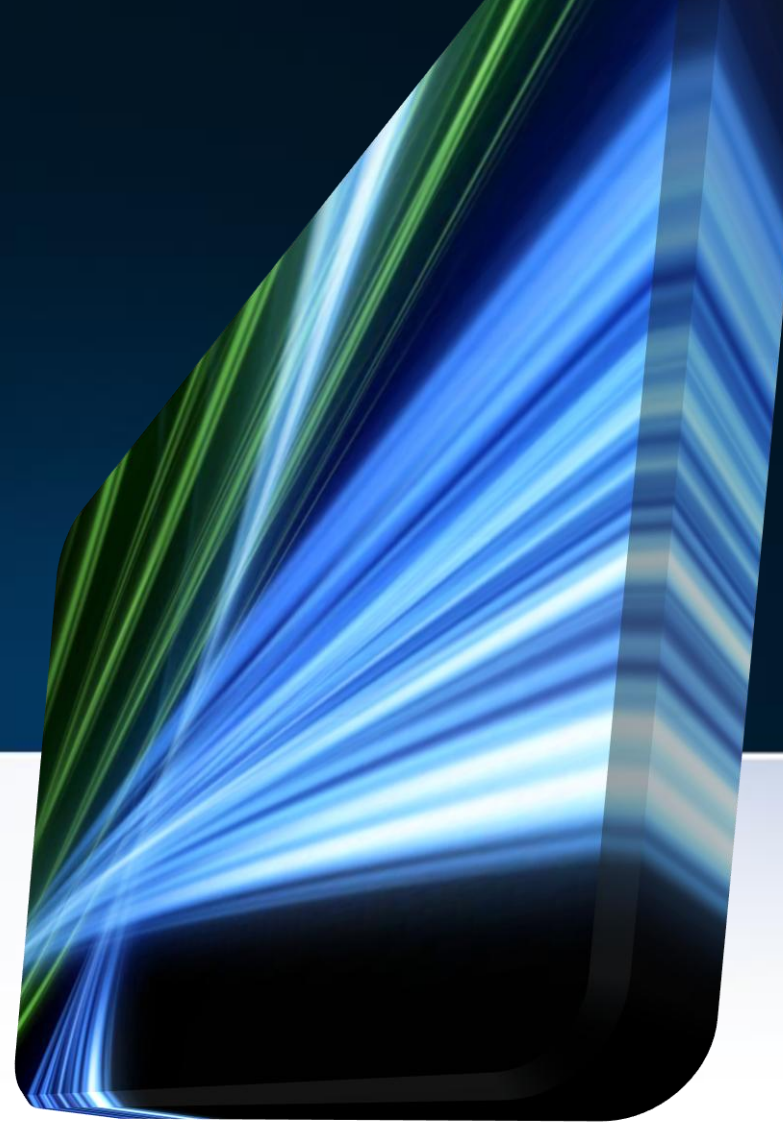
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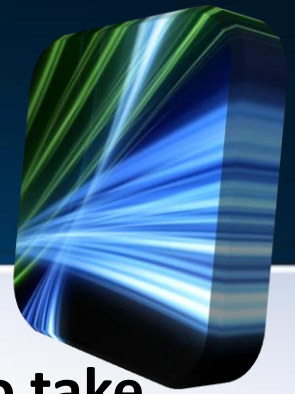


Executive Summary 1(2)



- **LTE and HSPA+ can be foreseen to coexist in parallel for years to come**
- **The evolution of both HSPA+ and LTE standards has introduced aggregation of carriers for higher data rates, better load balancing and increased spectrum utilization**
- **HSPA+LTE aggregation allows for transmitting data to one user simultaneously using both the HSPA and the LTE radios for maximal utilization of the available spectrum**
- **As an example, with aggregation of 900 MHz for HSPA and 800 MHz for LTE it is possible to provide the high data rates expected from the LTE services while at the same time maintain coverage for the HSPA devices**

Executive Summary 2(2)



- **At low or medium load, HSPA+LTE aggregation is able to take advantage of the unused resources leading to significant data rate increases both at the cell edge and the cell center for the carrier aggregation capable devices**
- **Most promising architecture options are seen with co-located multiradio base stations with the base station (NodeB + eNodeB) acting as the data aggregation point**
- **On the device side, receiver radio architectures capable of multiband carrier aggregation should be suitable also for HSPA+LTE aggregation**
- **HSPA+LTE aggregation is currently not standardized. It is a major feature, with a standardization effort comparable to that of LTE carrier aggregation**

HSPA, HSPA+, LTE

Global Deployments July 2012



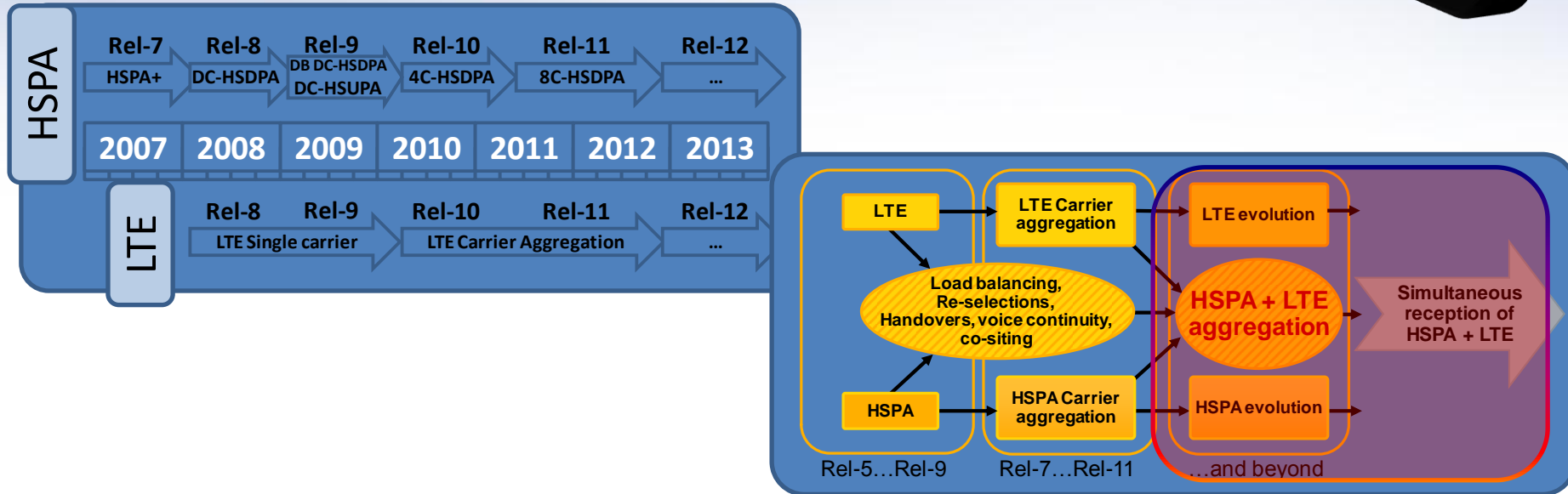
- **HSPA: 473 commercial networks in 180 countries**
- **HSPA+: 227 commercial networks in 109 countries**
- **LTE: 91 commercial networks in 47 countries**
- **LTE: 335 operator Commitments worldwide**
- **LTE: Over 130 commercial networks expected by year end 2012**

White Paper - overview



- **Section 1** introduces the paper and scale and projections of the HSPA and LTE network deployments
- **Section 2** provides technical background
 1. Describes relevant spectrum and deployment aspects
 2. Introduces Multicarrier HSDPA and LTE Carrier Aggregation
 3. Introduces HSPA and LTE interworking
 4. Envisions HSPA+LTE aggregation as a logical next step
- **Section 3** discusses benefits and use cases of HSPA+LTE aggregation
- **Section 4** discusses multiple HSPA+LTE aggregation architecture possibilities
- **Section 5** discusses implementation aspects of HSPA+LTE aggregation
- **Section 6** summarises the white paper

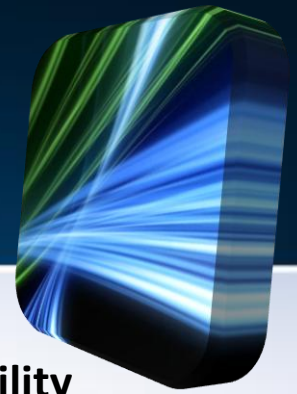
Background



- HSPA evolved from a single carrier system to up to 8-carrier aggregation
- LTE evolved from single carrier system to up to 5-carrier aggregation
- Tight interworking between HSPA and LTE radios supported from day 1

→ **Vision: Combination of the LTE and HSPA tracks by aggregating HSPA and LTE carriers**

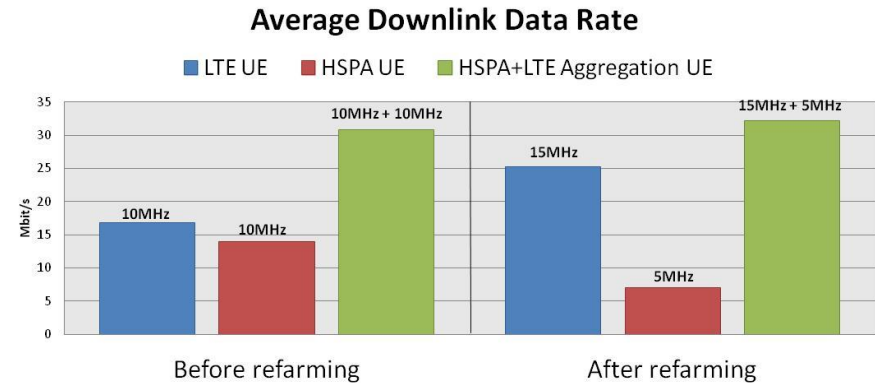
Benefits and use cases



- **Use cases related to existing deployment and practical spectrum availability**
 - Carriers may need to operate HSPA and LTE in parallel for a long time
 - Sufficient spectrum needed for both to maintain good user data rates
 - Available spectrum is not abundant
 - Not realistic to have maximum carrier aggregation of HSPA (40 MHz) or LTE (100 MHz)
 - The two systems will experience different loadings
 - Multiradio base stations supporting both LTE and HSPA

- **Same benefits as with Multicarrier HSDPA and LTE Carrier Aggregation**

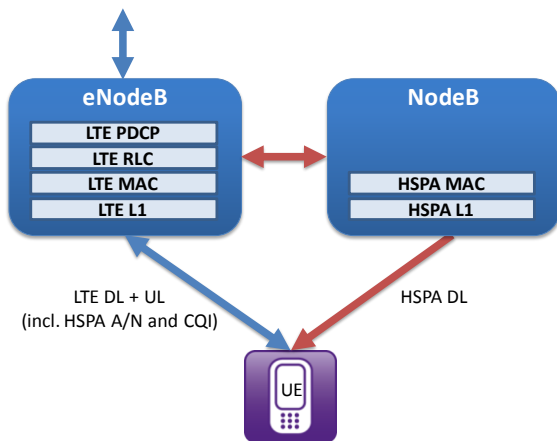
- Millisecond-level load balancing
- Better spectrum utilization
- Higher user data rates
- Higher deployed peak data rates



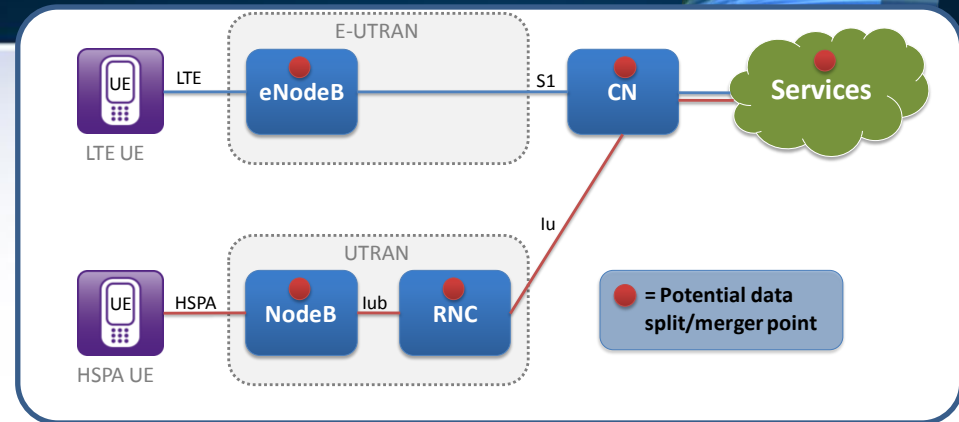
→ Combining the deployed spectrum makes sense, regardless of whether the spectrum is used for HSPA, LTE or split between the two

Multiple architecture options considered

- Multiple architecture options were considered
- Data flow could be split in LTE or UTRAN radio network, or core or services layer
- LTE and HSPA interworking already taking place at the radio layer
- Node B/eNode B data flow split fits to multi-radio base station thinking



Potential protocol stack for the HSPA+LTE data flow through radio network



Possible data split/merger points in the existing network architecture

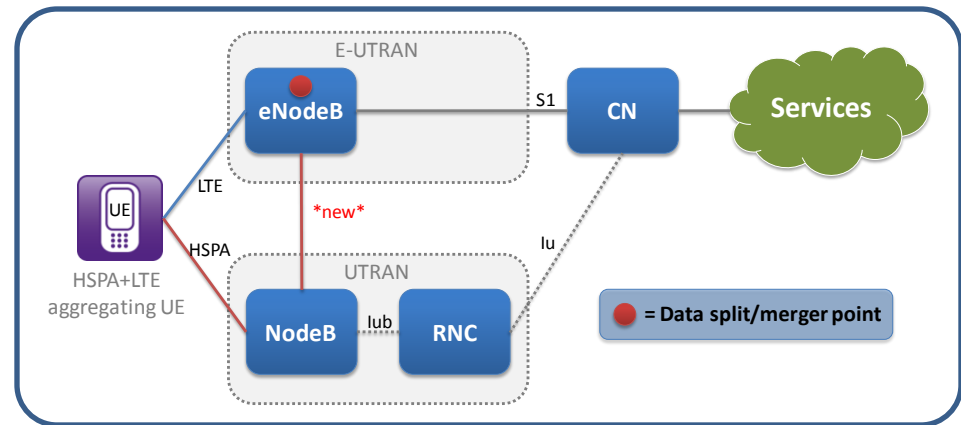
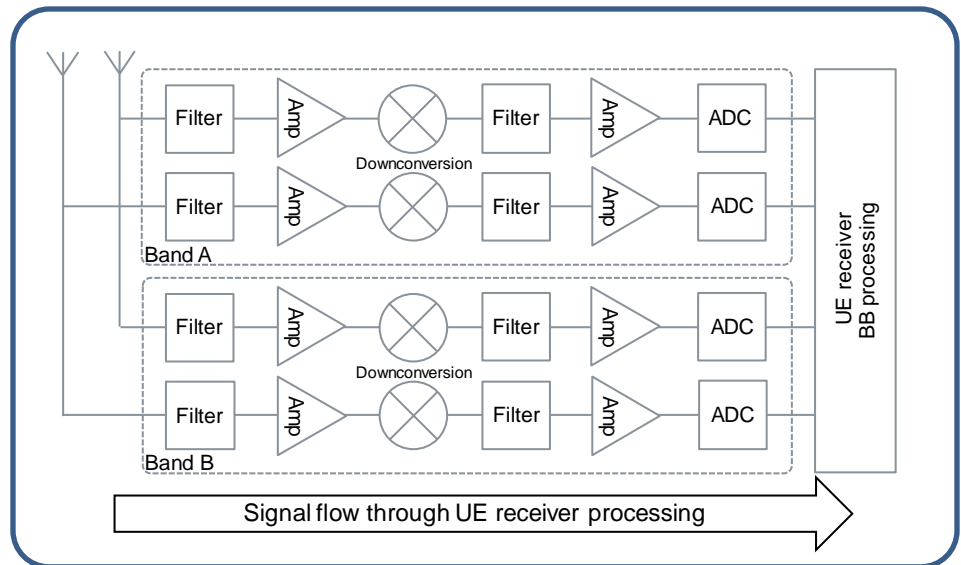
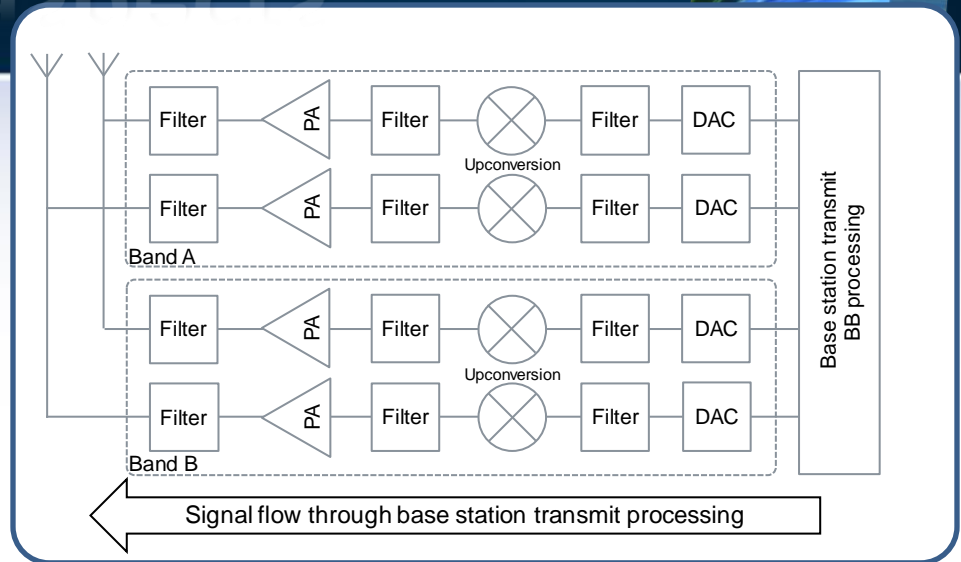


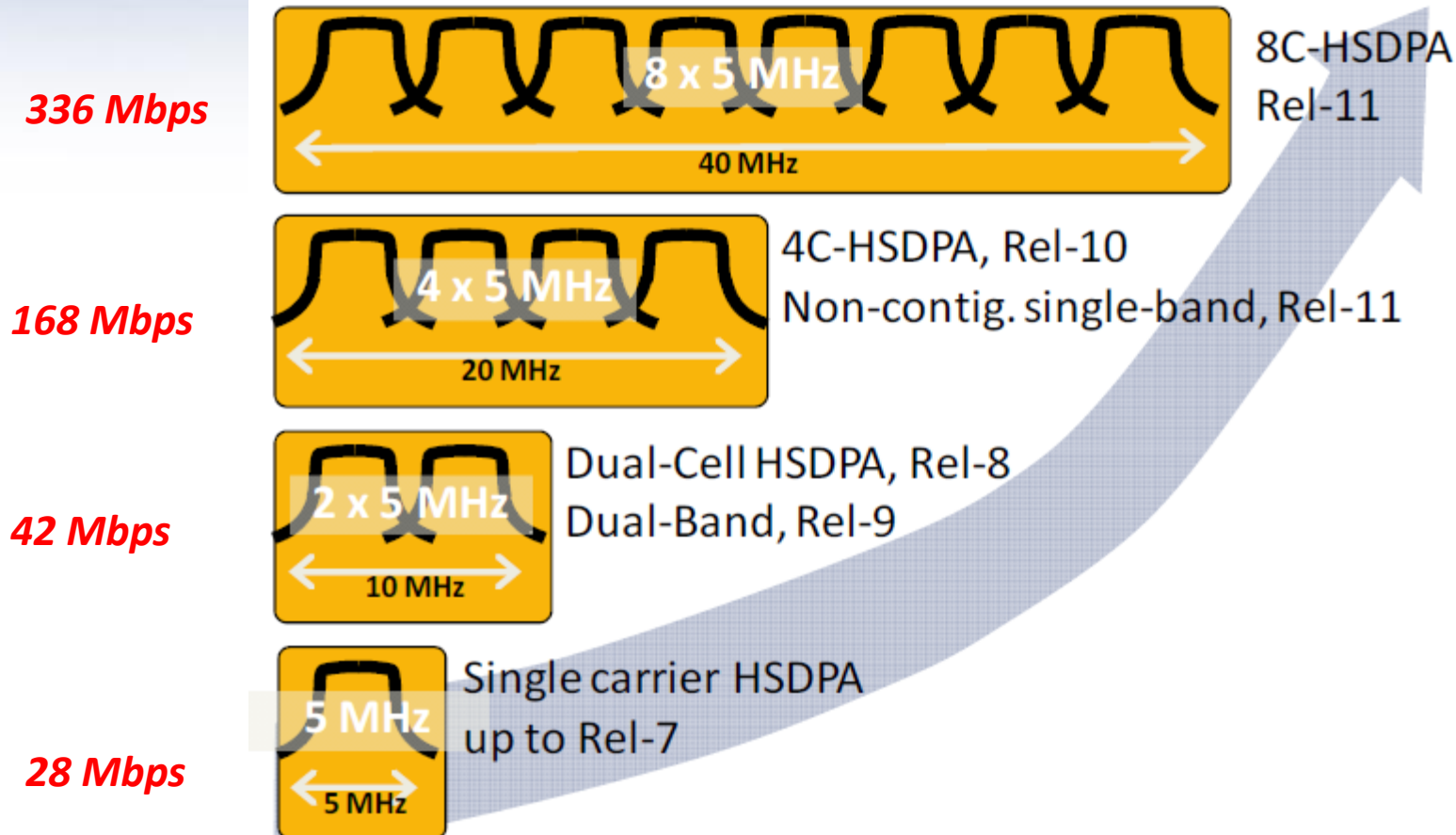
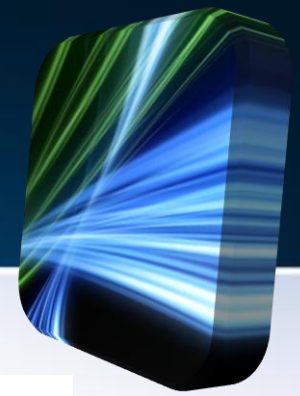
Illustration of network architecture when HSPA+LTE UE data is split in LTE basestation

Implementation aspects

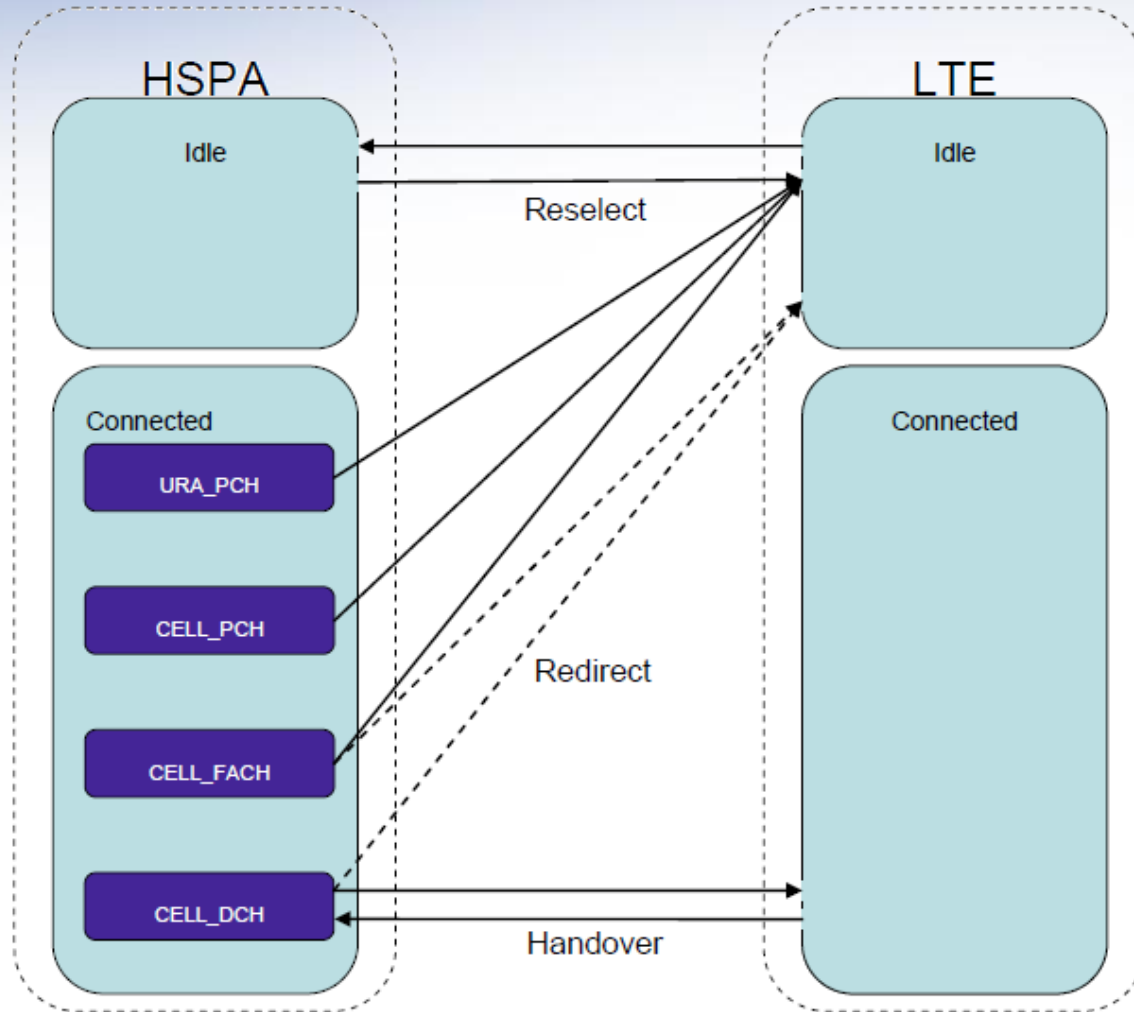
- Deployed multiradio base-station RF HW can be used
 - BB processing impacts due to data flow split
- Device RF architecture comparable to the carrier-aggregating device architecture



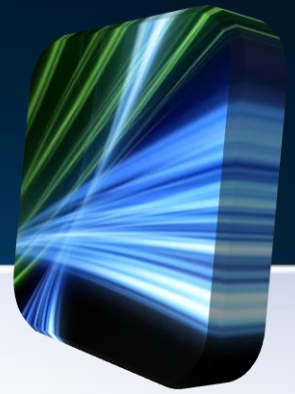
3GPP HSDPA carrier aggregation evolution



HSPA and LTE UE handling

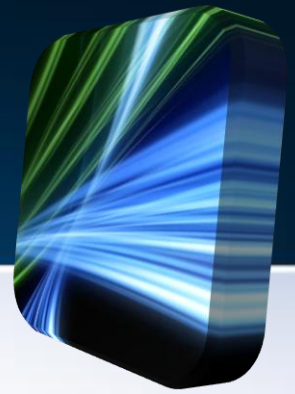


Conclusions



- **Multicarrier evolution is of both HSPA and LTE evolution**
- **Tight HSPA and LTE interworking for mobility and load balancing in place since day 1 of LTE**
- **Refarming spectrum away from HSPA difficult**
- **Vision: Aggregate HSPA and LTE carriers**
 - **Fits under the existing carrier aggregation frame work**
 - **Utilizes deployed spectrum of the two radios**
 - **Fits multistandard basestation thinking**
 - **Is no more complicated to device receivers than multiband carrer aggregation**

Obrigado!



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