LTE-Advanced
(3GPP Release 10 and beyond)
- RF aspects -

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- Outline -

- Radio Parameters of LTE-Advanced
  - Channel / Transmission Bandwidth Configuration
  - Transmission bandwidth configuration
  - Operating bans for LTE-Advanced
  - Deployment scenarios for initial study
  - Carrier aggregation
- Feasibility studies on radio aspects
  - Radio Transmission and reception for UE and BS
  - RRM (Radio Resource Management)
- Conclusion

Radio Parameters of LTE-Advanced

Channel / Transmission Bandwidth Configuration

Transmission bandwidth configuration

Operating bans for LTE-Advanced

Deployment scenarios for initial study

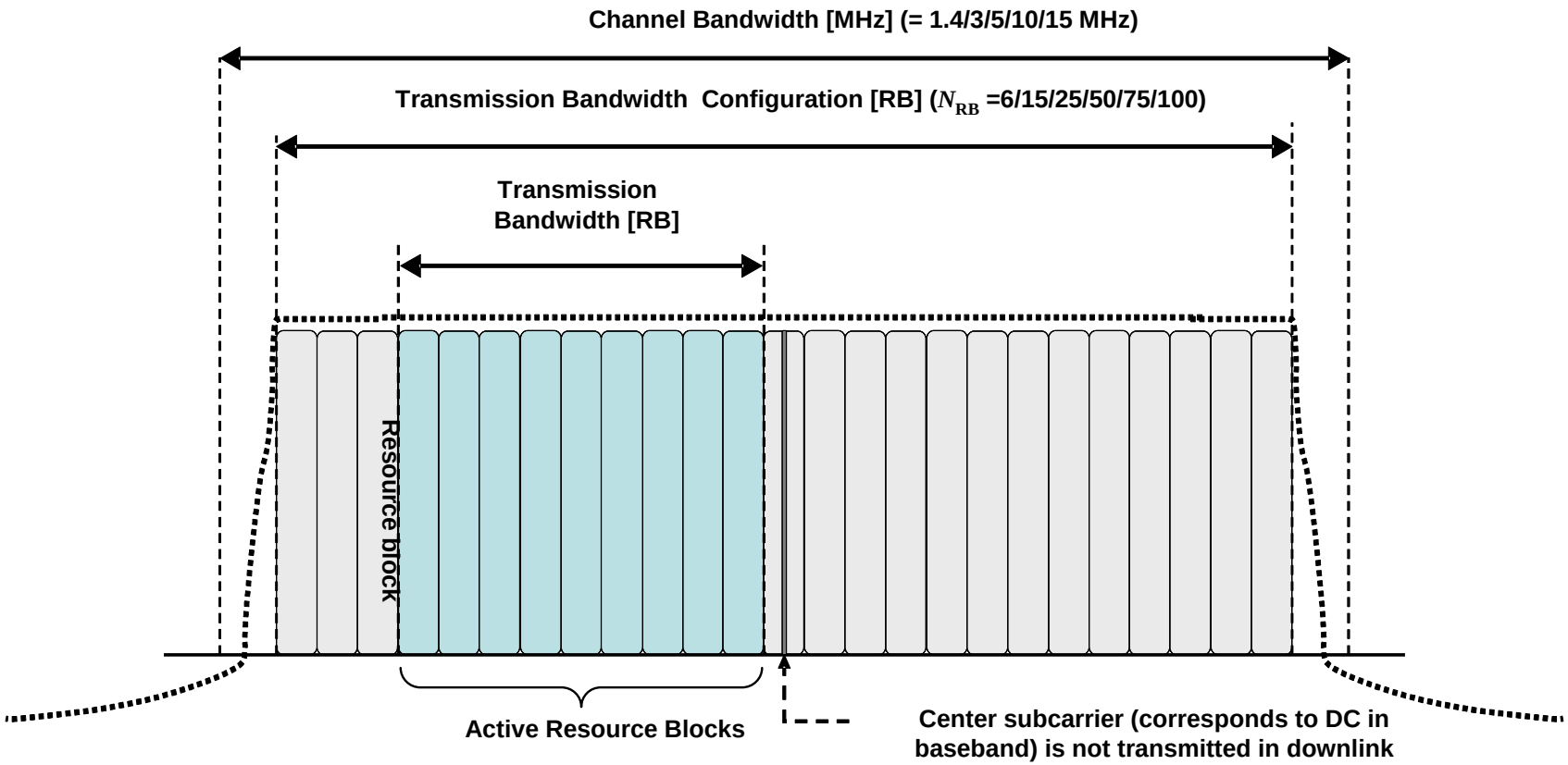
Carrier aggregation

Radio Parameters

Parameters		LTE (Rel-8)	LTE-Advanced (Rel-10)
Access Scheme	UL	DFTS-OFDM	Aggregated Component Carriers in Rel-8
	DL	OFDMA	
Bandwidth configuration		1.4, 3, 5, 10, 15, 20MHz	
Operating bands		LTE operating bands	LTE operating bands (+ possible ITU IMT bands) *
UE transmit power		BC3: 23dBm (Max)	Subset of Rel-8

*see slide #6

Channel / Transmission Bandwidth Configuration for LTE (E-UTRA)



Channel /Transmission Bandwidth Configuration for one E-UTRA carrier

Transmission bandwidth configuration in LTE (E-UTRA) channel bandwidths

Transmission bandwidth configuration N_{RB}

Channel bandwidth $BW_{Channel}$ [MHz]	1.4	3	5	10	15	20
Transmission bandwidth configuration N_{RB}	6	15	25	50	75	100

Operating bans for LTE-Advanced

Operating Band	Uplink (UL) operating band BS receive/UE transmit F_{UL_low} – F_{UL_high}	Downlink (DL) operating band BS transmit /UE receive F_{DL_low} – F_{DL_high}	Duplex Mode
1	1920 MHz – 1980 MHz	2110 MHz – 2170 MHz	FDD
2	1850 MHz – 1910 MHz	1930 MHz – 1990 MHz	FDD
3	1710 MHz – 1785 MHz	1805 MHz – 1880 MHz	FDD
4	1710 MHz – 1755 MHz	2110 MHz – 2155 MHz	FDD
5	824 MHz – 849 MHz	869 MHz – 894MHz	FDD
6	830 MHz- – 840 MHz-	865 MHz – 875 MHz-	FDD
7	2500 MHz – 2570 MHz	2620 MHz – 2690 MHz	FDD
8	880 MHz – 915 MHz	925 MHz – 960 MHz	FDD
9	1749.9 MHz – 1784.9 MHz	1844.9 MHz – 1879.9 MHz	FDD
10	1710 MHz – 1770 MHz	2110 MHz – 2170 MHz	FDD
11	1427.9 MHz – 1447.9 MHz	1475.9 MHz – 1495.9 MHz	FDD
12	698 MHz – 716 MHz	728 MHz – 746 MHz	FDD
13	777 MHz – 787 MHz	746 MHz – 756 MHz	FDD
14	788 MHz – 798 MHz	758 MHz – 768 MHz	FDD
15	Reserved	Reserved	-
16	Reserved	Reserved	-

Operating Band	Uplink (UL) operating band BS receive/UE transmit F_{UL_low} – F_{UL_high}	Downlink (DL) operating band BS transmit /UE receive F_{DL_low} – F_{DL_high}	Duplex Mode
17	704 MHz – 716 MHz	734 MHz – 746 MHz	FDD
18	815 MHz – 830 MHz	860 MHz – 875 MHz	FDD
19	830 MHz – 845 MHz	875 MHz – 890 MHz	FDD
20	832 MHz – 862 MHz	791 MHz – 821 MHz	FDD
21	1447.9 MHz – 1462.9 MHz	1495.9 MHz – 1510.9 MHz	FDD
22	3410 MHz – 3500 MHz	3510 MHz – 3600 MHz	FDD
...			
33	1900 MHz – 1920 MHz	1900 MHz – 1920 MHz	TDD
34	2010 MHz – 2025 MHz	2010 MHz – 2025 MHz	TDD
35	1850 MHz – 1910 MHz	1850 MHz – 1910 MHz	TDD
36	1930 MHz – 1990 MHz	1930 MHz – 1990 MHz	TDD
37	1910 MHz – 1930 MHz	1910 MHz – 1930 MHz	TDD
38	2570 MHz – 2620 MHz	2570 MHz – 2620 MHz	TDD
39	1880 MHz – 1920 MHz	1880 MHz – 1920 MHz	TDD
40	2300 MHz – 2400 MHz	2300 MHz – 2400 MHz	TDD
41	3400 MHz – 3600 MHz	3400 MHz – 3600 MHz	TDD

Introduction of the following other ITU-R IMT bands are not precluded in the future.

(a) Possible frequency bands in 3.4-3.8 GHz band
(b) Possible frequency bands in 3.4-3.6GHz as well as 3.6-4.2GHz
(c) Possible frequency bands in 3.4-3.6 GHz band
(d) Possible frequency bands in 450−470 MHz band,
(e) Possible frequency bands in 698−862 MHz band
(f) Possible frequency bands in 790−862 MHz ban
(g) Possible frequency bands in 2.3−2.4 GHz band
(h) Possible frequency bands in 4.4-4.99 GHz band

Deployment scenarios for initial study

The following four scenarios are being investigated for the initial study.

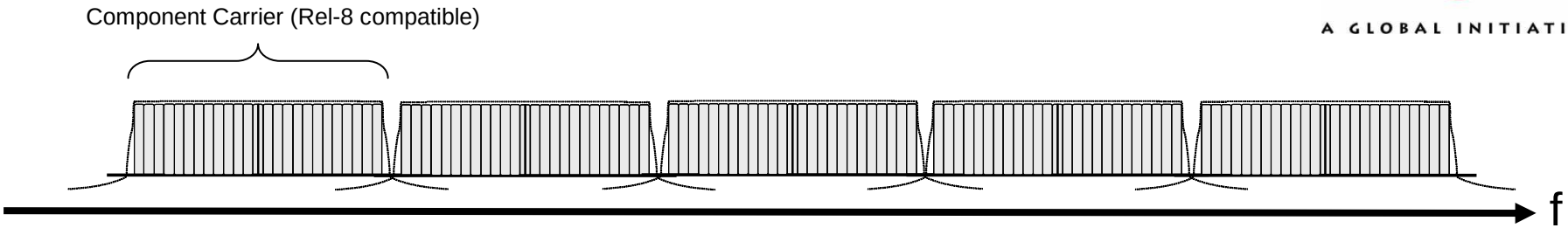
(Subset of the 12 scenarios identified as highest priority)

Scenario	Deployment scenarios
a	Single band contiguous allocation for FDD (UL:40 MHz, DL: 80 MHz)
b	Single band contiguous allocation for TDD (100 MHz)
c	Multi band non-contiguous allocation for FDD (UL:40MHz, DL:40 MHz)
d	Multi band non contiguous allocation for TDD (90 MHz)

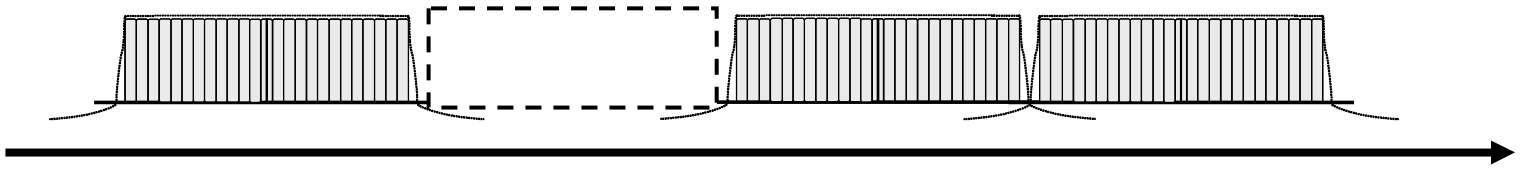
Carrier aggregation

- Support wider transmission bandwidths up to 100MHz
- Two or more *component carriers* (CC) are aggregated
- A terminal may simultaneously receive one or multiple component carriers depending on its capabilities
- Possible to aggregate a different number of component carriers of possibly different bandwidths in the UL and the DL
- In typical TDD deployments, the number of component carriers and the bandwidth of each component carrier in UL and DL will be the same.
- Both Intra and Inter band carrier aggregation are considered as potential Tx RF scenarios and parameters and cover both of; Contiguous Component Carrier and non-contiguous Component Carrier aggregation

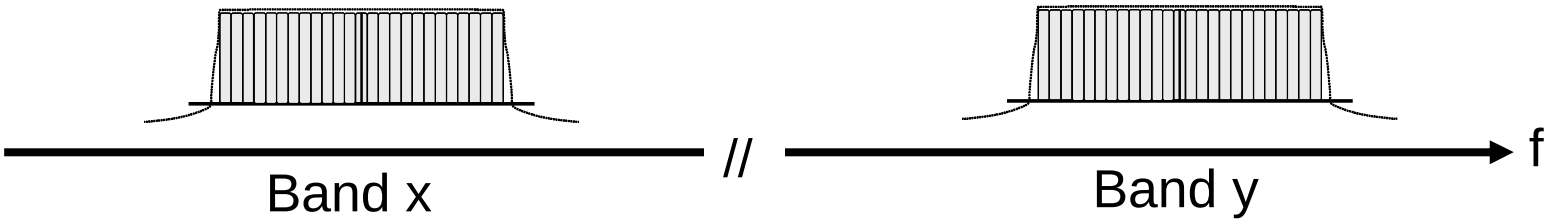
Carrier aggregation examples



Contiguous Intra-band Carrier Aggregation of five CCs (20 MHz CC x 5)



Non-contiguous Intra-band Carrier Aggregation of 3 CCs (20 MHz CC x 3)



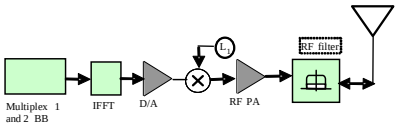
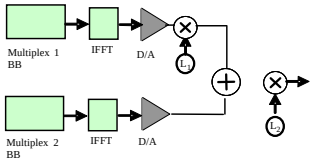
Inter-band Carrier Aggregation of 2 CCs (20 MHz CC x 2)

Feasibility studies on radio aspects

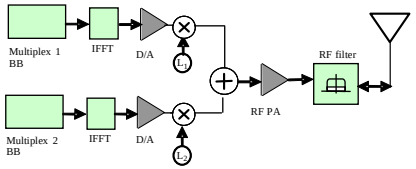
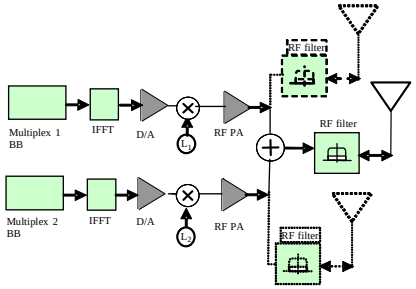
Radio Transmission and reception for UE and BS
RRM (Radio Resource Management)

Transmitter architecture models for the feasibility study (1/2)

As a basic assumption, eg. 2 Tx antenna port and 4 Rx antenna port are to be made are to be considered.

Tx Characteristics				
Option	**Description (Tx architecture)**	**Intra Band aggregation**		**Inter Band aggregation**
		Contiguous (CC)	**Non contiguous (CC)**	
A	 Single (baseband + IFFT + DAC + mixer + PA)	Yes		
B	 Multiple (baseband + IFFT + DAC), single (stage-1 IF mixer + combiner @ IF + stage-2 RF mixer + PA)	Yes	Yes	

Transmitter architecture models for the feasibility study (2/2)

Tx Characteristics				
Option	**Description (Tx architecture)**	**Intra Band aggregation**		**Inter Band CA**
		Contiguous (CC)	**Non contiguous (CC)**	
C	 Multiple (baseband + IFFT + DAC + mixer), low-power combiner @ RF, and Single PA	Yes	Yes	
D	 Multiple (baseband + IFFT + DAC + mixer + PA), high-power combiner to single antenna or Dual antenna	Yes	Yes	Yes + (depending on the specific EUTRA bands being aggregated)
X	OTHERS			

LTE-A UE transmitters

- Transmit power:
  - UE power class should be a subset of EUTR (LTE, Rel-8).
- Output power dynamics:
  - To be defined considering impact of PA architecture and carrier aggregation scenarios.
- Transmit signal quality
  - EVM (Error Vector Magnitude) to be defined.
- Output RF spectrum emissions
  - Spectrum emission mask scales in proportion to the channel bandwidth.

UE receiver architecture models for the feasibility studies

Rx Characteristics				
Option	Description (Rx architecture)	Intra Band aggregation		Inter Band aggregation
		Contiguous (CC)	Non contiguous (CC)	Non contiguous (CC)
A	Single (RF + FFT + baseband) with BW>20MHz	Yes		
B	Multiple (RF + FFT + baseband) with BW≤20MHz	Yes	Yes	Yes

LTE-Advanced UE receivers

The following aspects to be defined considering the CA scenarios, bandwidth of the Tx/Rx signals as well as multiple antenna effects.

- Receiver Sensitivity
- Selectivity
- Blocking performance
- Spurious response
- Intermodulation performance
- Spurious emission

LTE-Advanced
BS transmissions and receptions

Several aspects are to be considered when setting the requirements:

- Base station classes (Wide area, medium, pico or home node BS and relay node)
- Uplink single-user spatial multiplexing
- Local and regional regulatory requirements

- Transmitter aspects:
  - Base Station output power
  - Transmitted signal quality
  - Unwanted emissions
  - Transmitter spurious emissions
- Receiver aspects:
  - Reference sensitivity level
  - Adjacent Channel Selectivity (ACS)
  - Narrow-band blocking, Blocking
  - Receiver intermodulation
  - Demodulation Performance requirements

LTE-Advanced Radio Resource Management

- As already in LTE Rel-8 and also in LTE-Advanced *robust general minimum RRM requirements* ensure good mobility performance across the cellular network for various mobile speeds and different network deployments.
- The minimum RRM requirements are defined both in idle mode and in active mode.
- In Active mode the requirements are defined both without DRX and with DRX in order to ensure that good mobility performance in all cases while still minimising UE battery consumption especially with long DRX cycles.
- Different network controlled parameter values for cell reselection in idle mode and for handover in active mode can be utilised for optimising mobility performance in different scenarios, which also include low mobility and high mobility scenarios.

Conclusion

Spectrum capability requirements and other necessary aspects

FDD RIT component of SRIT "LTE Release 10 & beyond (LTE-Advanced)"
TDD RIT component of SRIT "LTE Release 10 & beyond (LTE-Advanced)"

4.2.4.2.1	**Spectrum bands** Is the proposal able to utilize at least one band identified for IMT?: ☑YES / ☐NO Specify in which band(s) the candidate RIT or candidate SRIT can be deployed.

3GPP LTE Release 10 & beyond (LTE-Advanced) technology satisfies the requirement on supported spectrum bands above,
and meets all the radio aspects required as an RIT for IMT-Advanced.

References

- 3GPP TS36.912 “Feasibility study for Further Advancements for E-UTRA (LTE-Advanced)”.
- 3GPP TS 36.101: "User Equipment (UE) radio transmission and reception".
- 3GPP TS 36.104: "Base Station (BS) radio transmission and reception".

http://www.3gpp.org/ftp/Specs/html-info/36-series.htm

Thank you for your attention.