3GPP TSG RAN WG1 Meeting #54bis
Prague, Czech, Sept. 29 – Oct. 3, 2008

R1-083565

DL Carrier Aggregation in LTE-A

Agenda Item: 11

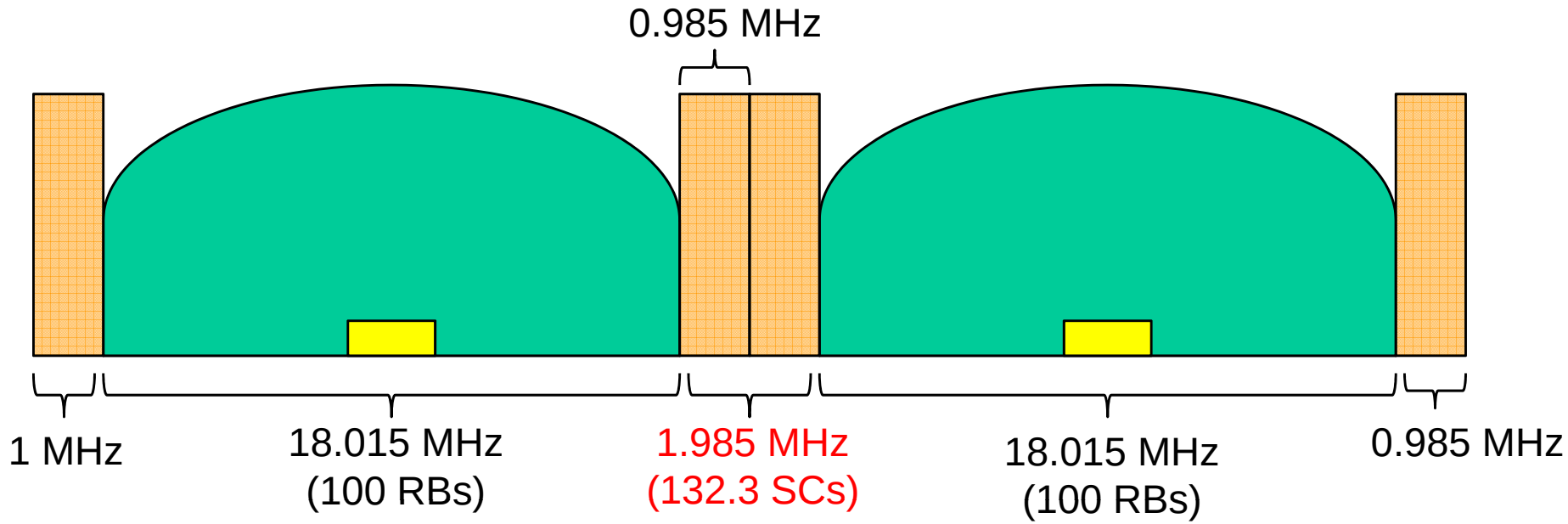
Source: Samsung

Document for: Discussion and decision

Introduction

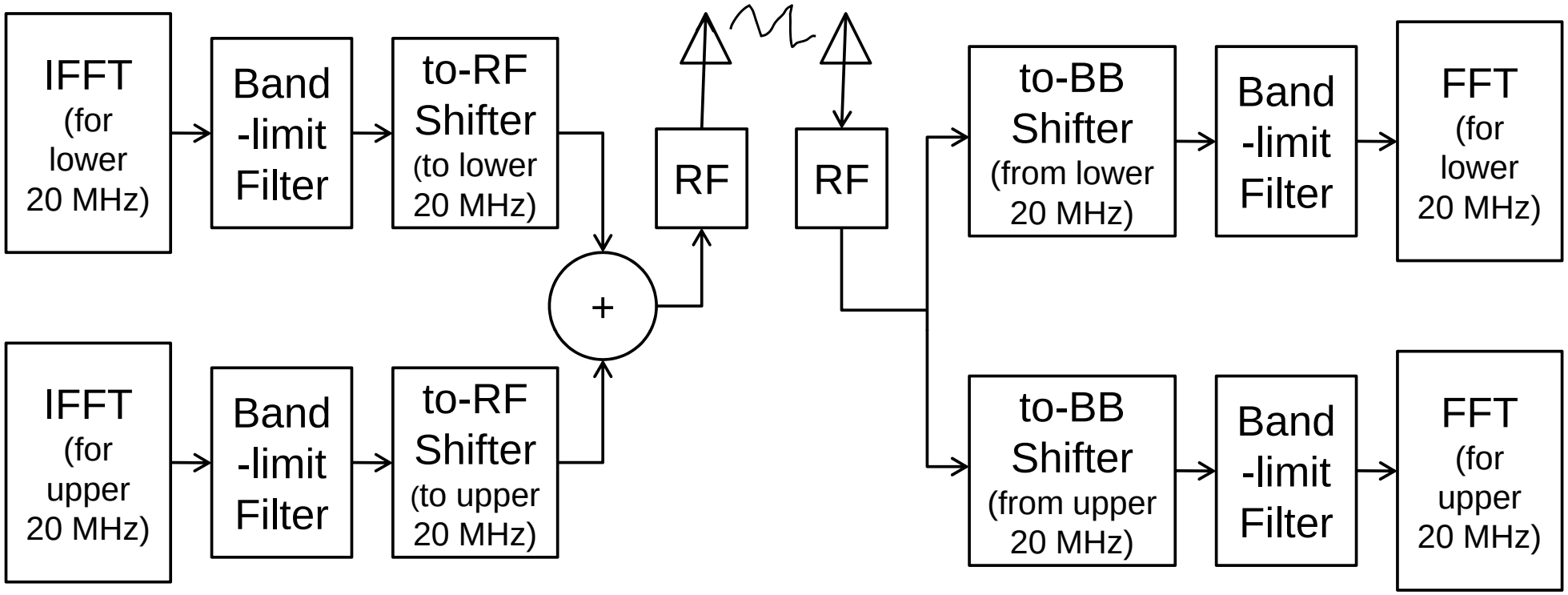
- **Decision in RAN1#53b in Warsaw meeting**
  - Extended BW (>20MHz)
    - For DL: consider carrier aggregation in our further work
- **Consideration issues**
  - Minimization of standardization efforts
  - Minimization of impacts on L1 specifications
  - Frequency raster condition: multiple of 100 kHz
  - Support of initial access to any chunk by LTE UEs
  - Impact on implementation complexity for transmitter/receiver

Design for 40 MHz BW: Alternative 1

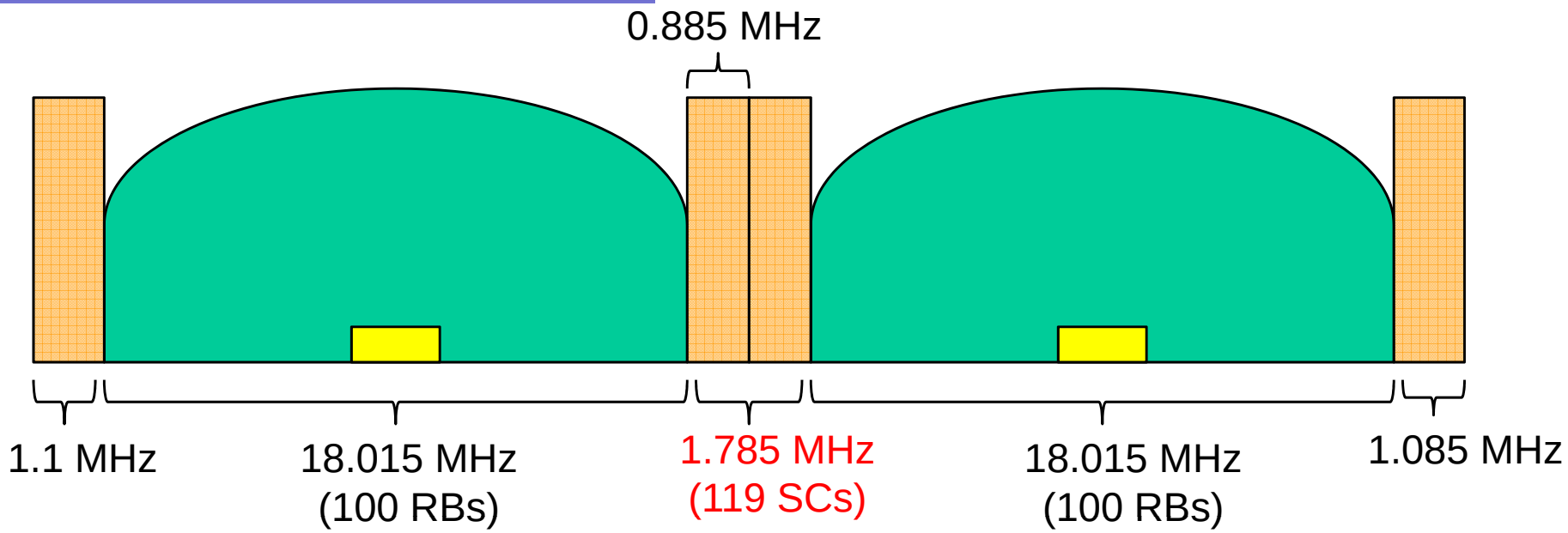


- **Straightforward extension of LTE BW cases to LTE-A band**
  - **A guardband without any DL signal exists between the chunks**
- **Both SCHs can be placed on frequency raster with 20 MHz separation**
- **Two 20 MHz IFFTs are needed in the eNB transmitter, since the guardband BW is not a multiple of subcarrier spacing (15 kHz)**
- **FFS if wideband RF filter with 1 MHz transition band is implementable**

TX / RX Block Diagram for Alternative 1

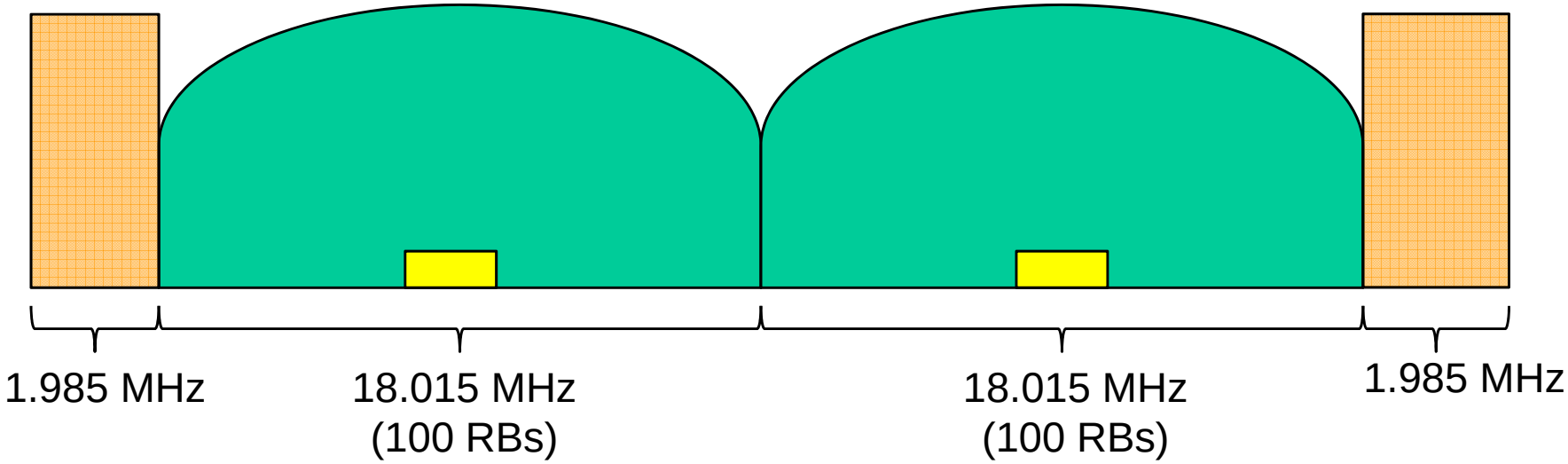


Design for 40 MHz BW: Alternative 2



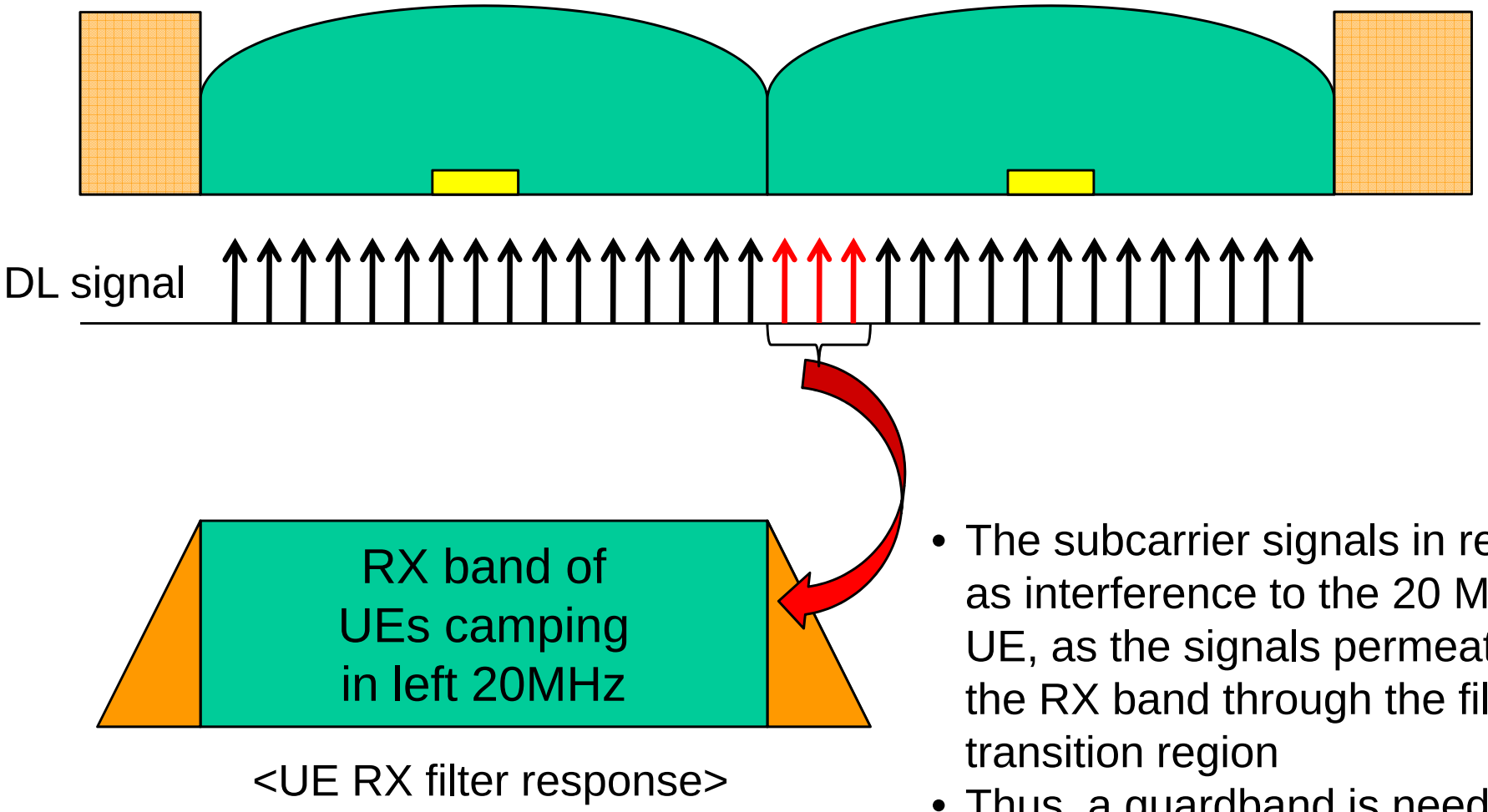
- **A single IFFT of 40 MHz BW in the eNB transmitter is sufficient, as the guardband in the middle consists of an integer number of subcarriers**
- **Also, both SCHs can be placed on the frequency raster**
- **The guardband in the middle is needed so that LTE UEs do not get interference from DL signals sent in the neighboring chunk**
  - **The guardband for LTE UEs does not sacrifice spectrum efficiency**
  - **Allocation of 119 SCs for the guardband is for illustration purpose**
    - **The exact size is what RAN WG4 would decide**

Design for 40 MHz BW: Alternative 3



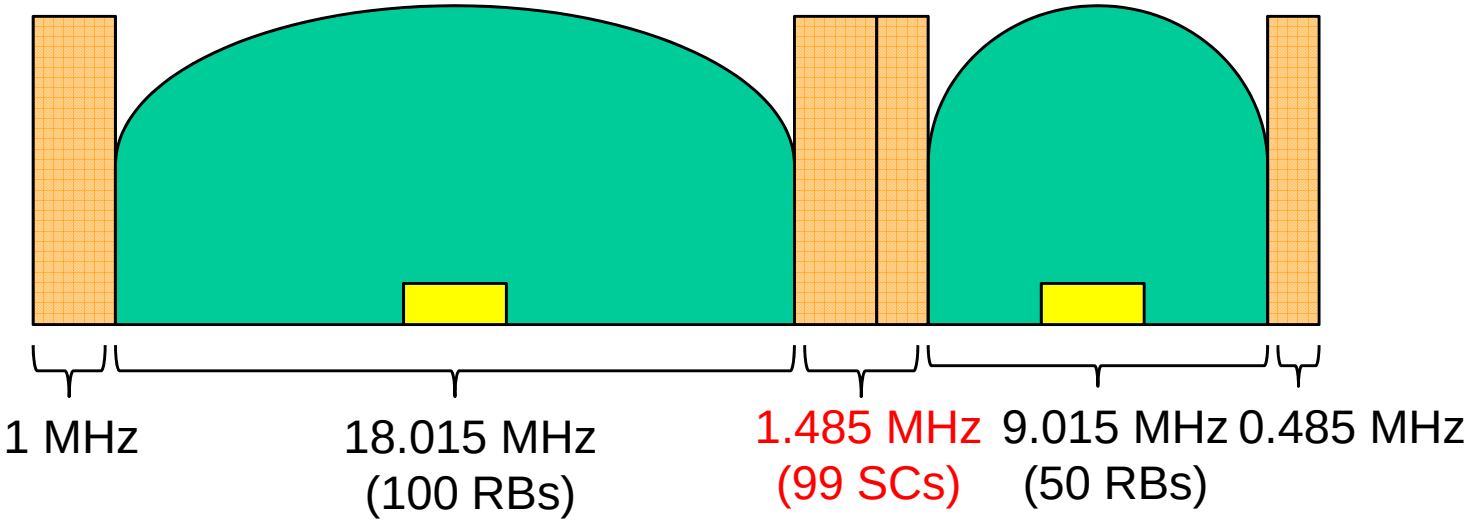
- **There is no guardband between the chunks**
  - **But, spectrum efficiency is the same as the other alternatives**
- **A single IFFT of 40 MHz BW in the eNB transmitter is sufficient**
- **But, not both SCHs can be on the frequency raster**
  - **as the separation is 18.015 MHz, not a multiple of 100 kHz**
- **LTE UEs camping in a 20 MHz chunk get interference due to DL signals sent in another chunk**

Neighbor Component Carrier Interference



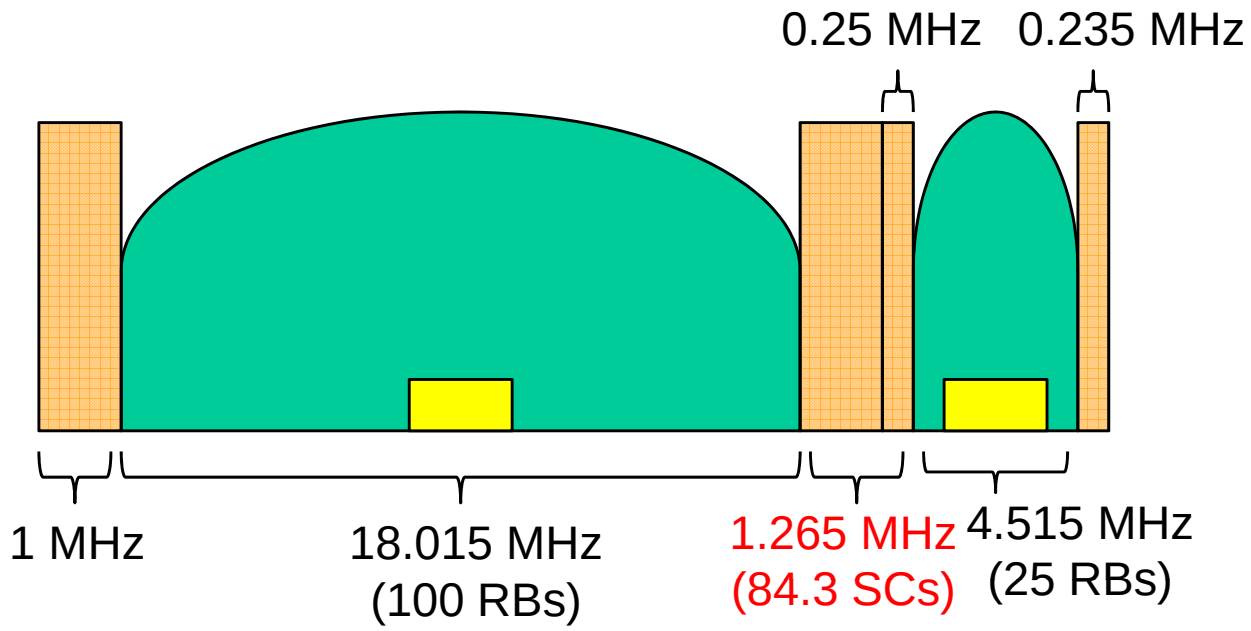
- The subcarrier signals in red acts as interference to the 20 MHz UE, as the signals permeate into the RX band through the filter transition region
- Thus, a guardband is needed between neighboring carriers

Design for 30 MHz BW



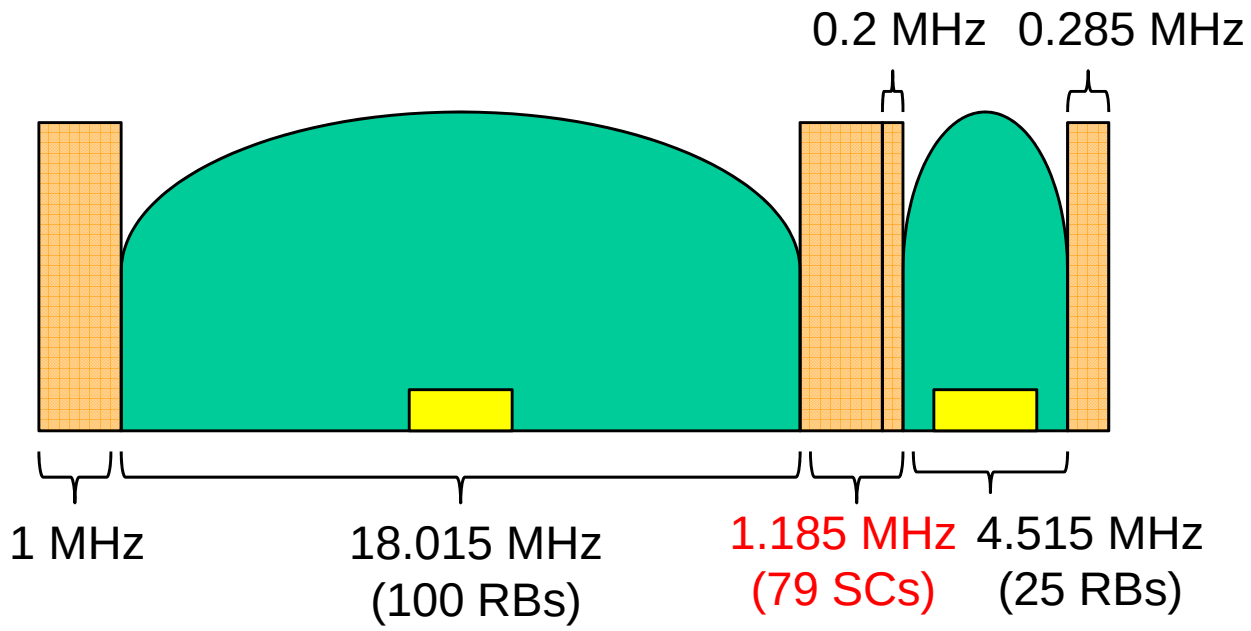
- **Equivalent to Alternative 1 of the 40 MHz case**
- **Straightforward extension of LTE BW cases to LTE-A band**
- **Both SCHs can be on the frequency raster**
- **A single IFFT of 30 MHz BW in the eNB transmitter is sufficient, thanks to an integer number of subcarriers in the middle guardband**

Design for 25 MHz BW: Alternative 1



- **Equivalent to Alternative 1 of the 40 MHz case**
- **Straightforward extension of LTE BW cases to LTE-A band**
- **Both SCHs can be on the frequency raster**
- **Multiple IFFTs are needed in the eNB transmitter**

Design for 25 MHz BW: Alternative 2



- **A single IFFT in the eNB transmitter is sufficient, due to the adjustment of the middle guardband width**
- **Not both SCHs can be placed on the frequency raster**

Alternative 1 vs. Other Alternatives (continued)

- **Merits**
  - Straightforward aggregation of LTE-numerology bands
    - Equivalent to the case that multiple LTE cells are contiguously deployed in a wide band
  - Easily extendible to other cases of various LTE BW combinations, leading to less standardization efforts
  - Impact on L1 specifications is minimized
- **Drawbacks**
  - Multiple IFFTs corresponding to the number of chunks are needed in the eNB transmitter
  - Accordingly, UEs will need multiple FFTs in the receiver
  - It may not be easy to implement corresponding RF filters with small edge guardbands compared to the bandwidth

Alternative 1 vs. Other Alternatives

- **Cell search**
  - Alternative 1 guarantees that all SCHs are placed on the frequency raster so that LTE UEs can camp in any of the chunks
  - Alternative 2 can also guarantee this by appropriate adjustment of the middle guardband size
- **Measurement for LTE cells**
  - Alternative 1 can support intra-frequency measurement for the cases that neighboring cells consist of multiple LTE carriers
    - E.g., Alternative 1 is identical to a natural LTE configuration for the cases that an LTE system with 40 MHz BW spectrum configures two 20 MHz LTE cells

Non-contiguous Carrier Aggregation

- **In L1 perspective, impact on standardization seems the same as the contiguous case**
- **Key differences from the contiguous case are:**
  - Multiple RF blocks corresponding to the number of non-contiguous chunks would be required
- **It is not clear whether LTE-A should support the non-contiguous carrier aggregation**
  - We can define a high capability UE class which can support the non-contiguous case
  - But, needs for these UEs in the market is not certain

Conclusion

- **Alternative 1 is slightly preferred**
  - A wide (>20 MHz) LTE-A band is constructed by aggregating carriers in compliance with the LTE numerology
  - E.g., a 50 MHz contiguous LTE-A band consists of two 20 MHz chunk and a 10 MHz chunk
  - Each chunk has guardbands at both edges based on the LTE numerology
- **But, it looks worth further investigating on Alternative 2**
  - It enables single IFFT / FFT implementations in the eNB / UE