

Agenda Item: 4.1

Source: Samsung

Title: XDD (cross-division duplex) for enhanced duplexing operation in 5G Advanced

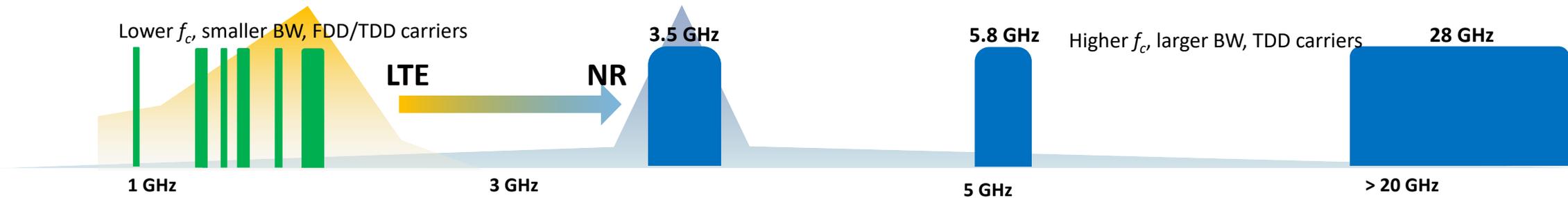
Document for: Discussion and Decision

- ◇ Motivation
- ◇ XDD (cross division duplex) concept
- ◇ Comparison with conventional duplexing schemes
- ◇ Interference handling
- ◇ Plans for Rel-18

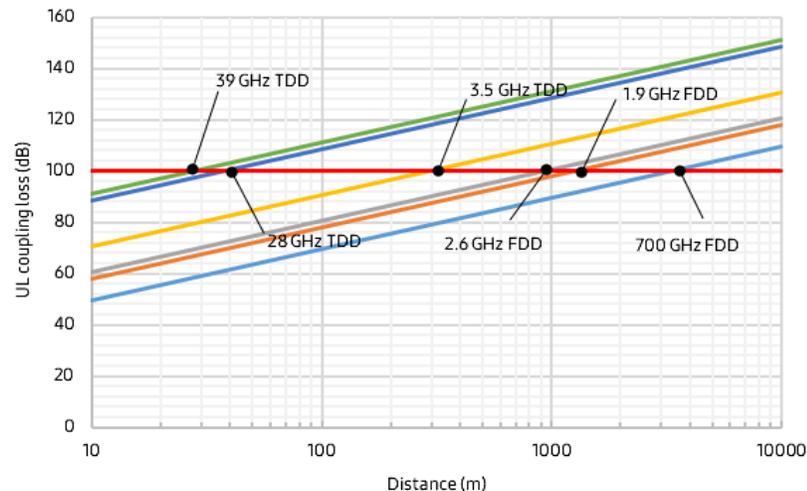
Motivation

- ◇ NR deployments use large bandwidths in mid- and high band to achieve high data rates and low latency
 - ◆ At the cost of a larger path loss due to higher carrier frequency (FSPL increases by 6dB for every doubling of f_c)

FSPL: Free Space Path Loss



- ◇ NR carriers >3 GHz are all TDD which is suitable for asymmetric DL – UL traffic such as video streaming
 - ◆ At the cost of a coverage imbalance between DL and UL due to often DL-dominant time resource allocations



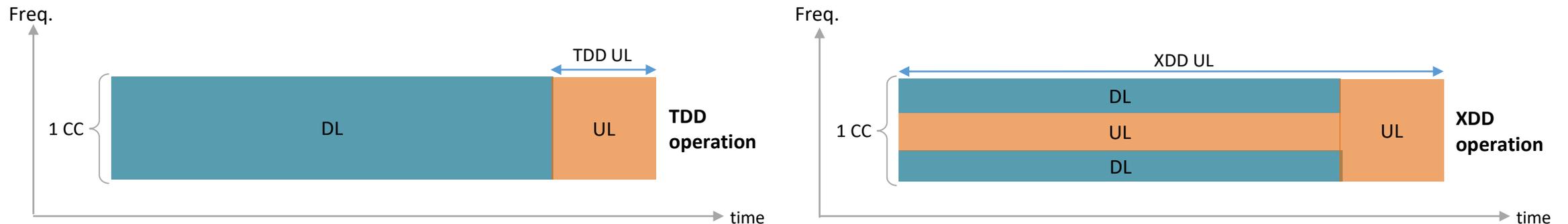
From FSPL perspective, a TDD cell on 3.5 GHz has an UL coverage area that is 10% of an FDD cell on 2 GHz

➔ 10 cells on 3.5 GHz needed to replace a cell on 2 GHz

- Efficient use of spectrum in mid and high frequency bands is a must
- Existing TDD short-comings such as more limited UL coverage and higher latency compared to FDD can be improved upon

XDD Concept

- ◆ **XDD (cross division duplex)** is an advanced duplexing scheme that enables simultaneous downlink/uplink operation within a TDD carrier (FR1) or among adjacent carriers (FR2)
 - ◆ Simultaneous TX/RX operation at gNB using non-overlapping frequency resources (“sub-bands”)
 - ◆ Extends the duration over which UL TX can occur to improve UL coverage/capacity and latency performance
 - ◆ Backwards compatible such that legacy TDD UEs and XDD UEs can coexist within the same carrier
 - ◆ Self-interference suppression/cancellation is used at gNB to handle high level of TX (DL) interference on RX (UL)
 - ◆ At a given time resource, a UE can receive DL or transmit UL but not both



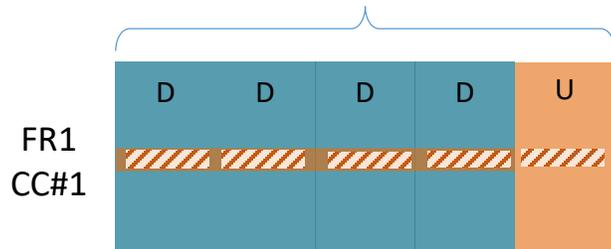
XDD Target Scenarios/Applications/Benefits

- ◇ Main target spectrum: TDD carriers in FR1 (e.g., 3.5 GHz) and FR2 (e.g., 28/39 GHz)
 - ◆ For FR1: intra-carrier XDD (XDD is operated within a single carrier)
 - ◆ For FR2: inter-carrier XDD (XDD is operated across multiple carriers)



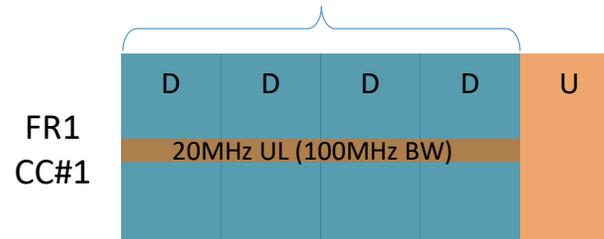
- ◆ Benefits: Coverage extension, uplink capacity enhancement, and latency reduction for TDD

UE can transmit 400% more energy than conventional TDD



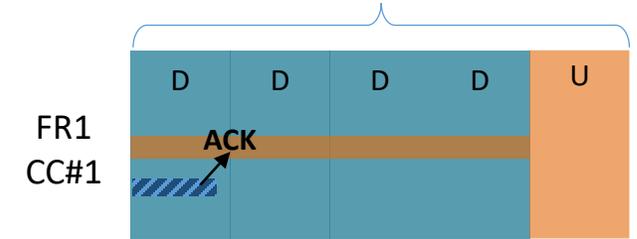
Improved UL coverage due to higher UL duty cycle

More UL resources



Improved system capacity

UL resource is available on all slots



Reduced access and user plane latency

Comparison with other duplexing schemes

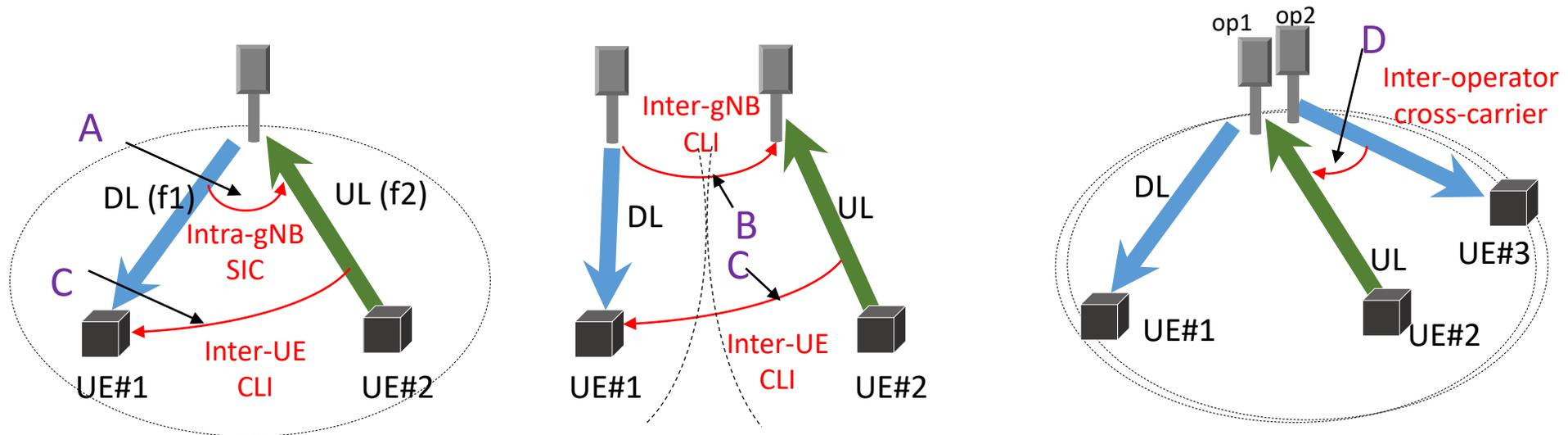
- ◇ Compared to conventional TDD, XDD offers better coverage, capacity, and latency performance
- ◇ Compared to other well known advanced duplexing schemes, XDD is more feasible for actual deployment

	XDD	Dynamic TDD	FD
Self interference handling	Feasible (can use antenna/frequency/digital domain isolation and cancellation)	Not needed	Feasible - but more complex than XDD (can use antenna/digital domain isolation and cancellation)
Cross link interference handling	Feasible (since UL and DL can use non-overlapping frequency resources)	Challenging (since UL and DL can use overlapping frequency resources)	Challenging (since UL and DL can use overlapping frequency resources)
Cross-operator interference handling	Feasible (e.g. UL subband can be placed in middle of BW so that DL subband acts as a guardband)	Challenging (Operator A has no control or access to the interference from Operator B)	Challenging (Operator A has no control or access to the interference from Operator B)

- ◆ Dynamic TDD may be applicable only for isolated cell scenarios but not for the general access link usage
- ◆ Full duplex offers similar or better benefits than XDD but there is no practical solution to handle cross-operator interference
- ◆ XDD is more practical in terms of handling relevant interferences in an access link environment

Interference handling for XDD

- ◇ Interference scenarios applicable for XDD that should be carefully evaluated as part of Rel-18 study
 - A. Intra-gNB self interference (new with XDD)
 - B. Inter-gNB cross-link interference (similar to dynamic TDD)
 - C. Inter-UE cross-link interference (similar to dynamic TDD)
 - D. Inter-operator adjacent carrier interference (similar to conventional TDD)



- ◇ Specification support for XDD should focus on providing means to accurately measure XDD relevant interferences and avoid performance degradation due to such interference

- ◇ Among the number of different advanced duplexing scheme, we think that XDD offers the best combination of benefit and feasibility
 - ➔ Study and specify XDD within Rel-18 time frame

- ◇ Compared to XDD, full duplex (using overlapping DL-UL frequency resources) offers more benefit but is more challenging (e.g. due to cross operator interference handling)
 - ➔ Full duplex to be studied and if deemed feasible, consider for Rel-19 specification

- ◇ Proposed scope for XDD in Rel-18
 - ◆ Identify applicable and relevant deployment scenarios and use cases for XDD
 - ◆ Summarize regulatory status when deploying XDD in TDD bands
 - ◆ Evaluate XDD system-level performance & methodology (RAN1)
 - ◆ Evaluate RF coexistence, impacts & constraints, feasibility of self-interference scenarios (RAN4)
 - ◆ Study enhancements to interference handling in presence of XDD operation