vivo

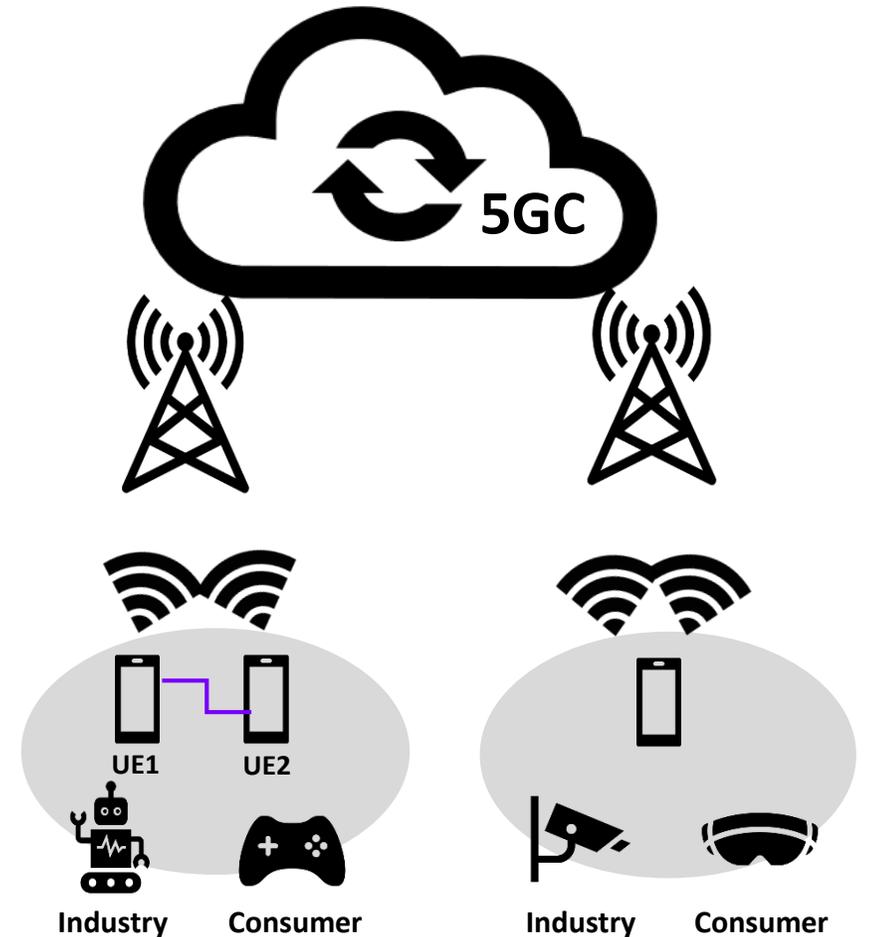**Study on UE Aggregation for Industry with Multi-connectivity**

2021.6

# UE Aggregation for Industry with Multi-connectivity
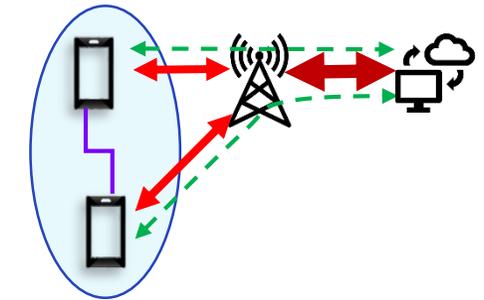
## Motivation

- Requirements and scenarios:

  - **Bottleneck of UL UE transmission** due to shortage of UL UE transmission power, while two or more UEs (physically or logically) in hand are more and more popular

  - **Improve UL/DL capability/reliability** for consumer scenarios (e.g. AR/VR) and industry scenarios

- Summary for RAN R18 workshop

  - Quite a few papers proposed to study UE aggregation for coverage and throughput such as RWS-210172(vivo), RWS-210355(CMCC), RWS-210451(Huawei), RWS-210479(ZTE), RWS-210422(interdigital), RWS-210192(FGI), RWS-210199(Rakuten)

  - It is suggested by RAN to also investigate this area from SA2 perspective such as architecture enhancement, UE grouping, charging and security.

  - **UL aggregation is most interesting part in RAN WG for UE aggregation**
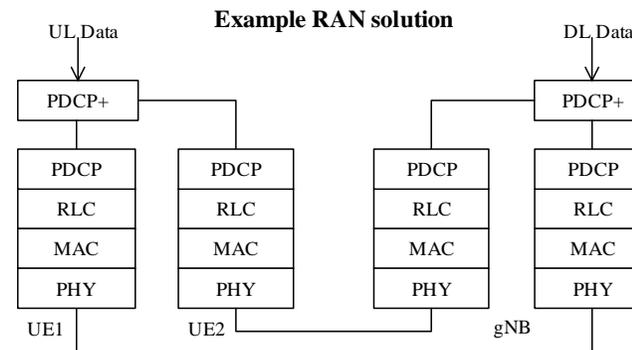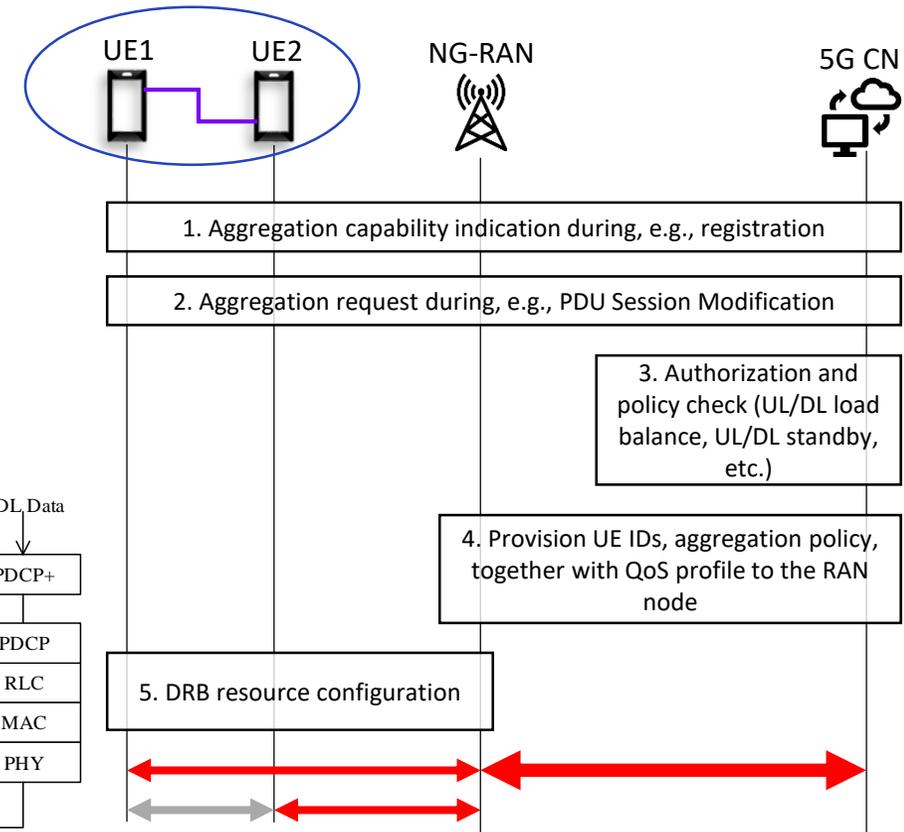
# UE Aggregation for Industry with Multi-connectivity

## SA study point for RAN based solution

- **Characteristics of the study**

  - UEs **with 3GPP defined aggregation layer, e.g., PDCP+**, integrated in a device or connected via direct link (e.g., WIFI, Bluetooth, wireline)

  - All UEs camp on same RAN node (but do not define interaction between UEs)

- **Benefit**

  - Minimal packet retransmission via another connection when one connection fails

- **Objectives**

  - How to provision group information and policy for UE aggregation to RAN, e.g., load balance, standby, etc.

  - How to support mobility in group

  - How to handle RAN report of connection failure for fast switch

High level concept of RAN based UE aggregation for an QoS Flow

**Example RAN solution**

UL Data → PDCP+

DL Data → PDCP+

| PDCP | PDCP | PDCP | PDCP |
| RLC | RLC | RLC | RLC |
| MAC | MAC | MAC | MAC |
| PHY | PHY | PHY | PHY |

UE1    UE2    gNB

UE1    UE2    NG-RAN    5G CN

1. Aggregation capability indication during, e.g., registration

2. Aggregation request during, e.g., PDU Session Modification

3. Authorization and policy check (UL/DL load balance, UL/DL standby, etc.)

4. Provision UE IDs, aggregation policy, together with QoS profile to the RAN node
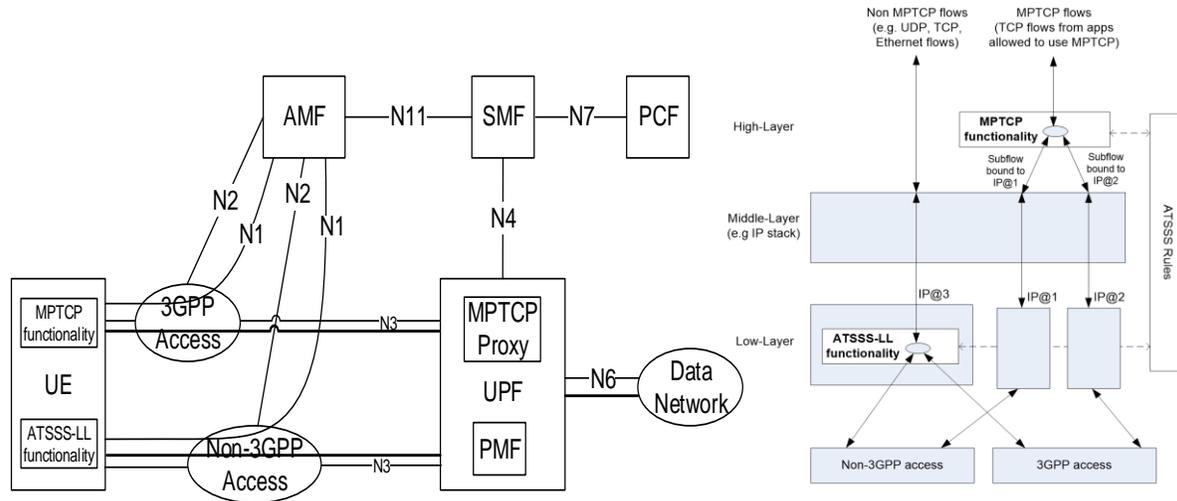
5. DRB resource configuration

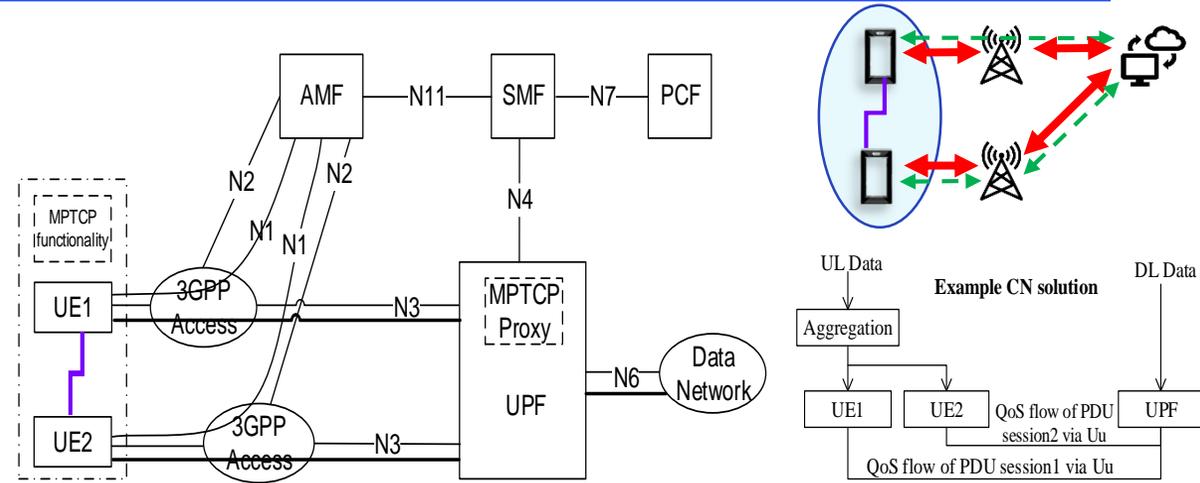# UE Aggregation for Industry with Multi-connectivity

## CN based solution

### R17 ATSSS Summary



1. **Single UE** with both 3GPP and non-3GPP registration;
2. Multi-path based on **single UE's MA PDU session** with **user planes on 3GPP access or non-3GPP access or both**;
3. Traffic routing, splitting or switching based on MPTCP or ATSSS-LL functionality

### UE Aggregation on High-Layer



**Requirement :**

1. **Two UEs** integrated in a device or connected via direct link (e.g., WIFI, Bluetooth, wireline) ;
2. Multi-path based on **two UE's PDU sessions** with **user planes both on 3GPP access** controlled by the same SMF/UPF;
3. UE aggregation layer on High-Layer (e.g. based on MPTCP);

**Objectives:**

1. How to anchor aggregated PDU sessions of UEs to same SMF/UPF;
2. Policy enhancement  for UE aggregation provided to UE and UPF, e.g., load balance, standby, etc.
3. How to handle RAN report of connection failure for fast switch
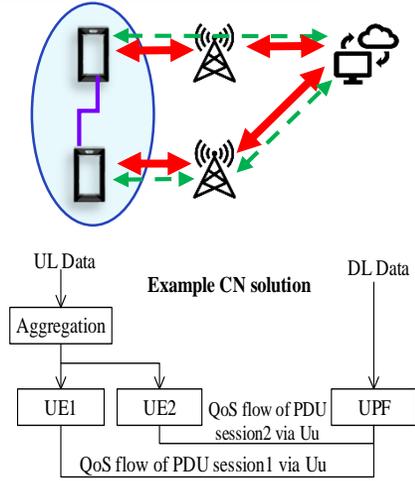
# UE Aggregation for Industry with Multi-connectivity

## Motivation of fast switch

- **Requirement and scenarios**

  - **Summary for RAN R18 workshop:** RWS-210172(vivo), RWS-210060 (Spreadtrum), RWS-210345(CMCC), RWS-210346(CMCC), RWS-210454(Huawei), RWS-210229(LG), RWS-210422(interdigital), RWS-210479(ZTE)

  - **Ultra fast switch with resource efficiency**, i.e., do not duplicate air resources for good condition in most time, and ultra fast switch from UE1 to UE2 in case of UE1 failure or connection of UE1 failure
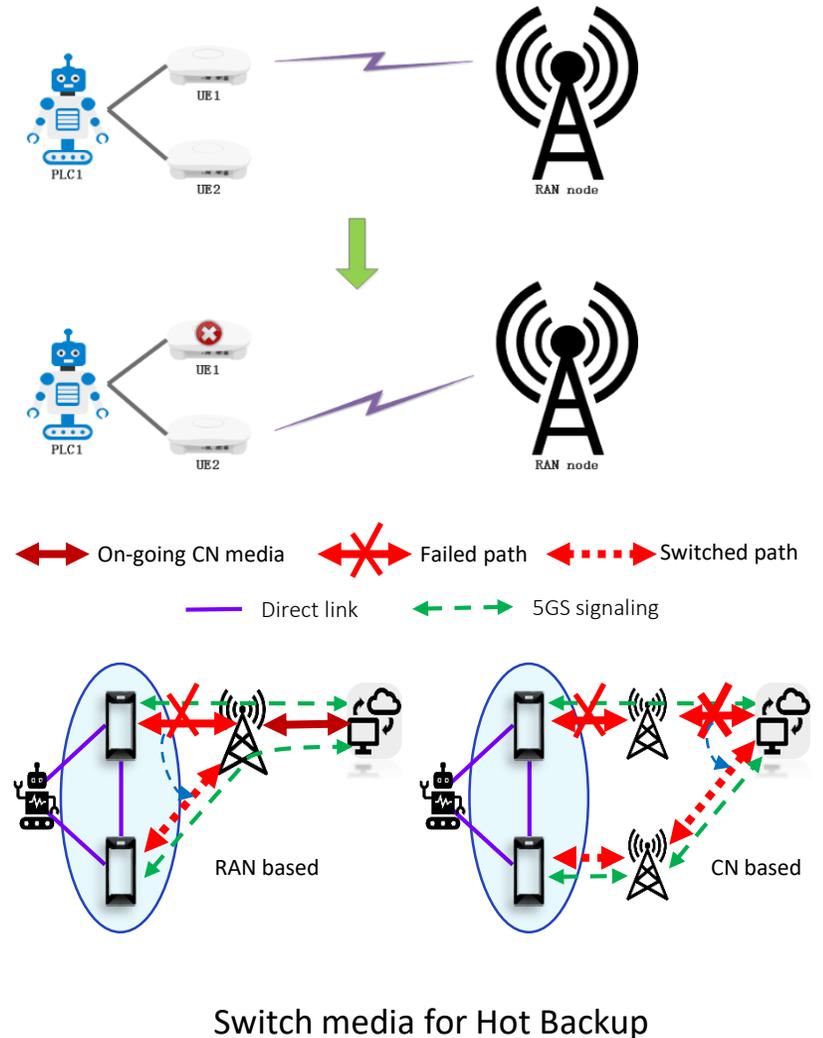
- **Drawback of application layer solutions**

  - Application level switch, including IMS IUT and MPTCP, **can't meet ultra fast switch due to lack of radio condition awareness**, hence cannot meet stringent requirement (e.g., less than 50ms) of the minimal UP interruption and rapid completion of data forwarding between terminals

  - MPTCP is based on TCP, not all services are based on TCP, and **the switch is based on application layer path failure awareness**

- **Solution consideration**

  - Solution(s) defined for UE aggregation can be enhanced to support fast switch, e.g., cf. page 5/6



On-going CN media  Failed path  Switched path
Direct link  5GS signaling

RAN based          CN based

Switch media for Hot Backup

# UE Aggregation for Industry with Multi-connectivity

## Potential objectives

- **RAN based solution**

  - How to provision group information and policy for UE aggregation to RAN, e.g., load balance, standby, etc.

  - How to support mobility in group

  - How to handle RAN report of connection failure for fast switch

- **CN based solution**

  - How to anchor aggregated PDU sessions of UEs to same SMF/UPF;

  - Policy enhancement  for UE aggregation provided to UE and UPF, e.g., load balance, standby, etc.

  - How to handle RAN report of connection failure for fast switch

- **Common aspects**

  - Group Management: study the potential enhancement for 5GC to manage group with multiple UEs for a task

  - Study the possible coordination with other SA WGs for, e.g., charging, security

  - Coordination with RAN WGs for assisting RAN solutions

# UE Aggregation for Industry with Multi-connectivity

vivo

## Timeline of the study

- Expect to start with other Rel-18 studies

  - **6 TUs for study phase**

- Send to SA plenary for information in **SA#96 June 2022**

- Send to SA for approval in **SA#97 Sept. 2022**