Split Options for 5G Radio Access Networks

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Introduction
Two splits envisioned in the 5G RAN

- Control-Plane / User-Plane Split
- "CU/DU"-Split (Central and Distributed Units)
Central and Distributed Units
Central and Distributed Units

- Centralization of parts of the processing in a central unit
- Motivation: Simplified implementation of interference coordination, multi-connectivity, traffic-steering, ...
- Several options to split the protocol stack, each with different demand on the underlying interface (xHaul)
- Flexibility to implement centralization in different deployments

![Split Options in the Protocol Stack Diagram](image_url)
Examples for data rate requirements on the xHaul interface

### Potential 5G Air Interfaces

- **LTE 20 MHz**
- **5G AIV (< 6 GHz / 100 MHz)**
- **5G AIV (> 6 GHz / 400 MHz)**

### 3GPP Split Option

- **2 antenna ports / 2 layers**
- **4 antenna ports / 4 layers**
- **8 antenna ports / 8 layers**
Control-Plane / User-Plane Split
Control-Plane / User-Plane Split

- Categorize network functions into Control-Plane (CP) and User-Plane (UP) functions
- Define standardized interfaces for interaction between CP and UP

<table>
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<tr>
<th>Pros</th>
<th>Cons</th>
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<td>› Consistent control over network elements from different vendors</td>
<td>› Tight coupling of CP / UP → Full separation might be complex</td>
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<td>› Avoid replacement of UP in case CP is modified</td>
<td>› Standardization for all interfaces is required</td>
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<td>› More flexible network</td>
<td>› Additional effort in terms of testing</td>
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Interactions between CP and UP

1: DL Buffer Status
2: Payload Selection
3: Payload Selection, DL Resource Assignment, UL Grants
4: Retransmission Control
5: Broadcast Channel Information
6: Coding Scheme
7: Antenna Mapping, Precoder, Modulation Scheme
8: Reference Symbols, Synchronization Channels
9: Antenna Weights
10: Channel State Information (from UL Sounding)
11: Channel State Information (CQI Reporting), UL Scheduling Request
12: HARQ Status
Overall Network Architecture
Forwarding of data in the transport network through based on SDN
  - Implements CP/UP split

Central Access Controller (CAC) is the centralized network element in Radio Access Network
  - Separated into CP and UP part

xHaul-Interface to the radio sites
  - Flexible adaptation depending on the network deployment
Use Case: Multi-Connectivity

- Multi-Connectivity is important in 5G, especially for:
  - mmWave Radio
  - Ultra-Reliable Communication

- Figure shows potential implementation based on CU / DU split option 2

- Additional CP functions for:
  - Traffic Steering (Multi-Cell / Multi-AIV Resource Mapping)
  - Quality of Service
  - Network Slicing

Central Unit (CU)

Distributed Unit (DU)

Downlink User Plane

Uplink User Plane

Central Unit (CU)

Distributed Unit (DU)
Summary and Conclusions
Two split options under discussion for 5G
- Central and distributed unit ("CU/DU split")
- Control-Plane / User-Plane split

CU/DU split
- Important for multi-connectivity, interference coordination, traffic-steering
- Split at lower layers can lead to extremely high data rates on the interface

Control-Plane / User-Plane split
- Important for flexible future networks and consistent control functions
- Tight coupling in the RAN make full separation complex
Thank You
https://metis-ii.5g-ppp.eu/