



NR Architecture

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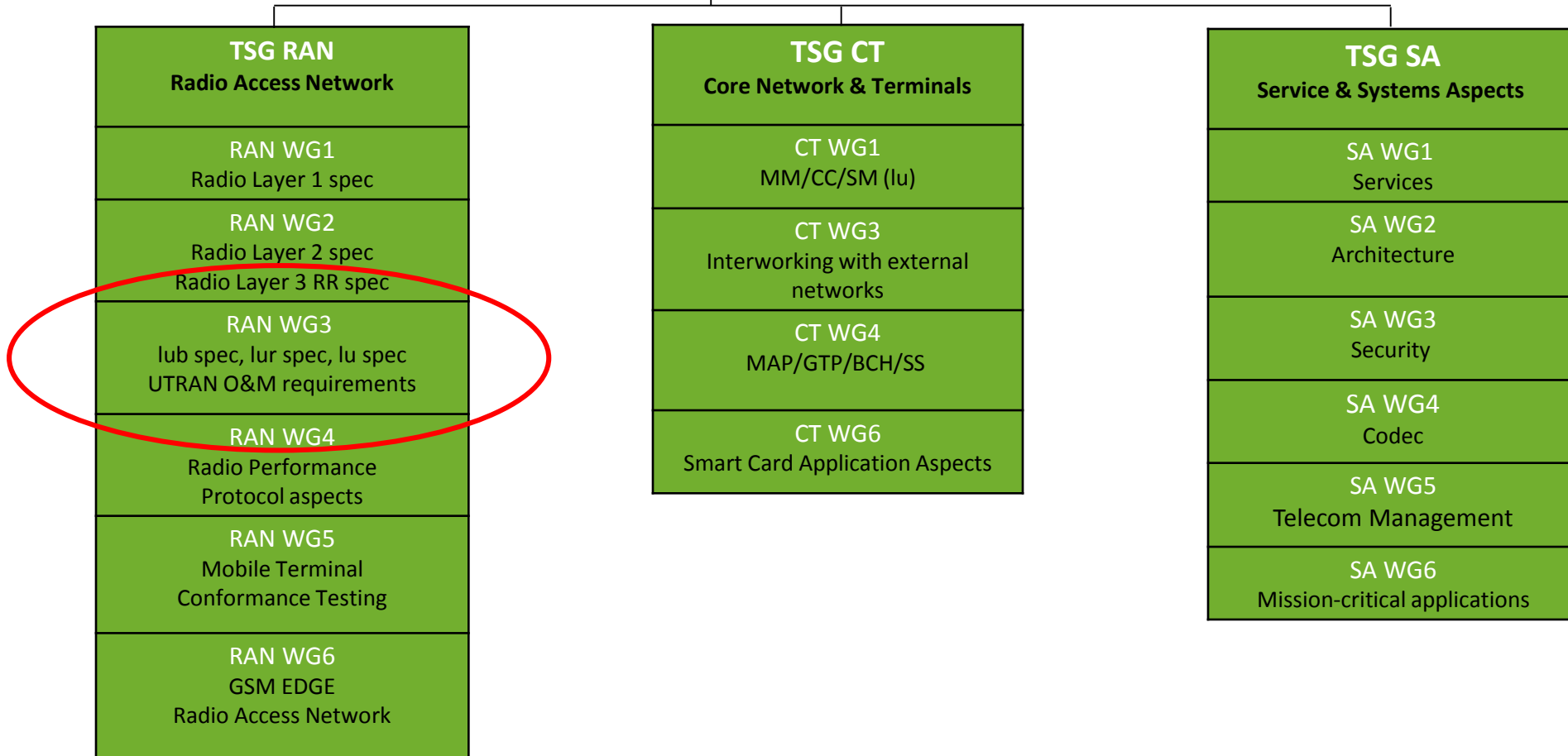
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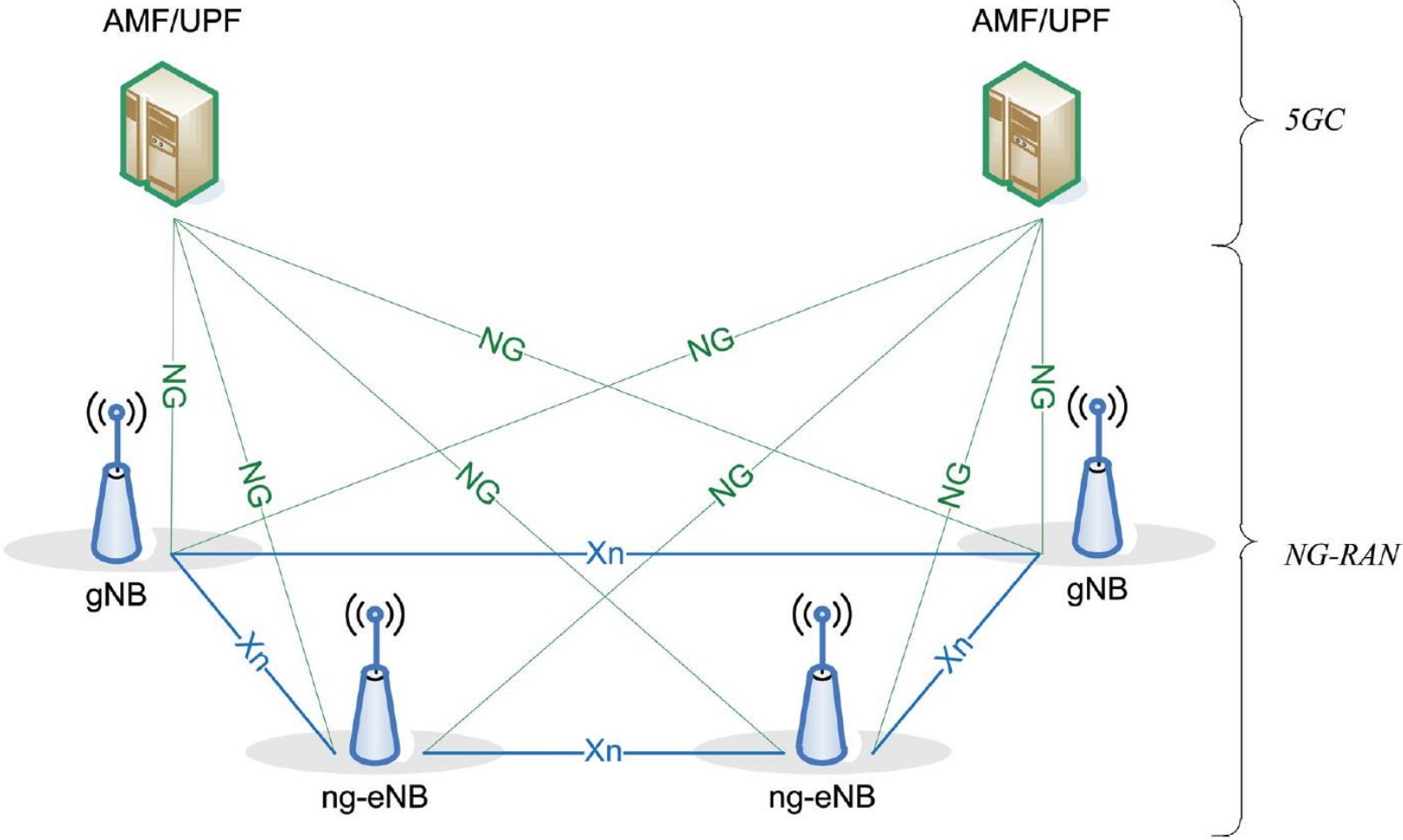
Summary

- What is NG-RAN?
- Stand-Alone (SA) and Non-Stand-Alone (NSA)
- gNB split architecture
- The unified User Plane
- gNB CP-UP split architecture
- Conclusions

What is NG-RAN?

- The New RAN (Radio Access Network) for 5G
 - 📶 Provides both NR and E-UTRA (“LTE”) radio access
- An NG-RAN node is *either*
 - 📶 **gNB** – (“5G base station”, providing NR access) *or*
 - 📶 **ng-eNB** (“enhanced 4G base station”, providing E-UTRA access)
- NG-RAN nodes are connected:
 - 📶 To the 5G core network – NG interface
 - 📶 To one another – Xn interface

The NG-RAN



Deployment Options (1)



- Both **Stand-Alone (SA)** and **Non-Stand-Alone (NSA)** deployments are possible
- Maximum flexibility for operators




Deployment Options (2)

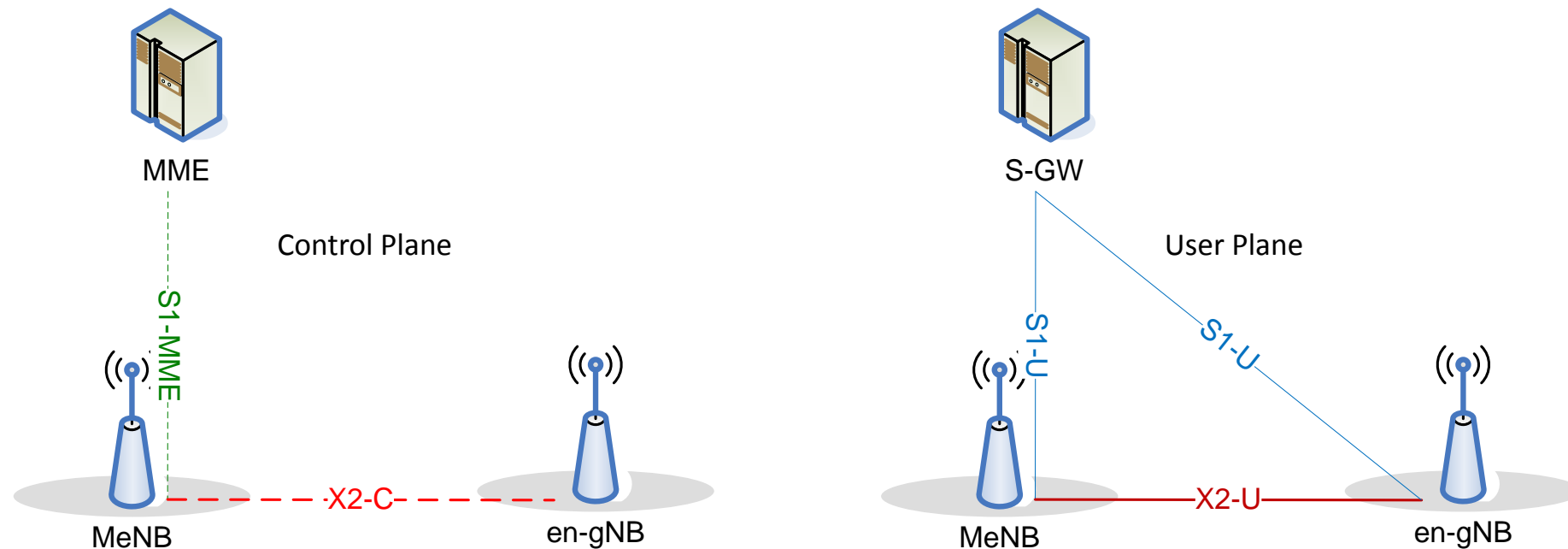
- **Stand-Alone (SA):** gNB connects to the 5G Core Network (5GC)
- **Non-Stand-Alone (NSA):** tight interoperation between gNBs and ng-eNBs
 - Connected to the same core network: *either*
 - EPC, the existing LTE core network (NSA within “4G RAN”) *or*
 - 5GC, the 5G core network (NSA within NG-RAN)
 - **Dual Connectivity (DC) toward the terminal**
 - A Master Node (MN) and a Secondary Node (SN) concurrently provide radio resources toward the user, for higher bit rate
 - The terminal “sees” a Master Cell Group (MCG) and a Secondary Cell Group (SCG)

Architecture “Options”

- Combinations of various alternatives for Master Node (MN), Secondary Node (SN), and core network types
 - (numbering is for reference only)
 - Different migration paths are possible according to operator strategy

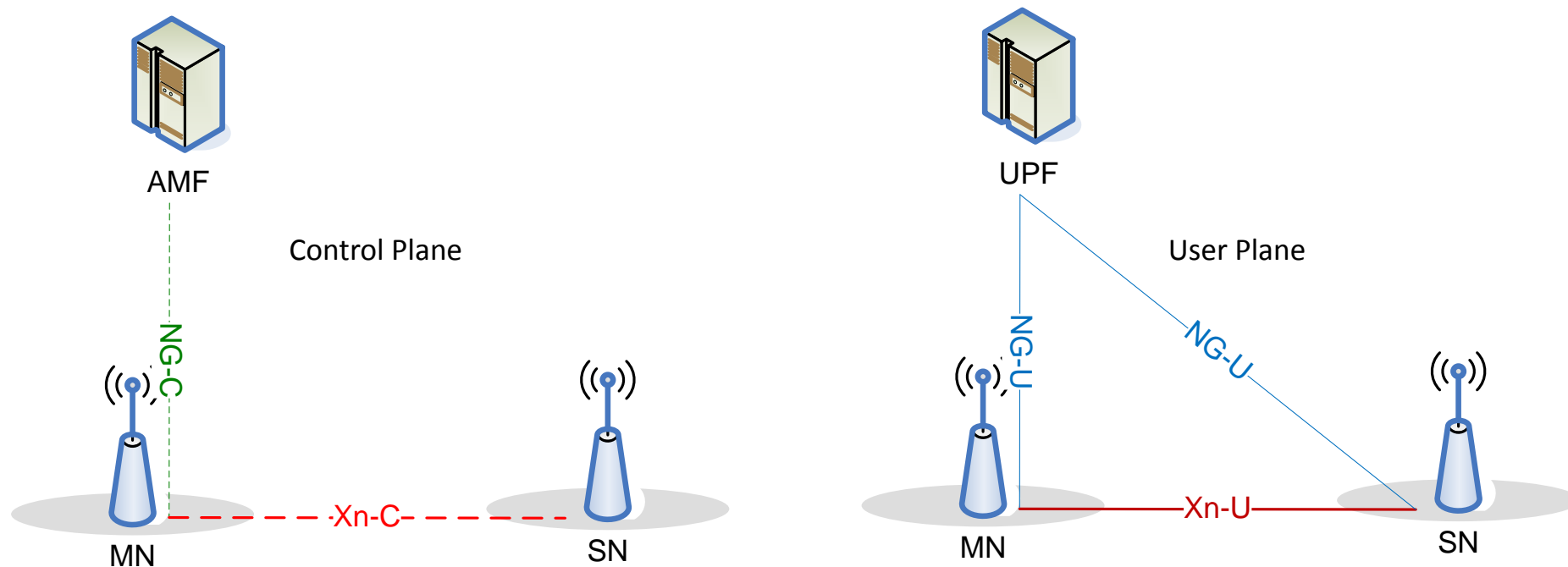
Option 3 (“EN-DC”)

-  eNB as MN, connected to LTE core network
-  “en-gNB” as SN
-  Only a subset of 5G radio functionality is needed for this use



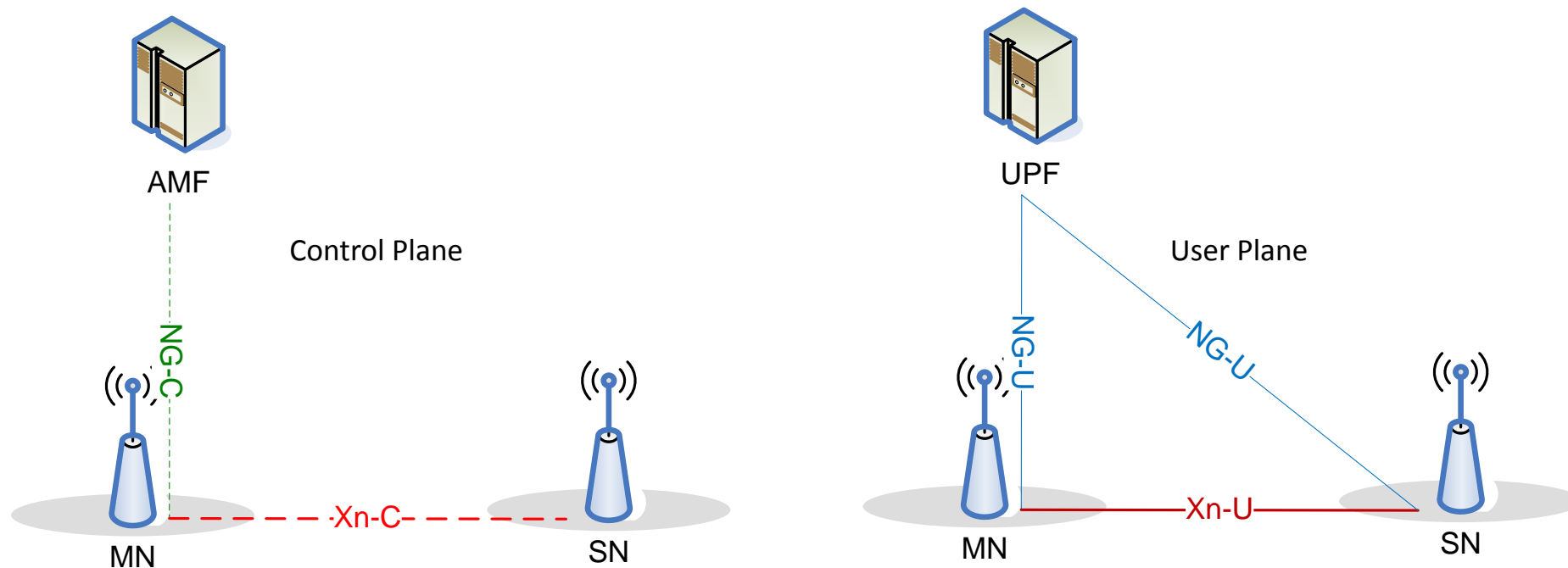
Option 4 (“NE-DC”)

- gNB as MN, connected to 5G core network
- ng-eNB as SN



Option 7 (“NGEN-DC”)

- ng-eNB as MN, connected to 5G core network
- gNB as SN



Other Available Options

- Option 2: gNB connected to 5G core network (SA operation)
 - “NR-NR DC” is supported (gNBs as MN and SN)
- Option 5: ng-eNB connected to 5G core network

Migration Considerations (1)

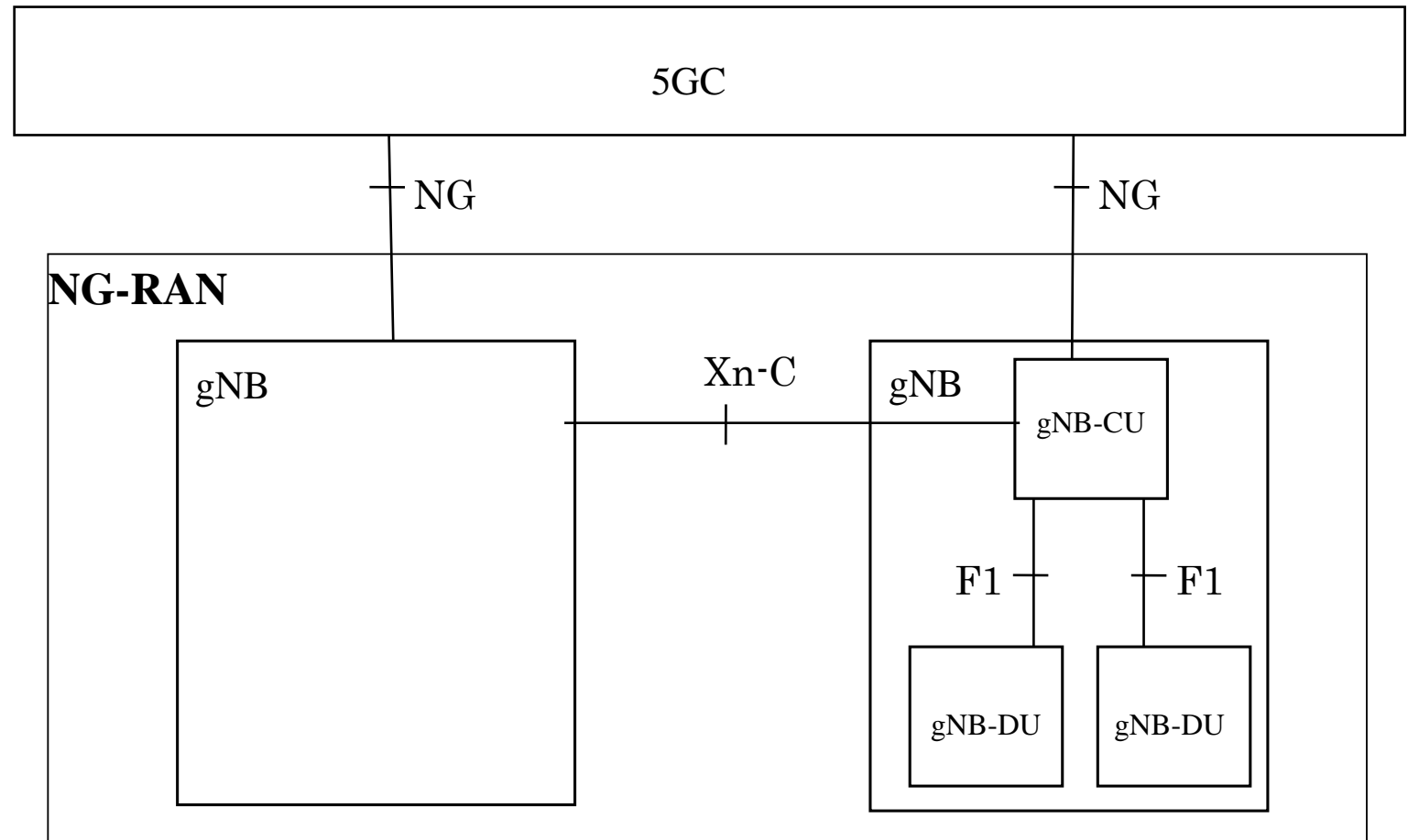
- Migration choice and path depends on:
 - 📶 Operator strategy
 - 📶 Business decision on when to deploy the 5G core network
 - Introduction of new distinctive 5G features (e.g. slicing)
 - 📶 Availability of new frequencies for NR
 - 📶 Existing network density
 - 📶 Increase of end-user traffic
 - 📶 Availability of terminals with the right feature set / bands
 - 📶 ...

Migration Considerations (2)

- If initial NR deployments use higher frequencies (e.g. above 6 GHz):
 - Smaller coverage on NR than on LTE
 - **Opt. 3** uses LTE for coverage and NR for higher capacity in busy areas, leveraging existing investments
- When 5G core network is deployed:
 - **Opts. 2** (SA) and **4** (NR for coverage, LTE as booster) use NR as basis for coverage
 - **Opts. 5** (ng-eNB for coverage) and **7** (ng-eNB for coverage, NR as booster) use LTE as basis for coverage

gNB Split Architecture





- gNB may be split into a central unit (gNB-CU) and one or more distributed units (gNB-DUs)
 - More deployment flexibility
 - Better support for e.g. low latency services
- One gNB-CU may connect to multiple gNB-DUs
- One gNB-DU may support one or more cells

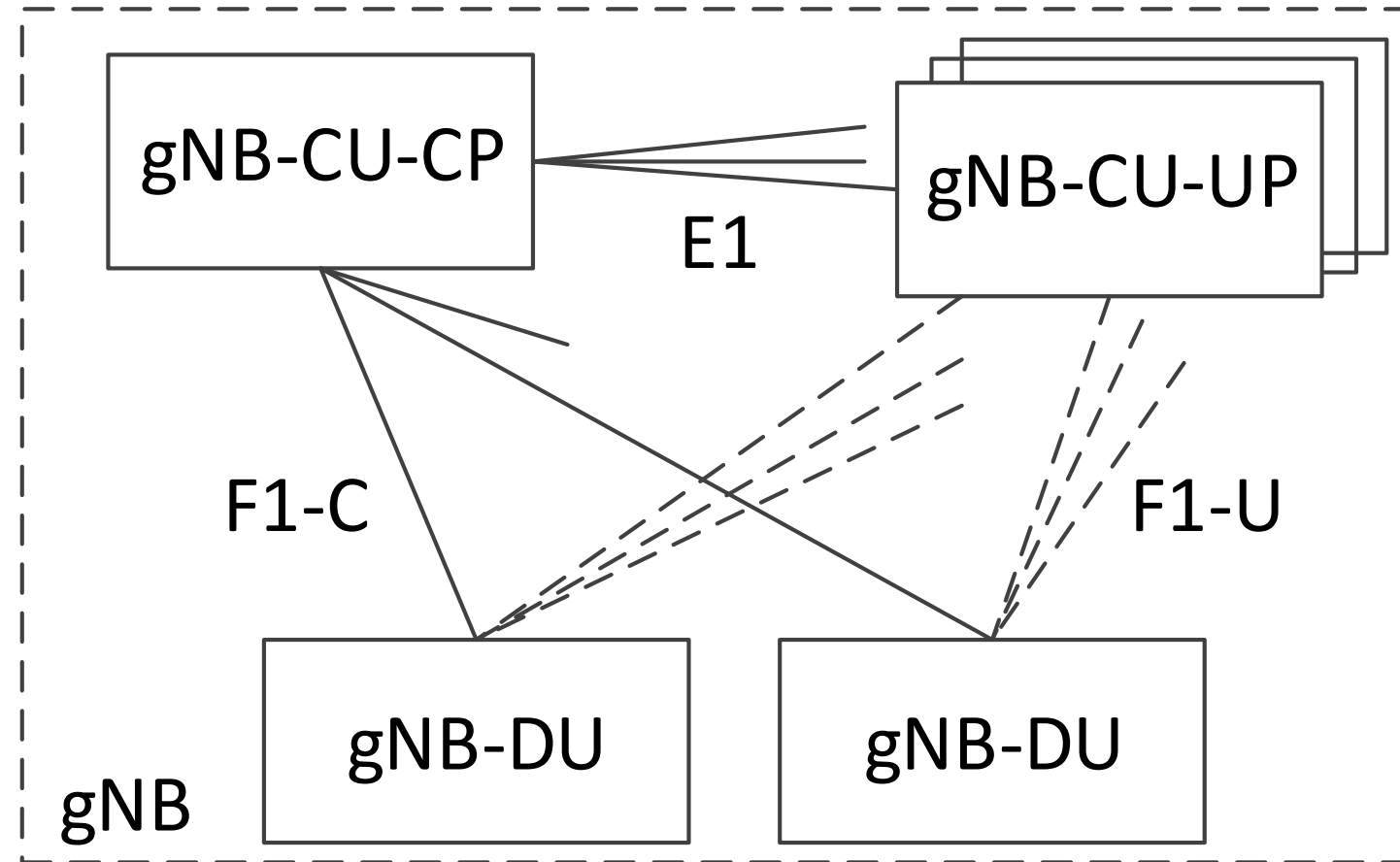


The Unified User Plane

- The same user plane protocol is used for:
 - 📶 Xn-U (between NG-RAN nodes connected to 5GC)
 - 📶 X2-U between an eNB and an en-gNB for Option 3
 - 📶 F1-U (between gNB-CU and gNB-DU)
- A single user plane instance may run all the way from the gNB-DU to another NG-RAN node
 - 📶 One “hop”, no intermediate terminations

gNB CP-UP Split Architecture

- 
 gNB-CU may be split into its control plane and user plane parts (gNB-CU-CP and gNB-CU-UP)
 - 
 More deployment flexibility
- 
 One gNB-CU-CP may connect to a single gNB-CU-UP
- 
 One gNB-DU may support one or more cells



Conclusions



- NR tightly interoperates with existing LTE networks
- The NG-RAN interfaces and protocols specified by 3GPP facilitate the evolution of 4G to 5G and help the uptake of the 5G core network
- Upcoming enhancements address new requirements beyond mobile broadband
 - e.g. automated driving, industrial automation, e-health services, etc.