ENEA | 5G DATA MANAGEMENT

THE SIX BENEFITS OF A NETWORK DATA LAYER

FOR MOBILE OPERATOR NETWORKS

SPRING 2020

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1 INTRODUCTION

The shift to 5G presents a genuine disruption to telco data management. New types of services demand a new approach that includes cloud-based, distributed data processing, storage and synchronization. There are many types of data to be managed in 5G including end user subscriber data, user plane content and applications data, and control plane policy, session and configuration data.

5G's cloud native architecture allows for the external storage of real time state information required by network processing nodes and this data requires almost instantaneous access and delivery.

On the other hand, other types of data are stateless and can tolerate hundreds of milliseconds or even seconds of delay for processing and retrieval. Additionally, authorized applications may reside in the cloud or locally at the edge. All of this requires that telco data management must evolve from simply managing subscriber data to managing many types of diverse data that are complex, disparate, and both stateful and stateless.

Of course, while 5G provides an ideal network architecture blueprint for the future, 4G investments at many operators have not yet been fully monetized. Moving to 5G may not therefore be their highest priority. These operators need to scale their networks urgently to handle increased traffic; and find agile ways to launch new services and monetize them quickly. These operators may turn to Network Functions Virtualization (NFV) and Software-Defined Network (SDN) to transform, open and automate their existing 4G networks, but they also need to develop robust and innovative methods to manage disparate data sources based on a cloud native architecture that is '5G ready'.

For both 5G and pre-5G cases, the immediate adoption of a Cloud Data Layer or Network Data Layer (NDL) offers the most cost effective solution to meet both current and next generation data management requirements. This e-brief provides an overview of the role and benefits of the NDL.

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SIX BENEFITS

01 Create network simplification

02 Enable efficient automation, scalability and redundancy

03 Provide greatly enhanced reliability

04 Enable edge computing while being subscriber aware

05 Share data across network slices

06 Allow responsible sharing of data with authorized third parties

Conclusion

BENEFIT

01 CREATE NETWORK SIMPLIFICATION:

REDUCE COUPLING OF IT SYSTEMS, ELIMINATE DATA DUPLICATION

In the past, network database functions such as HLR/HSS were monolithic ie the application and database used to store subscription data were combined and deployed as one unit.

To use such network functions, the subscriber information needed to be provisioned and stored on the same platform by IT systems, creating dependency on IT teams. Network teams had to co-ordinate roll-outs with IT whenever they made changes to the database or provisioning attributes.

This coupling is time-consuming, expensive and creates multiple points of failure. Frequently two different vendors, one on the network side and the other on IT, are involved in the changes. Typically, operators have around 30 to 40 such monolithic network functions or applications.

A Network Data Layer greatly simplifies the coupling between network and IT teams – specifically:

- Allows an updated superset of subscriber attributes for network applications to be provisioned and made accessible to network functions almost immediately
- Supports changes required to add another network application to be done in parallel since the **data is separated from specific instances of the application**
- Enables IT systems to define and provision new attributes into the Network Data Layer autonomously

Another potential problem with monolithic applications is **data duplication.** Separate provisioning of subscription data in every application leads to data and operational duplication. As the number of data centers increases, provisioning systems must be synchronized flawlessly to keep all network elements up-to-date.

Any update failures or entry errors can lead to major ‘synch’ issues that are hard to detect and may adversely impact user experience. Network Data Layer plays a pivotal role in simplifying the OSS/BSS process and ensuring that administrative systems integrate with the network systems in real time as part of an end-to-end Digital Network Transformation process.

BENEFIT

02 ENABLE EFFICIENT AUTOMATION, SCALABILITY AND REDUNDANCY

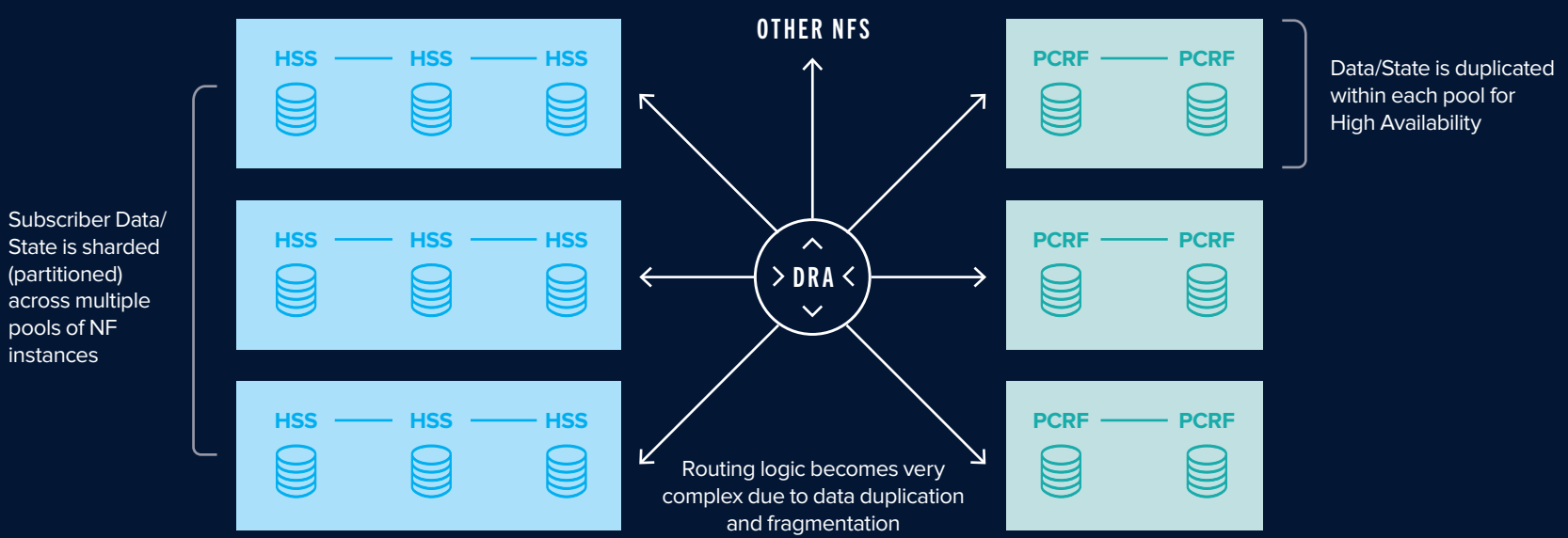
Complexity inevitably leads to inefficiency

Monolithic applications that store subscriptions and subscriber state must be ‘sharded’ (ie horizontally partitioned for scalability) so that users are assigned or ‘nailed up’ to an application server instance eg PCRF1, on a pool of servers. Control plane calls that are directed to the specific server instance will attempt to implement subscriber aware load balancing based on executing policy rules etc.

If at the time of configuration, network element instances are statically assigned to serve designated subscribers, over time, as subscribers are added or removed, the server resources will become imbalanced leading to complex physical subscriber re-balancing operations.

Real-world example - Legacy approach

A Tier-1 operator in the Americas needed to deploy 2 PCRF instances (1+1 redundancy) for every 5 million subscribers to support a subscriber base of 100 million. This required 40 PCRF instances. A similar data partitioning scheme was needed for other network functions, HSS, MME, etc. Such a 'data sharding' architecture introduced the need for a DRA (Diameter Routing Agent) to implement highly complex routing logic.

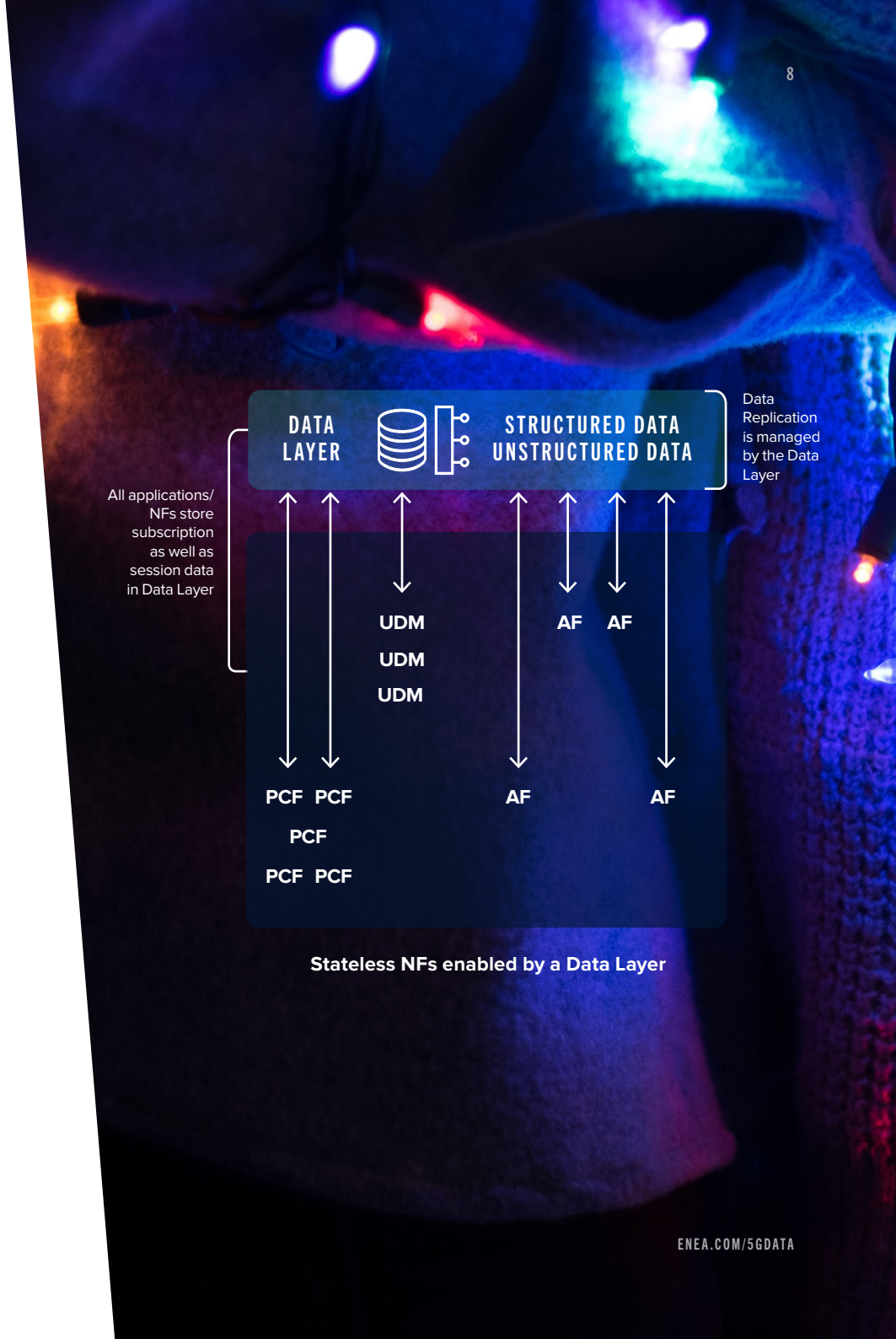


Legacy approach for managing subscriber context

Network Data Layer approach

Compare this with a network where subscription data and subscriber state are externalized and stored in the Network Data Layer (NDL). Network applications now operate ‘statelessly’ and any network application instance can potentially service any subscriber by retrieving the subscription and state almost instantaneously from the (NDL). Now dynamic network resource allocation can be fully automated – typically saving over 30 percent of server processing resources.

The NDL allows the servers to be stateless and ready for automated auto-scaling as recommended by 3GPP which leads to additional benefits.



Stateless NFs enabled by a Data Layer

BENEFIT

03 PROVIDE GREATLY ENHANCED RELIABILITY

In NFV environments the underlying infrastructure is built using commodity hardware which provides only 99.9 – 99.95% availability, but typically 99.999% (five nines) is required for carrier class performance. To create a high reliability system from less reliable components application data and state information are often replicated in multiple availability zones and data-centers. Replicating large amounts of subscription and session data makes operations complex and application vendors frequently rely on expensive proprietary databases and replication tools to perform this task. To create a high reliability telco cloud, this database software must be aware of all availability zones across multiple virtual machines (VMs).

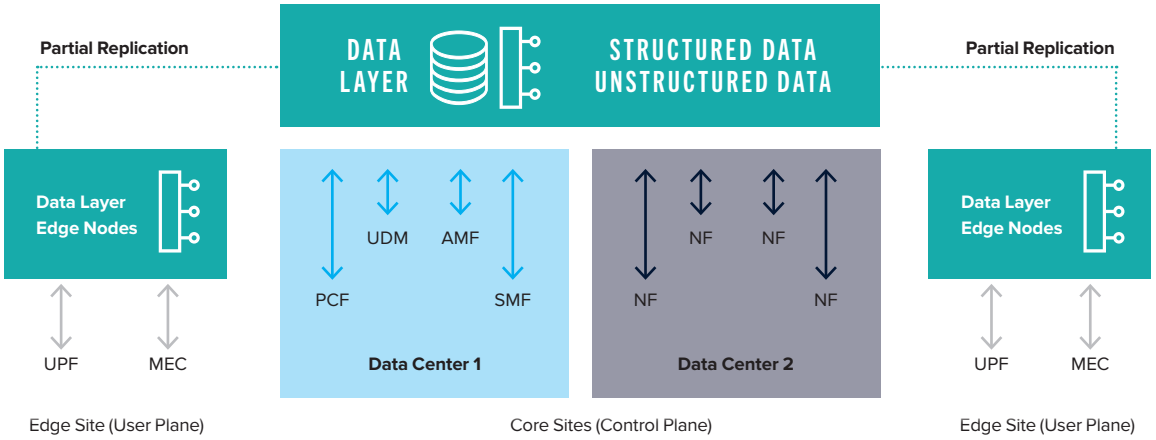
By contrast with a NDL architecture, the database is distributed and can scale horizontally to support externalized state and subscriptions across the network. In addition, instead of solving the problem of virtualized storage and resource allocation for each and every network function, it solves it once and for all.

BENEFIT

04 ENABLE EDGE COMPUTING WHILE BEING SUBSCRIBER AWARE

Some latency sensitive use cases require application servers to be deployed close to a specific application process or end user ‘at the edge’ of the network. Such applications may need access to subscription data eg to enrich a user’s Quality of Experience.

A Data Layer that supports multi-tier deployment scenarios can facilitate the dynamic provision of this subscriber data close to the edge in an efficient manner – ie by replicating only the data that is needed at the edge.



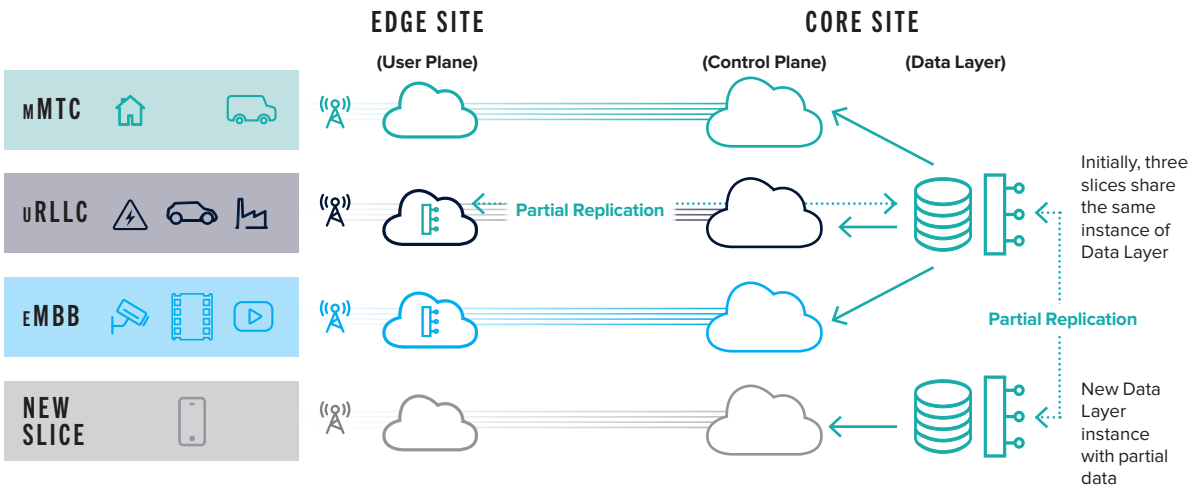
Data Layer providing subscriber context at the edge

BENEFIT

05 SHARE DATA ACROSS NETWORK SLICES

In 5G, ‘network slices’ may be instantiated to deliver different classes of service for different use case categories, eg enterprise applications may be connected to a secure ‘enterprise slice’ with a Service Level Agreement (SLA) while other applications may be connected to a generic public internet ‘best efforts’ network slice.

While some core functions are slice-specific, they all need access to common subscription and identity data. The Data Layer therefore becomes “slice aware” to facilitate seamless sharing of data across slices.



Data Layer and Network Slicing

BENEFIT

06 ALLOW RESPONSIBLE SHARING OF DATA WITH AUTHORIZED THIRD PARTIES

Frequently data are siloed and locked tightly to innumerable network applications that make it difficult to extract and consolidate shared data.

The reliability of such shared or 'common' data decreases rapidly if consolidation and analysis are not done in real time. A Data Layer solves this by providing an interface that makes the subscriber, session, application, and policy data accessible in near-real time and shared as required. Eventually the Data Layer can manage access to all types of network and user data including that of application providers and authorized third parties.

To support increased demands for subscriber privacy and additional data regulation such as the EU's General Data Protection Regulation (GDPR), the Data Layer offers a framework for managing Personally Identifiable Information (PII) in a responsible manner that is secure (encrypted), with controlled access (only shared after explicit opt-ins) and transparent (allowing subscribers to know what information is shared with third parties).

CONCLUSION

The six important benefits of installing the Network Data Layer described above will not only provide CAPEX and OPEX savings, they will simplify the scalability of operations and increase redundancy as they minimize network configuration and subscriber data corruption.

While the architecture is defined as part of 5G, several operators are looking at ways to deploy the Network Data Layer in 2020 to capture many of these benefits on today's LTE networks, even before 5G New Radio (NR) is fully deployed. The Network Data Layer can provide significant benefits today in advance of 5G.

APPLYING THE SIX IMPORTANT BENEFITS WILL SIMPLIFY THE SCALABILITY OF OPERATIONS AND INCREASE REDUNDANCY

3

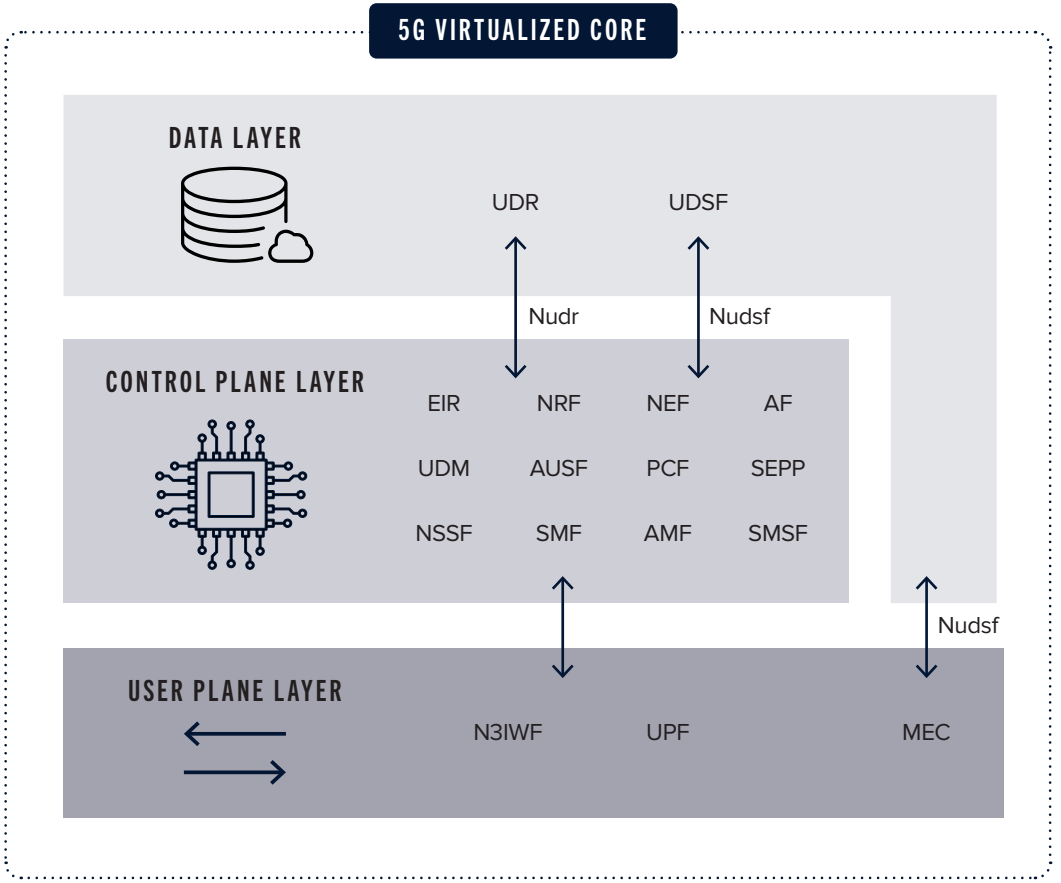
APPENDIX

How the network data layer enables 5G service functions

APPENDIX:
HOW THE NETWORK DATA LAYER ENABLES 5G SERVICE FUNCTIONS

3GPP defines the 5G core network as multiple Service Functions (SFs). Some functions are responsible for moving packets - user plane functions (UPF), some trigger the flow of packets (control plane layer) and some request and store data (data layer).

The figure shows a simplified layered view of functions in each of the three categories. Note the Data Layer fulfils the important role of managing all data on 5G networks.



5G Network Functions

DATA TYPES AND ASSOCIATED FUNCTIONALITY

DATA TYPE	FUNCTIONALITY
Subscription data	Stores the type of service the subscriber or a device is allowed to use
Policy data	Sets priorities, rules and constraints on how services can be accessed by each subscriber or device
Session data	Context data that is created as subscribers or devices connect for a session
Application data	Data specific to an application
Configuration	Required to configure network functions that can be stored in the Data Layer

FUNCTION SUMMARY

FUNCTION NAME	USE UDR FOR	USE UDSF FOR
UDM	Subscriptions	Session Data
AUSF		Session Data
5G-EIR	PEI Data	
PCF	Subscriber Policies	Session Data
NRF	NF Registration Data, NF Subscriptions	
NEF	Subscriptions, NEF Application Data	
AMF	Storing Application & Mobility data for exposure	Subscriber Registrations
SMF	Storing Session data for exposure	
IOT Gateway (SCEF)	Device Subscriptions	MO-message-cache MT-message-buffer
MEC	UDR-Edge configuration can selectively pull subscriptions from core	UDSF-Edge configuration can be used to selectively move session/state to core

How different functions in 5G will use the Data Layer (UDR + UDSF)