



**I E T F<sup>10</sup>**

# **Service Function Chaining Use Cases in Fog RAN**

## **draft-bernardos-sfc-fog-ran-00**

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Chicago, SFC WG, March 2017

# Motivation

- Virtualization is becoming pervasive to all domains of E2E networking
  - E.g., virtualization of core network functions in data centers
- The Radio Access Network (RAN) can also be *softwarized*
  - Centralized processing of certain RAN functions (C-RAN) enables efficiency gains
  - Virtualization of RAN functions envisaged as one step forward for the C-RAN

# Computing at the edge

- Certain 5G applications would require extremely low latency
  - This is extremely challenging for the network to deliver through a pure centralized architecture
  - It is therefore needed to provide networking, computing, and storage capabilities closer to the users
- This has led to what is known as ***intelligent edge***
  - ETSI is addressing this at the MEC (Mobile Edge Computing) ISG

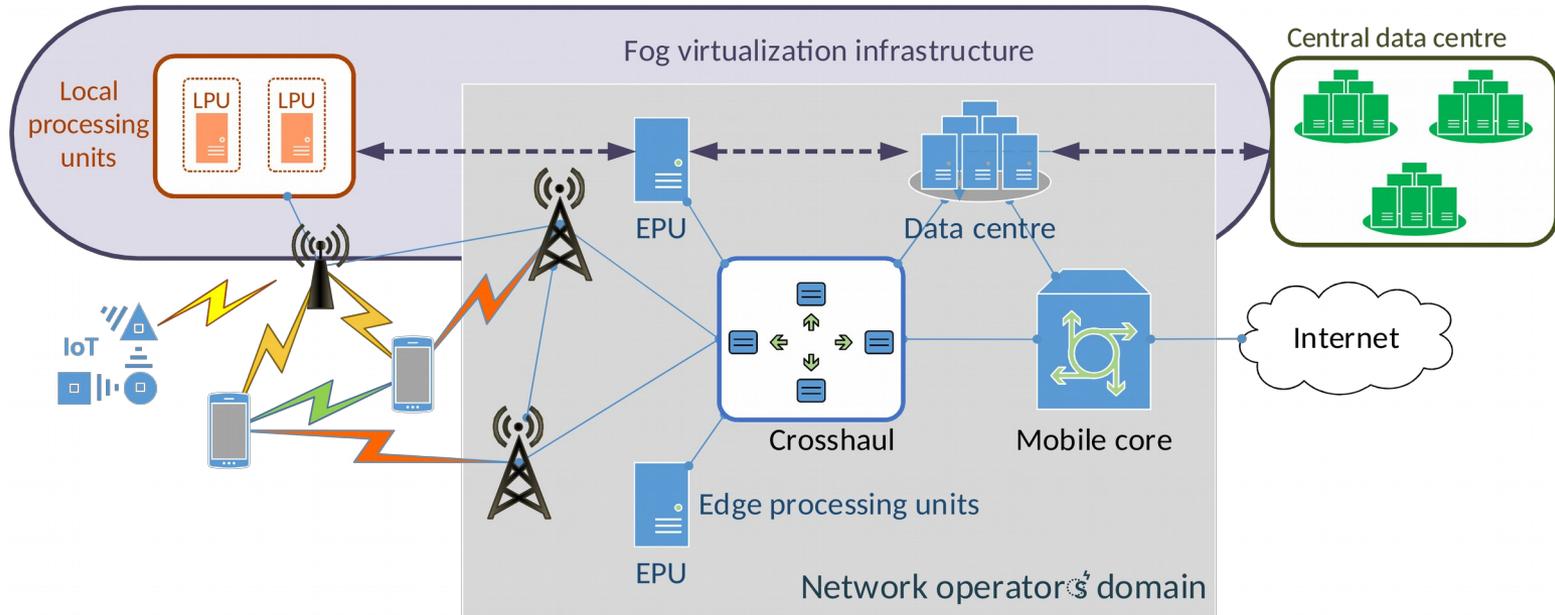
# Virtualization at the edge

- The intelligent edge needs of virtualization
  - Beyond apps, network functions can benefit from lower latencies by executing at the edge
  - RAN, transport and core networking functions can take advantage of a virtualization hosting environment at the edge,
    - saving bandwidth in their respective domains and offering local breakout options where required.
    - Context information from the RAN could be offered to/used by other services and applications

# What is Fog RAN?

- The edge virtualization substrate has been largely assumed to be fixed or stationary
  - But it is now being extended to scenarios where the edge computing substrate is on the move, distributed further down the edge, and even integrating resources from different stakeholders
  - This is referred to as *the fog*
- The computing and virtualization capabilities available down into the fog are of particular advantage to the virtualized-RAN/cloud-RAN
  - leading to what we refer to as *Fog RAN*

# Fog RAN



- The fog is composed by virtual resources on top of heterogeneous resources available at the edge and even further in the RAN and end-user devices
  - Virtual networking functions (VNFs) related to the RAN may execute in the fog



# Applicability of SFC to Fog RAN

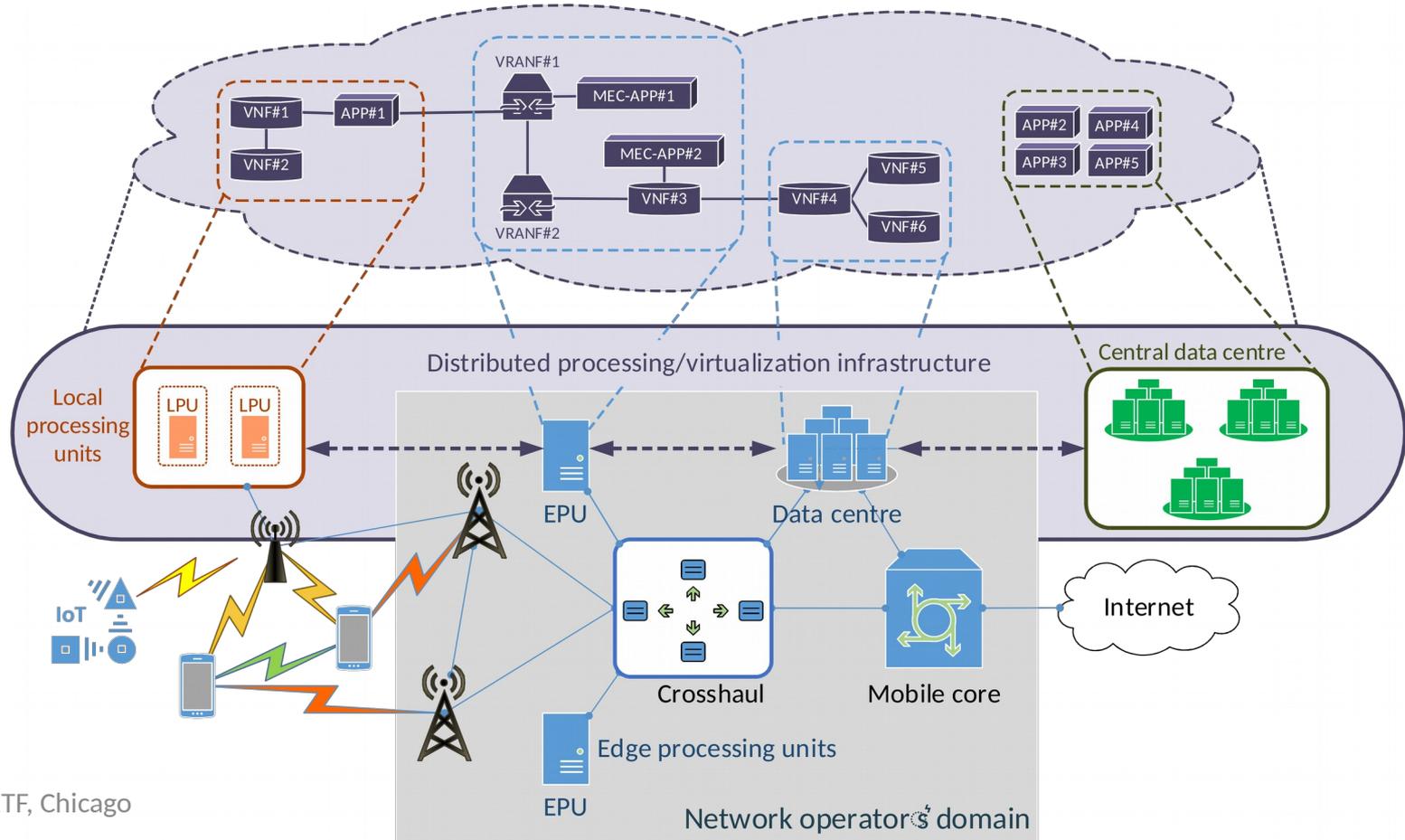
- There are different use cases for service function chaining in mobile networks:
  - draft-ietf-sfc-use-case-mobility describes in general how to use SFC for mobile networks focusing on the core functions
  - draft-aranda-sfc-dp-mobile looks more at RAN aspects
- Our draft focuses on applying SFC to the fog RAN environment

# Applicability of SFC to Fog RAN

- The VNFs being chained implement mostly RAN functionality
  - The strict latency and bandwidth requirements imposed by C-RAN triggered the concept of RAN as a Service, i.e., flexible functional split of the radio protocol stack
  - With fog RAN, virtualization resources are placed closer to users, reducing E2E latency
- Fog RAN enables new optimizations when information of (or available at) the access is used
- The fog computing environment can also be used to virtualize functions from the end-user devices, not only from the RAN
  - This facilitates better convergence of multiple access technologies

# Applicability of SFC to Fog RAN

- Fog RAN implementations will benefit from applying SFC
  - Virtual RAN functions executed on resources from different stakeholders
  - SFC encapsulation can be used to ensure proper data processing



# Fog RAN requirements

- R1: SFC MUST support user traffic flows with very low delay budgets (e.g., less than 1ms) at the edge of the network
- R2: SFC MUST support mobility of Service Functions (e.g., edge network node containing SF that is located on a high speed train)
- R3: SFC MUST support Service Functions (e.g., MEC) that are located at the edge of the network and that perform L7-Application processing very early in the forwarding path
- R4: SFC MUST support metadata used to exchange information about the network and virtual resources status, so it can be used to decide about updates of the service function path
- (more to be added)

## Next steps

- Collect feedback from the WG
- Continue extending the use case with more details and requirements
- Contribute/collaborate to draft-ietf-sfc-use-case-mobility?
- We will work on this use case extensively at the 5G-CORAL project (starting in June 2017)



A 5G Convergent Virtualised Radio  
Access Network Living at the Edge