FACILITY FOR LARGE-SCALE ADAPTIVE MEDIA EXPERIMENTATION

5G Edge Cloud Architecture

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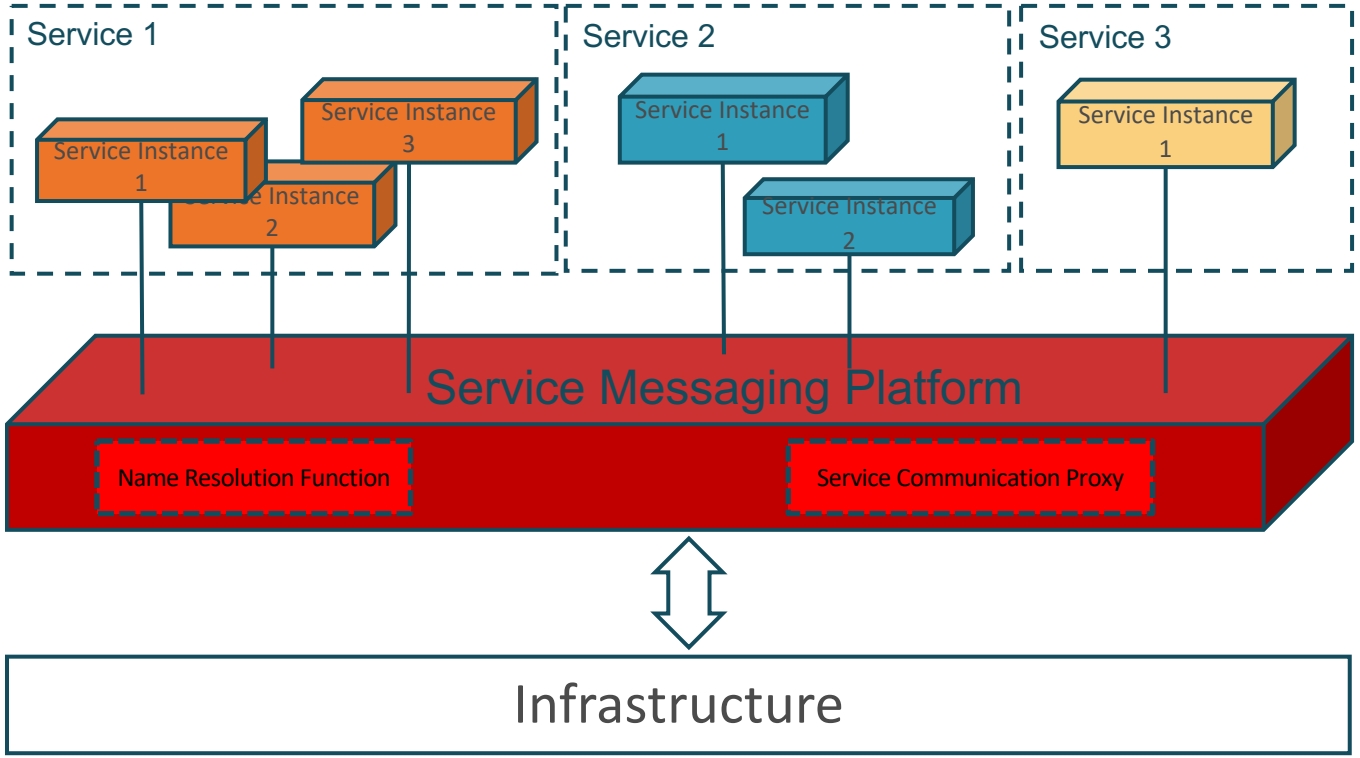
Urban Hacking in 5G

Background & Drivers

Move to Cloud-Native Operator Environments

- Micro-service vision with anything-as-a-service
- Efficient service message routing
- Regional data centres with SD-WAN transport (incl. L2 whitebox switching)

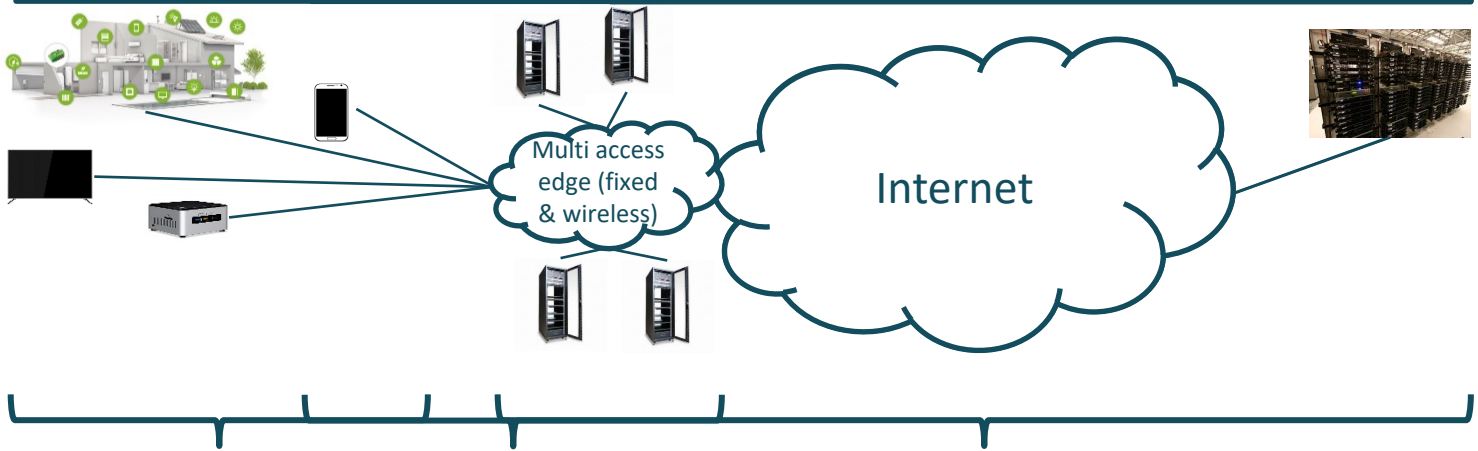


Micro-Services From Far-Edge to Distant Cloud

Anything-as-a-Service (new interactive, immersive experiences, localized where possible)

Service-based architecture across all edge devices and the Internet

Well-proven Internet technology, such as web services, HTTP, IP, … mixed with virtualization technology



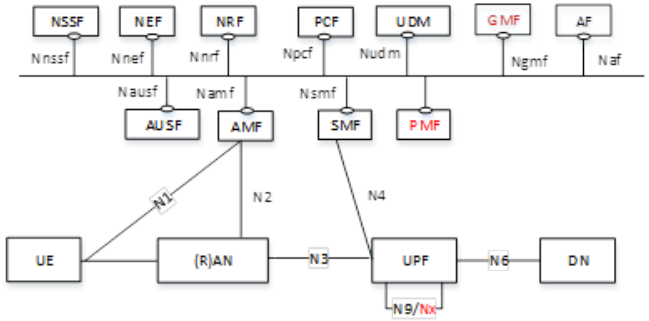
SBA-based far edge

SBA-based 5G cellular

Internet Connectivity

Services over Distributed (Cellular) LANs

- Idea of every mobile terminal carrying a virtual Ethernet cable
  - Currently being specified in 3GPP Rel 16 FS-VertLAN SI



- Any service being an Intranet service with possible Internet backend connection

- Suitable for scenarios in, e.g.,
  - Industrial IoT or generally site-specific experiences, such as virtual tourist guides
  - ...ultimately any app-centric service experience (demo at upcoming MWC2019)?

FLAME Platform

Technical Proposition of Our Platform

FAST, ADAPTIVE

- **Faster response, better engagement**
  - service deployment at the edge of the network (e.g. in a street cabinet)
  - compute located just one hop away (at best) from the users, low latency access
  - compute workload distributed across the network
- **Improved service request routing**
  - fast (between 10 and 20ms) switching time from one service instance to another by not relying on the DNS.
  - overcomes inefficient ‘triangular’ routing of requests in current IP networks
- **Multicast delivery of http responses**
  - multicast-based delivery of HTTP responses to service request transparently to the (otherwise unicast) semantic of HTTP transactions.

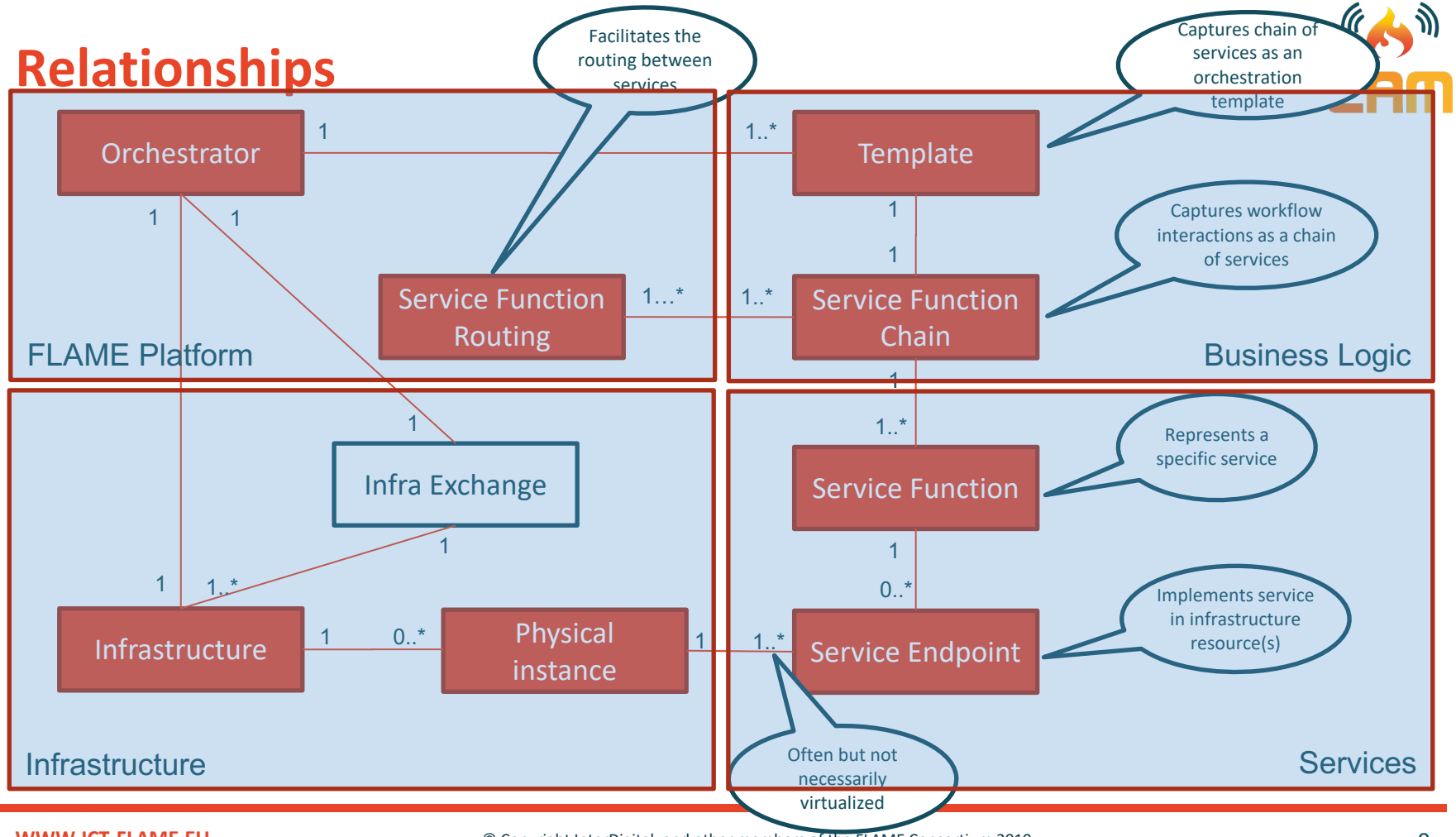
ROBUST, SECURE

- **Net-level indirection**
  - indirection of service requests at the network level allowing error response to redirect the original request to another alternative surrogate
  - nesting operations leads to a net-level ‘search’ among all available surrogate instances
- **Less chance of insecure direct object references**
  - CDNs morph into surrogate service endpoints with the potential to hold the necessary security context when serving the desired content
- **Secure end-to-end access to content**
  - CDNs deployed as properly secured endpoints with the necessary certificate sharing between content
  - Securing content delivery according to the originally intended end user facing contract -more secure for provider and consumer.

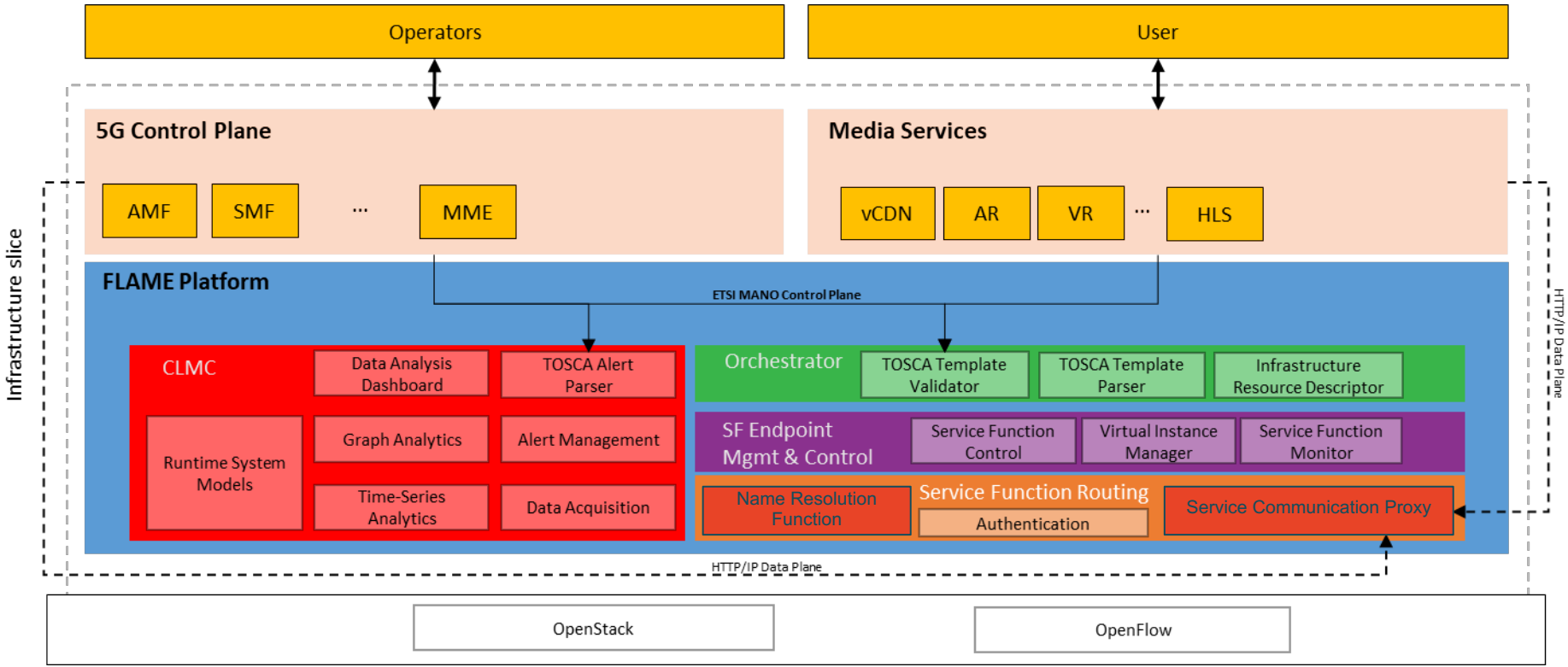
Basic Concepts for Our Platform Design

- Capture service interactions based on a **service function chain (SFC)**, i.e., serialized execution of **service functions** (SFs)
  - For notation utilize concepts introduced in https://tools.ietf.org/html/rfc7665
  - Concepts are applied across the entire FLAME platform, both at the level of the services running over the platform as well as in the internal design
- SFCs are usually captured through **templates** and deployed through a process of **orchestration**, deploying and managing compute, storage and connectivity resources

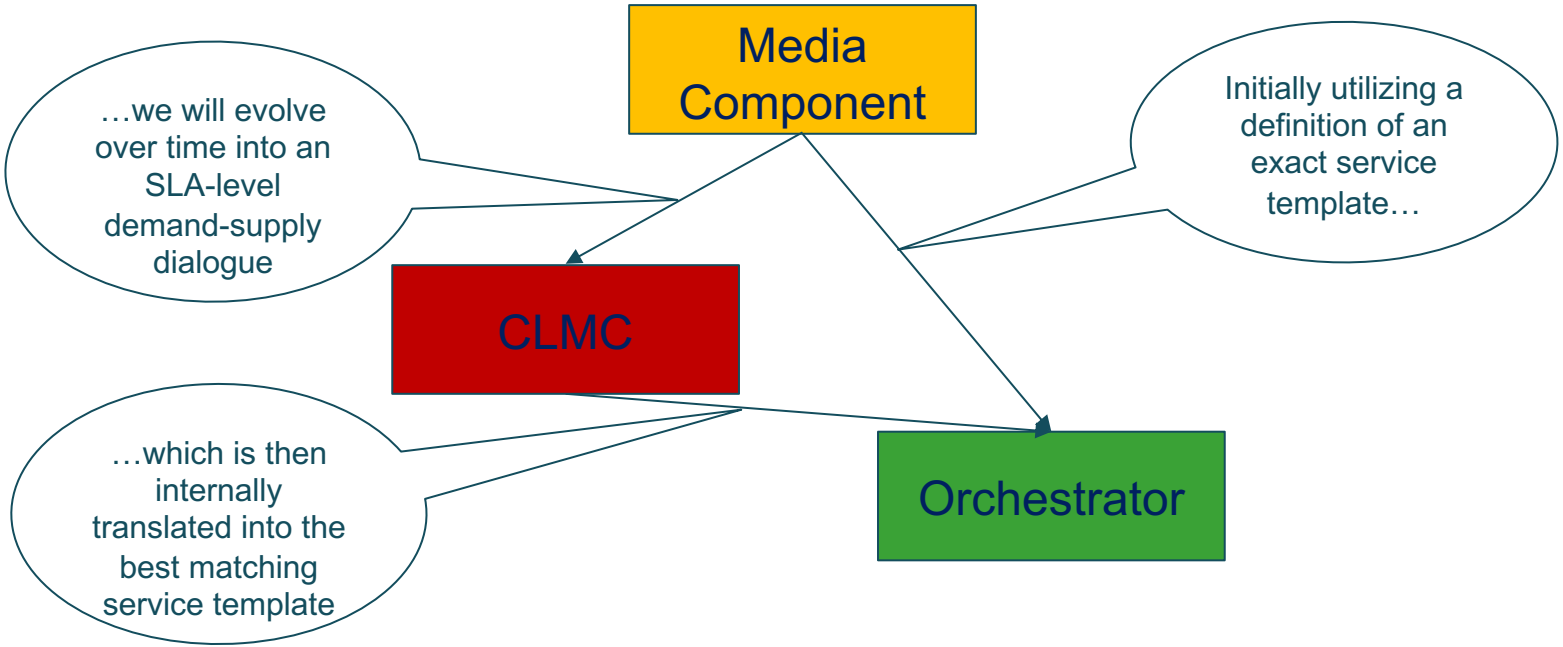
Relationships



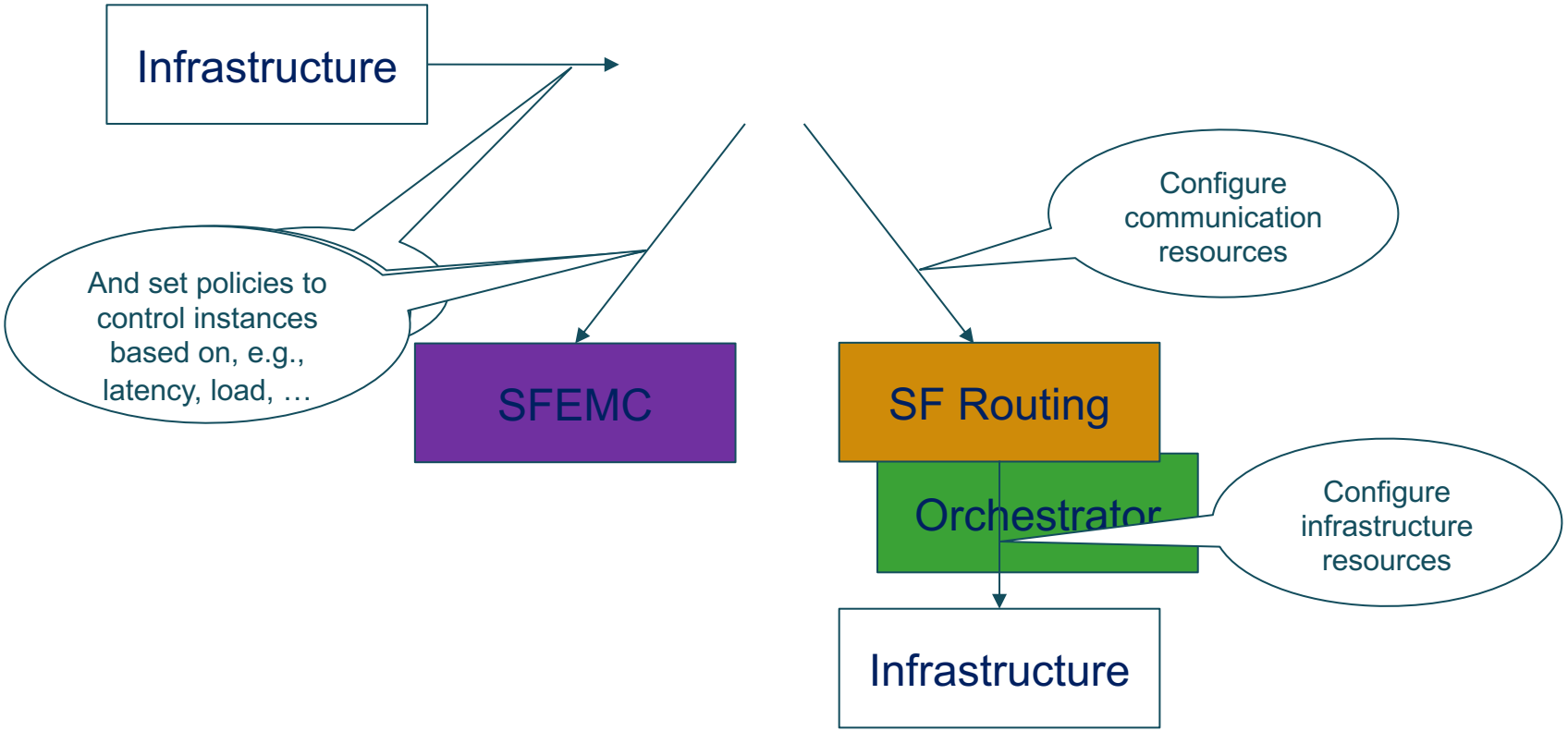
A 5G Service Delivery Platform



An Increasingly Rich Dialogue between Experimenter & Platform

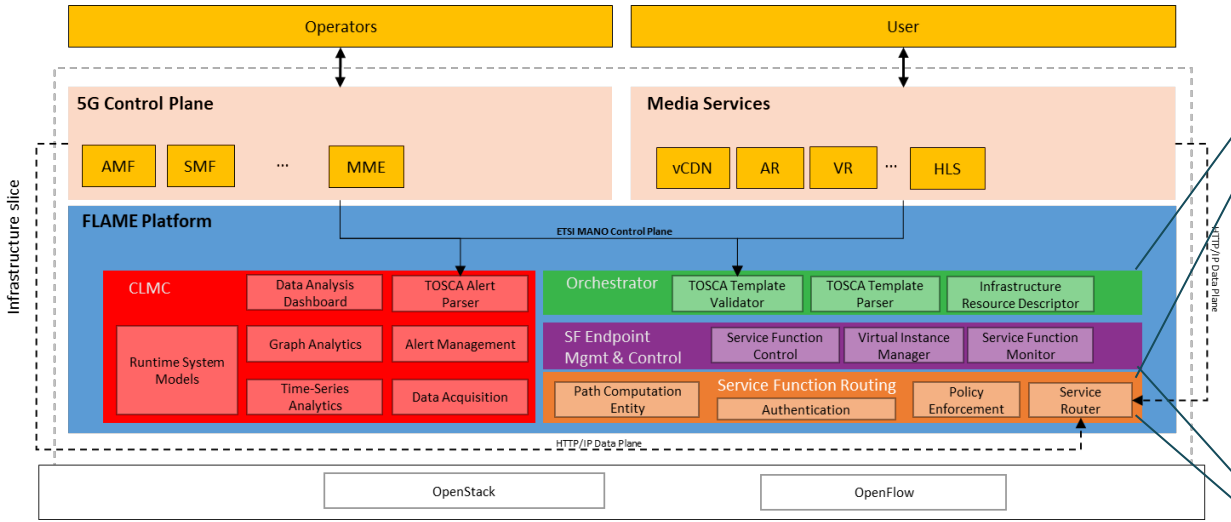


Supported by Flexible Management and Control



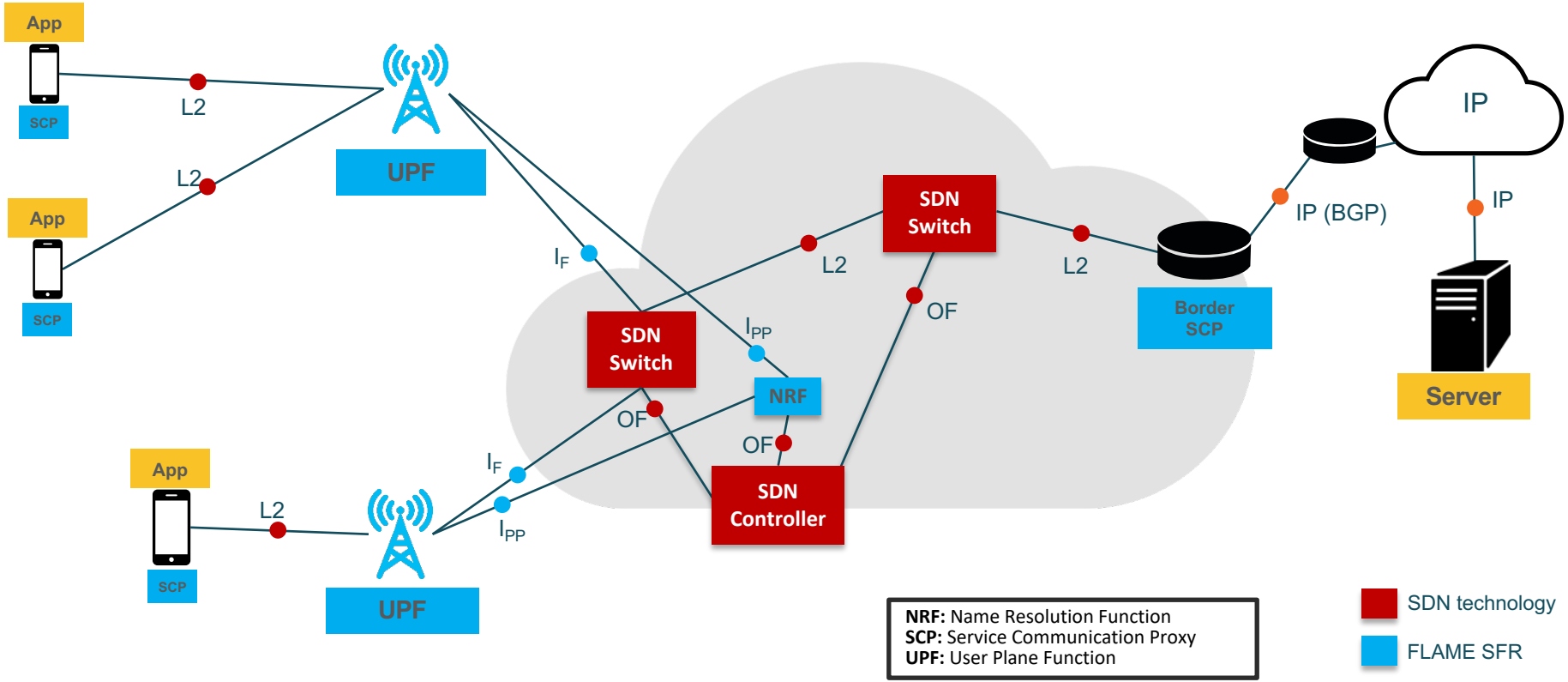
5G Integration

FLAME in 5G



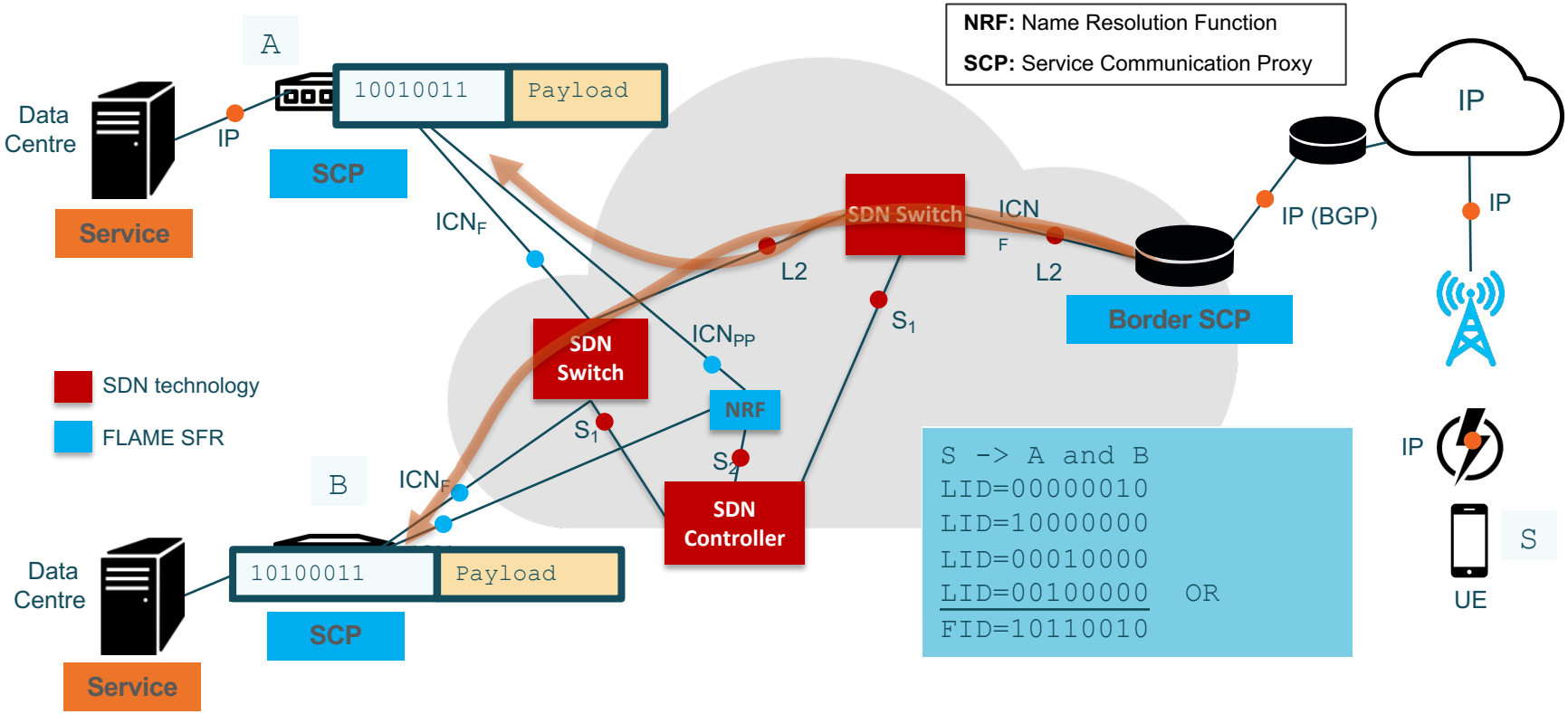
- Provides lifecycle management for 5G (not just media) services
- Orchestration with (simplified) ETSI NFV compliant templates
- Demonstrated as world's first 5G control plane in 2018

Future Deployments Beyond Current 5G



Integration with SDN

Path Forwarding through Bitfields

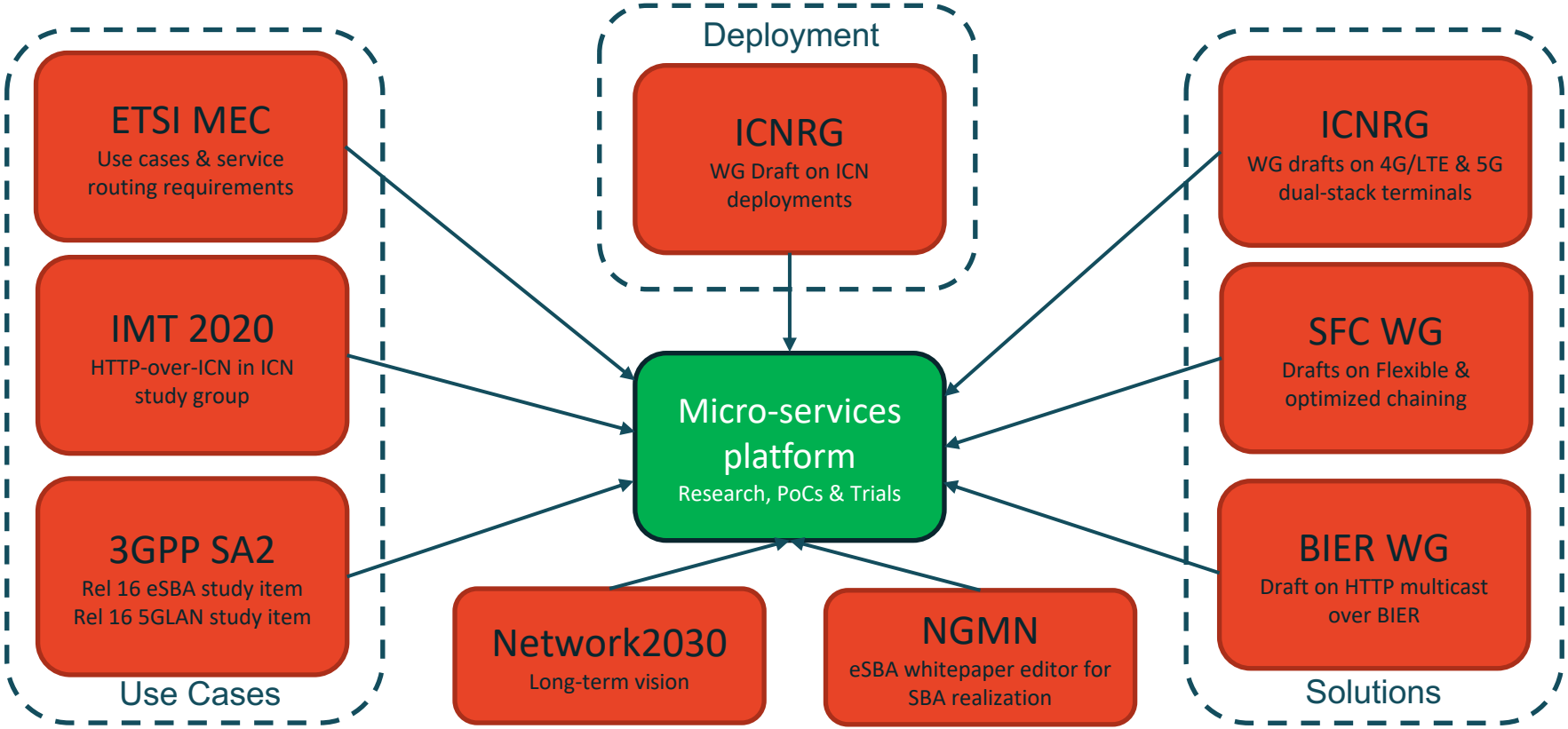


Integration with SDN

Advantages of Path-based Forwarding

- Only proactive insertion required
  - Rule changes/additions only when inventory changes!
- Can be deployed with **low TCAM requirements** in SDN environments
  - TCAM sizes are important
  - in practice quite limited (thousands of entries)
  - TCAM is the most power-hungry
  - Will co-exist with existing protocols – plenty of TCAM left for IP, MPLS, L2switch …
- Solution can provide native multicast **with no additional TCAM entries!**
  - Existing technologies (or proposed solutions) either require high-state churn (IP-multicast) or large amount of state (various MPLS multicast proposals).
- Compatible with SDN, P4, BIER (for overlay multicast networks)

FLAME in 5G Standards



FLAME

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THANKS FOR YOUR ATTENTION!

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