FACILITY FOR LARGE-SCALE ADAPTIVE MEDIA EXPERIMENTATION

Full stack DevOps toolchains accelerating ideas from the desktop to city testbeds

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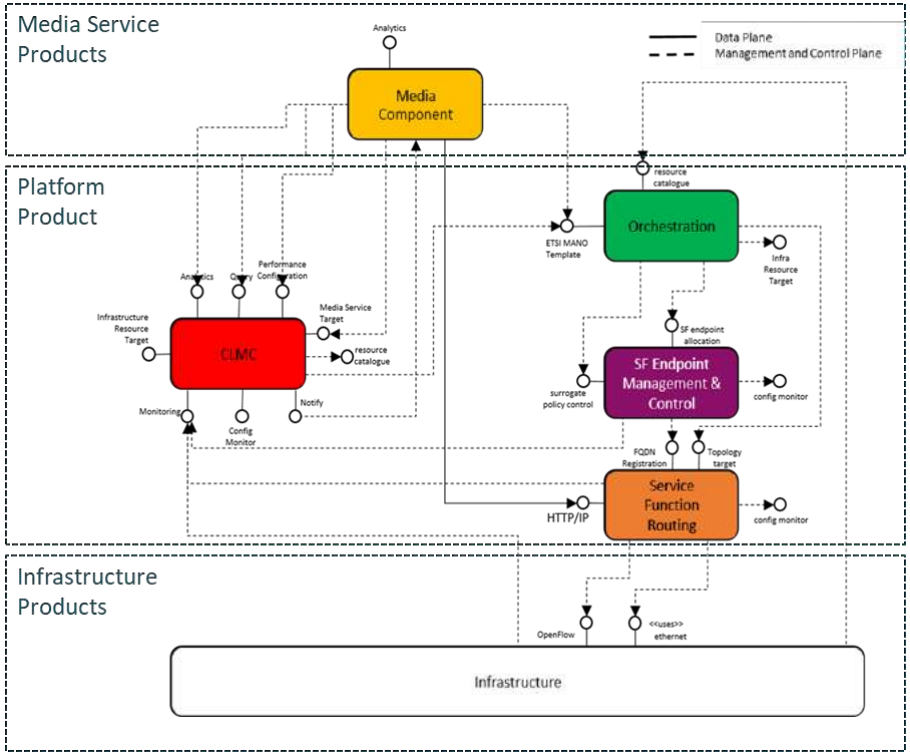
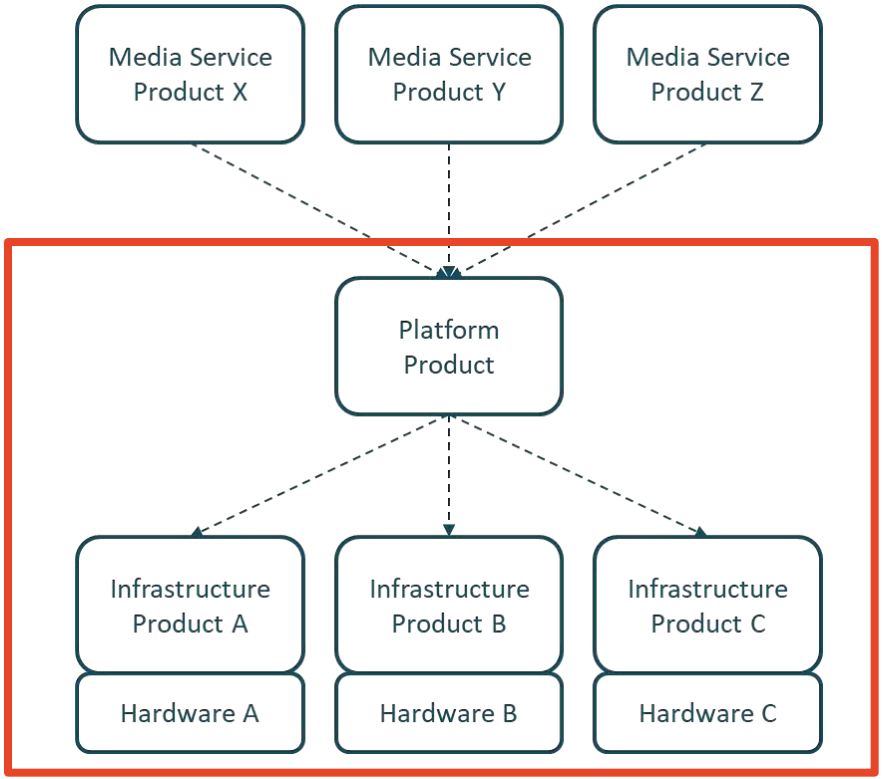
FLAME's DevOps Pipeline

- Verification, validation and evaluation of novel full stack 5G systems with users is challenging
  - infrastructure, platform, services have complex interdependencies
  - all require significant resources to be fully operational
  - trials with users have specific non-technical requirements (logistics, GDPR)
- FLAME provides a set of connected DevOps environments that are designed to:
  - address specific test objectives related to the level of resources available
  - control costs by incrementally increasing levels of realism at each stage
  - allow developers to seamlessly (as possible) transition between environments through platform portability and consistent APIs

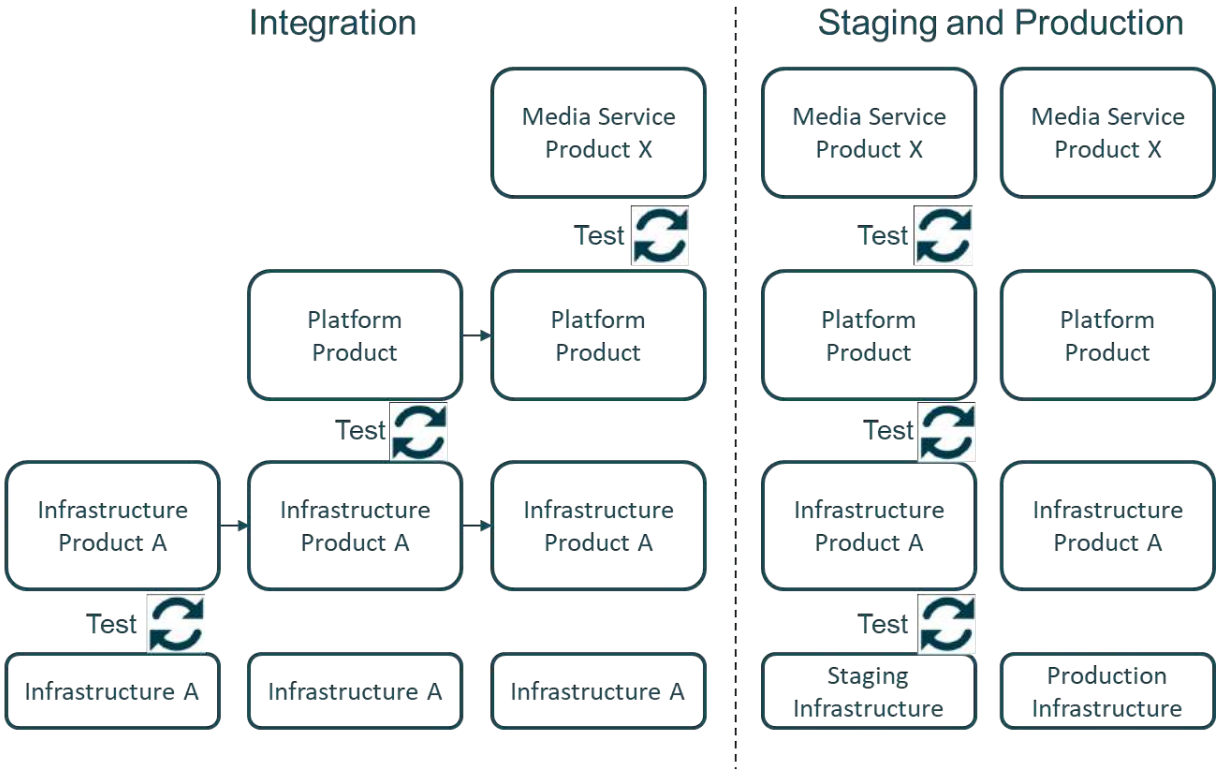
Platform Engineering

Software Artefacts

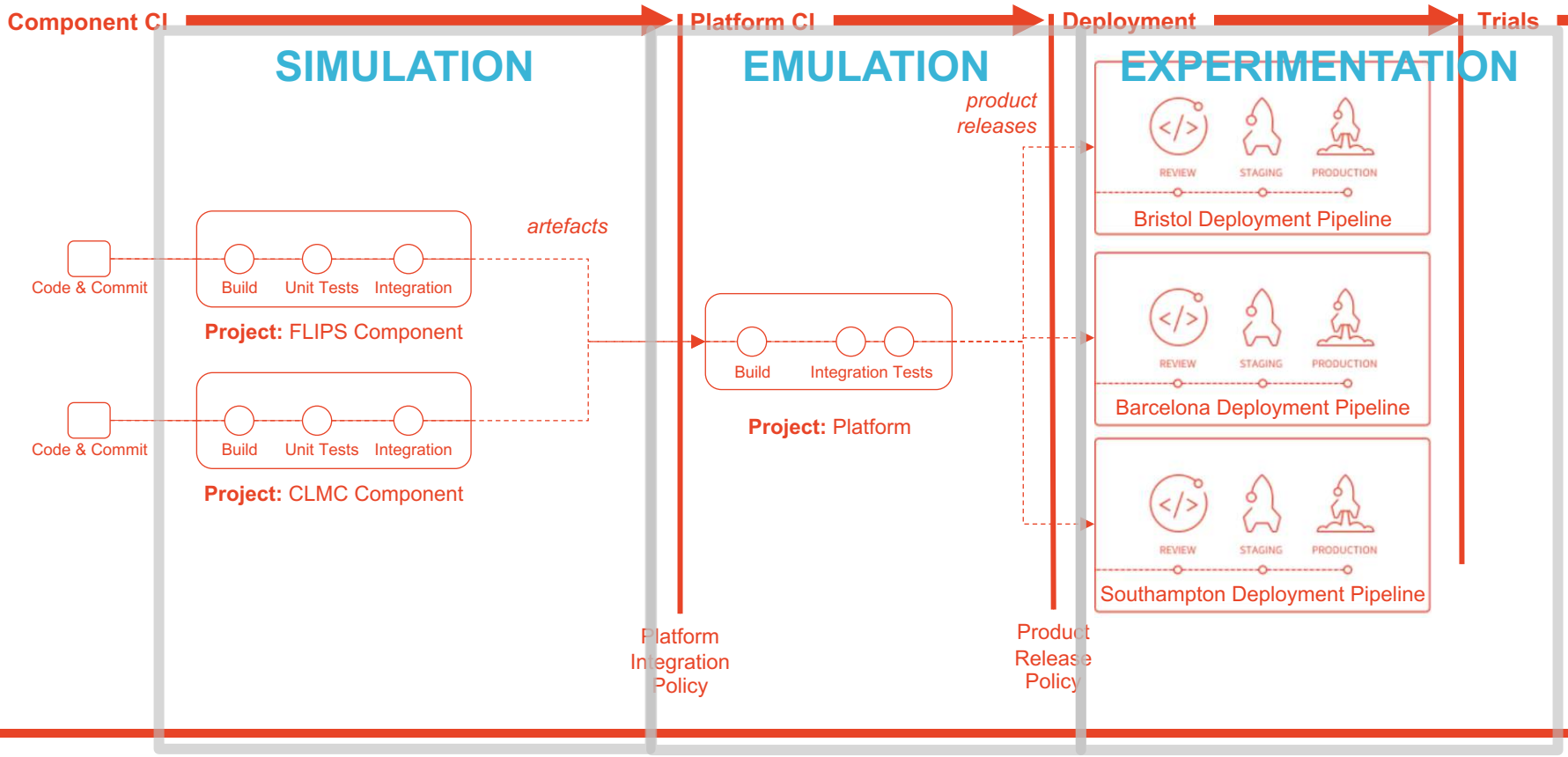




Integration and Release



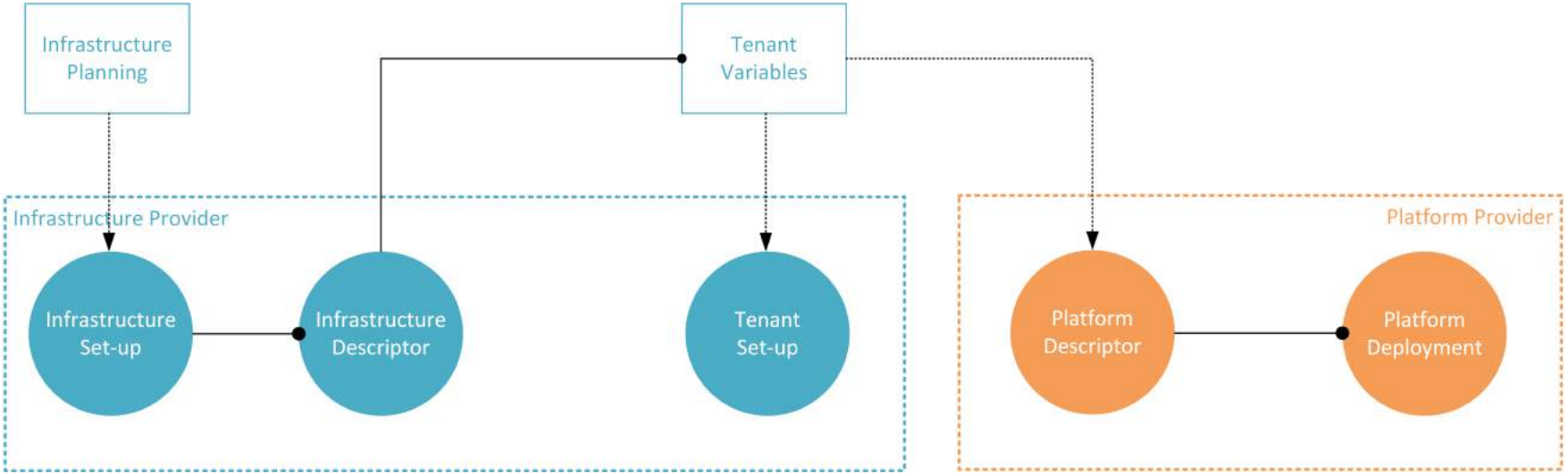
Platform Integration Pipeline



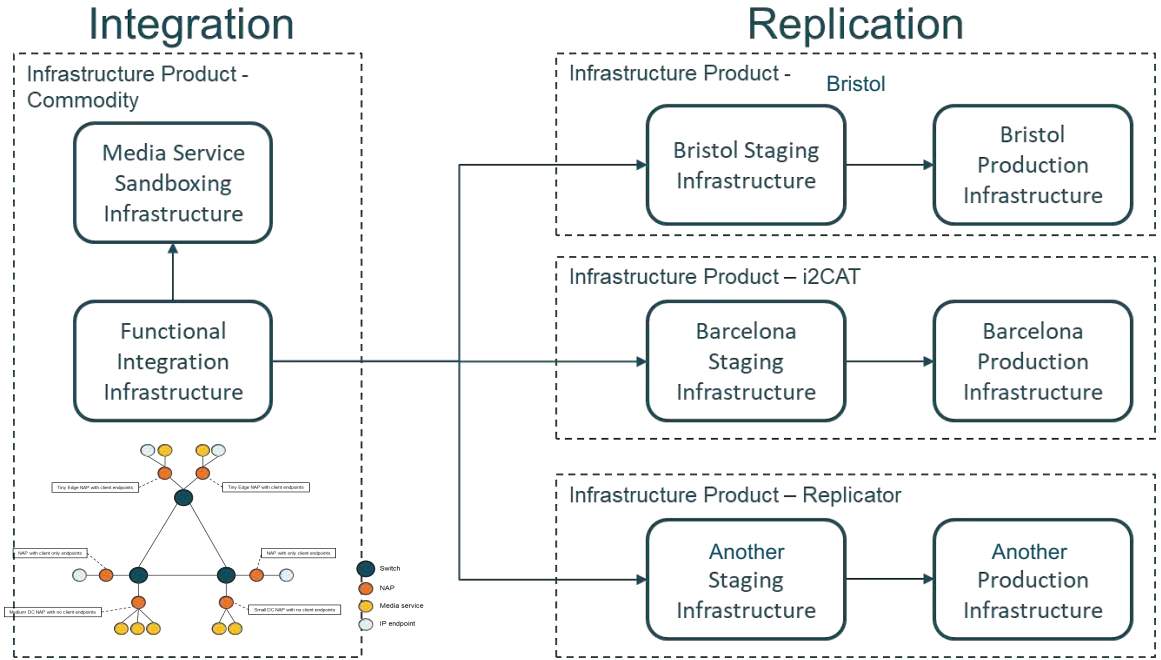
ARDENT: Objectives & Challenges

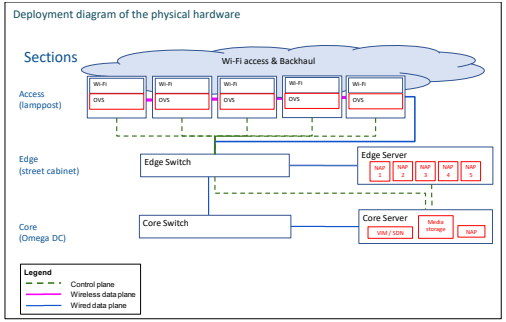
- Automated platfoRm DEploymeNt Toolchain (ARDENT)
- Automate platform deployment into infrastructure slice
  - Focus on OpenStack
  - Sanity checks (networks, subnets, port security, security groups)
  - Resource quota calculation and configuration
  - Creating NVF resources preparing for platform deployment
  - Deployment of platform using platform descriptor (HEAT)
- Preserve/respect tenancy relationship with infra provider

ARDENT


Infrastructure Planning
Tenant Variables
Infrastructure Provider
Platform Provider
Infrastructure Set-up
Infrastructure Descriptor
Tenant Set-up
Platform Descriptor
Platform Deployment

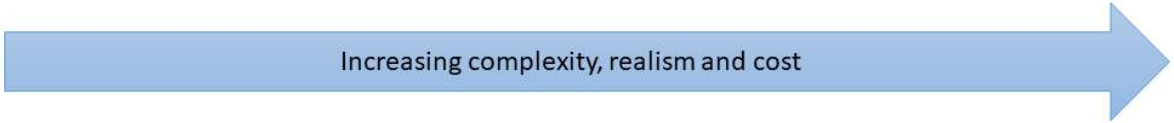
Infrastructures





Media Service Development

DevOps Pipeline



Developer machine	FLAME-in-a-Box	Sandpit	Replica	Replica with people
				
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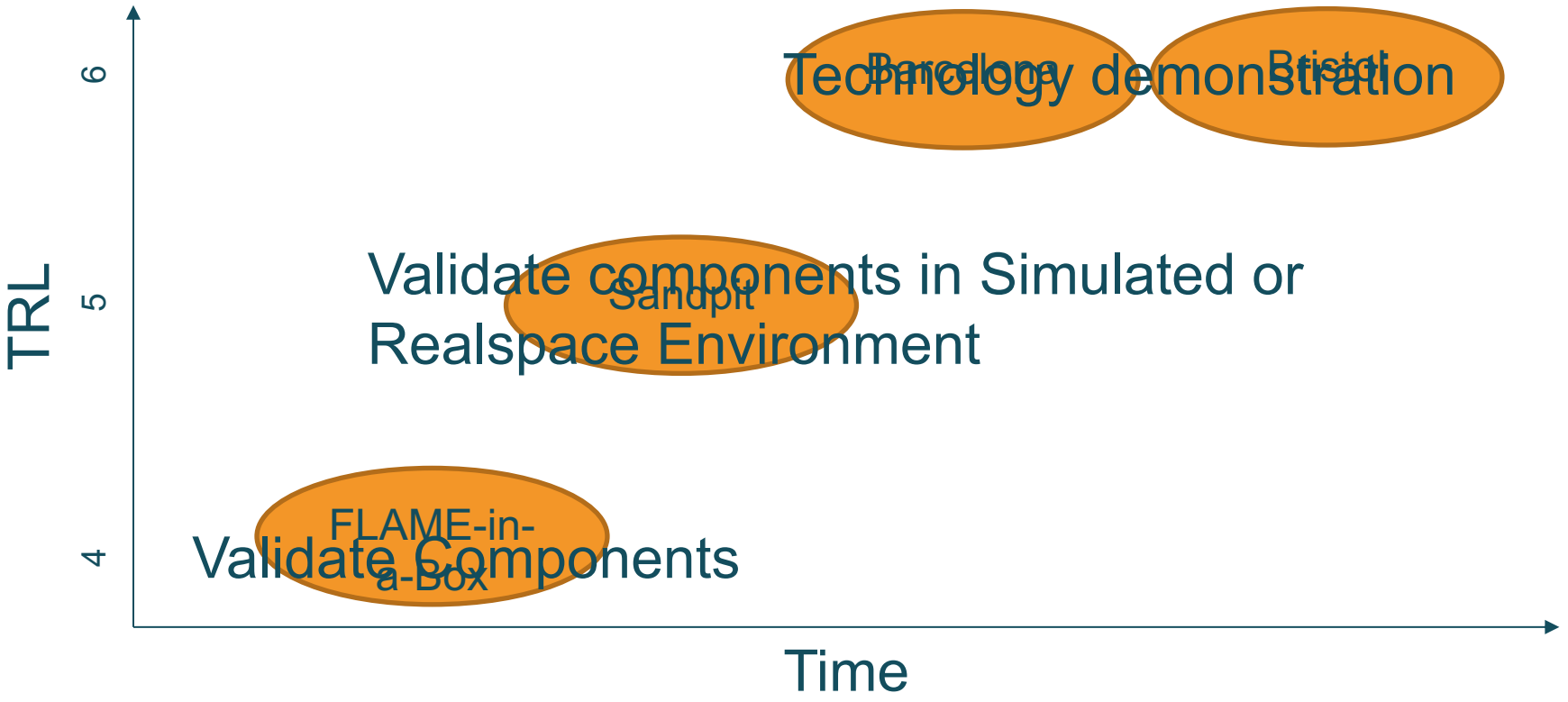
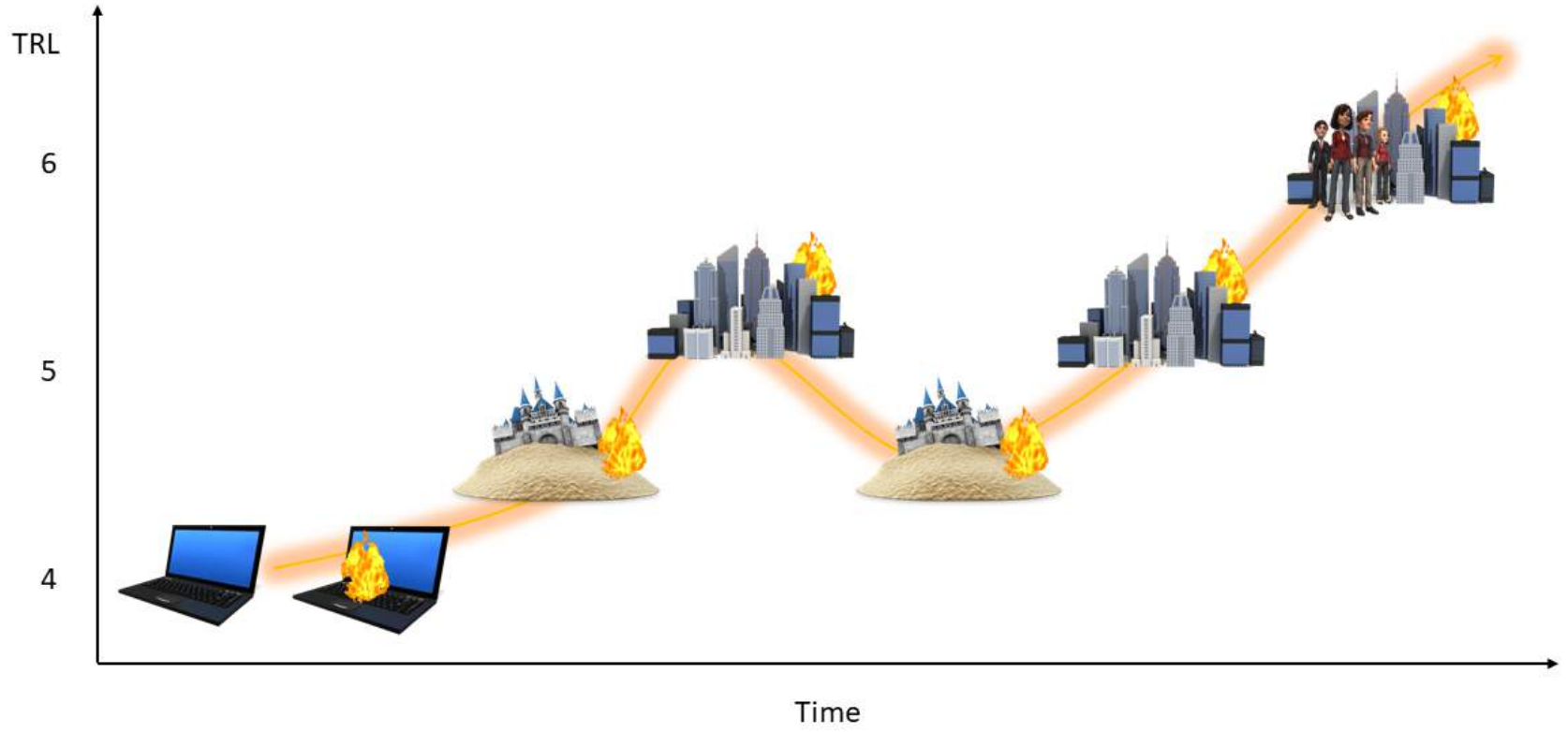
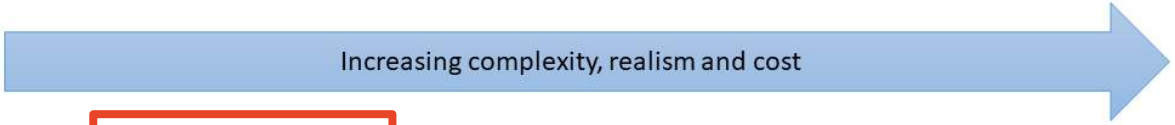
Experimentation Workflow



Iteration / Non-linear



DevOps Pipeline



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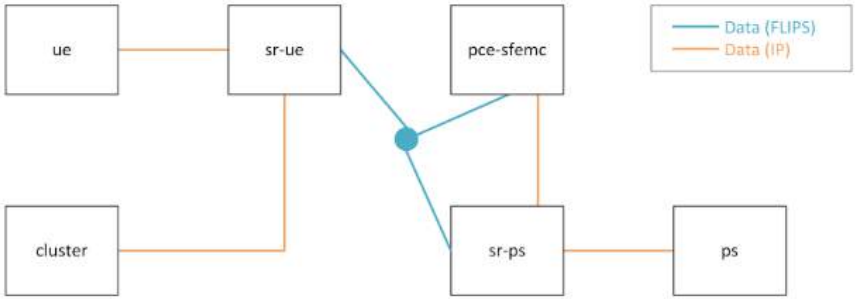
FLAME-In-A-Box

- FLAME-in-a-Box is a virtual appliance that fits on an ordinary modern office laptop
- FLAME-in-a-Box is a VirtualBox-base mini-FLAME platform which allows for testing of:
  - SFC orchestration templates
  - SF provisioning
  - Basic communication tests of deployed SFEs
- All instances that come as a single OVA and can run on a normal laptop 4 cores and 8GB of RAM.

FLAME-In-A-Box – Topology

- a UE (user equipment node) for the test or client software;
- a “cluster” where packaged service functions are deployed;
- the “sr-ue” which is a service router connecting the ue, cluster and pce-sfemc;
- the “pce-sfemc” node (path computation element and service function endpoint management and control services) which also includes the FLAME orchestrator;
- another service router (“sr-ps”); and
- a “ps” instance for platform services such as DHCP, IP gateway and DNS.



DevOps Pipeline

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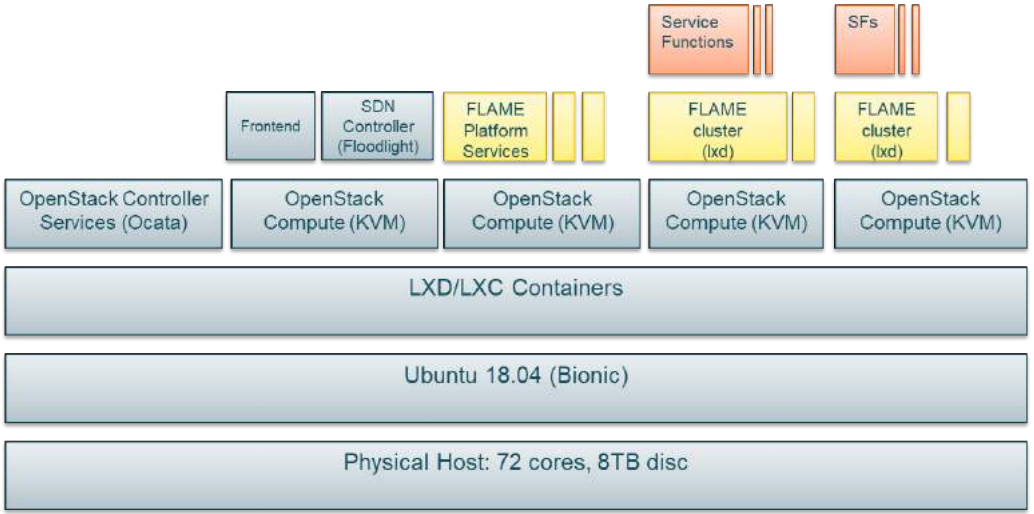
FLAME Sandpit

- The Sandpit supports integration testing, functional testing and experimentation of control scenarios
- Uses a combination of containers and virtual machines to emulate a deployment of the FLAME platform in a physical infrastructure
- In contrast to FLAME-in-a-Box
  - provides FLAME's cross-layer management and control (CLMC)
  - provides sufficient resources for service functions to execute and tested
- Includes "emulated UE" nodes which allow experimenters to install their test clients on the user-equipment (UE) nodes

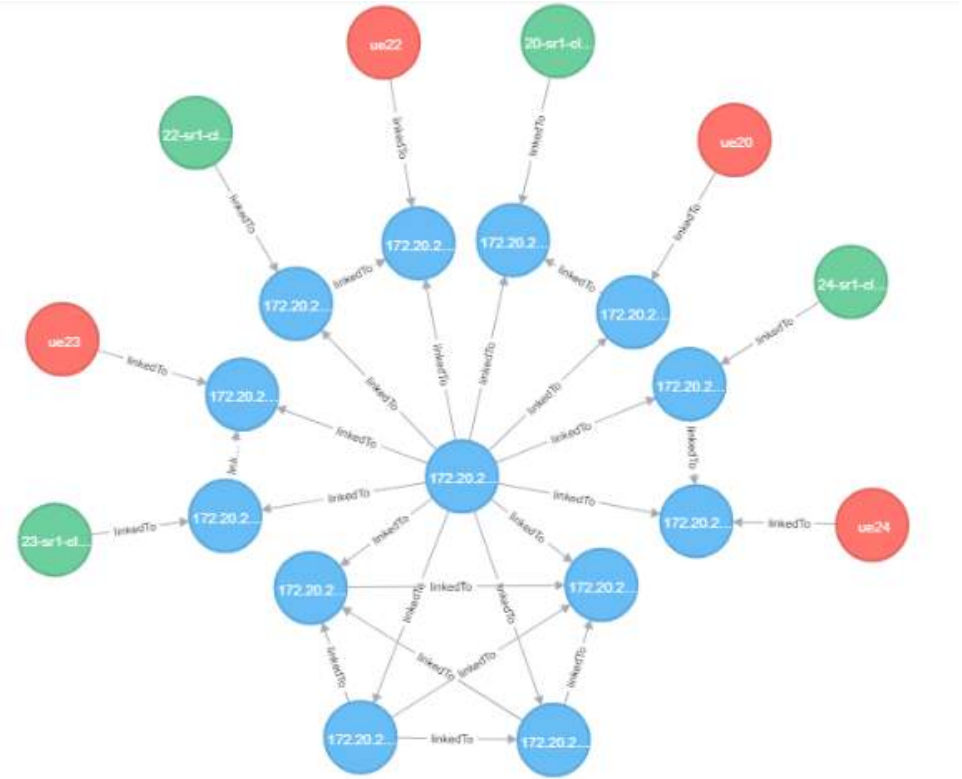
FLAME Sandpit Architecture

- The physical infrastructure is a single machine with 72 cores and 8TB of disk.
- OpenStack and Floodlight provide management of virtual compute and the SDN fabric
- OpenStack is deployed within LXD/LXC containers
  - the topology of the compute infrastructure and the capacity constraints of each compute to be flexibly configure
- No physical SDN fabric beyond OVS switches deployed as part of the FLAME platform itself



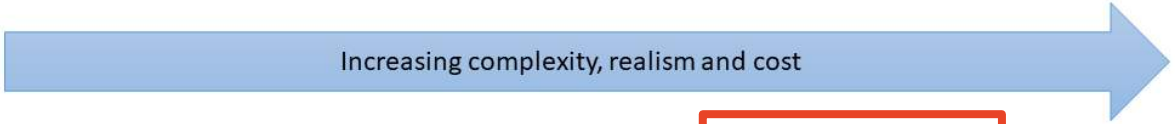
FLAME Sandpit Topology

- The data plane topology of the sandpit with clusters (green), emulated UE (red) and SDN switches (blue)
- Design supports a hierarchical topology of edge and metro data centres with different capacity constraints
- Configuration offers a practical baseline for testing scenarios
  - switches allows different SF routes to be explored including cases of routing loops.
  - The heterogeneity in DC and Edge resources allows SF endpoint management policies to be explored under different resourcing constraints
  - The distribution of UEs allows for demand to be generated from different parts of the network



Sandpit Tutorial Demonstration

DevOps Pipeline



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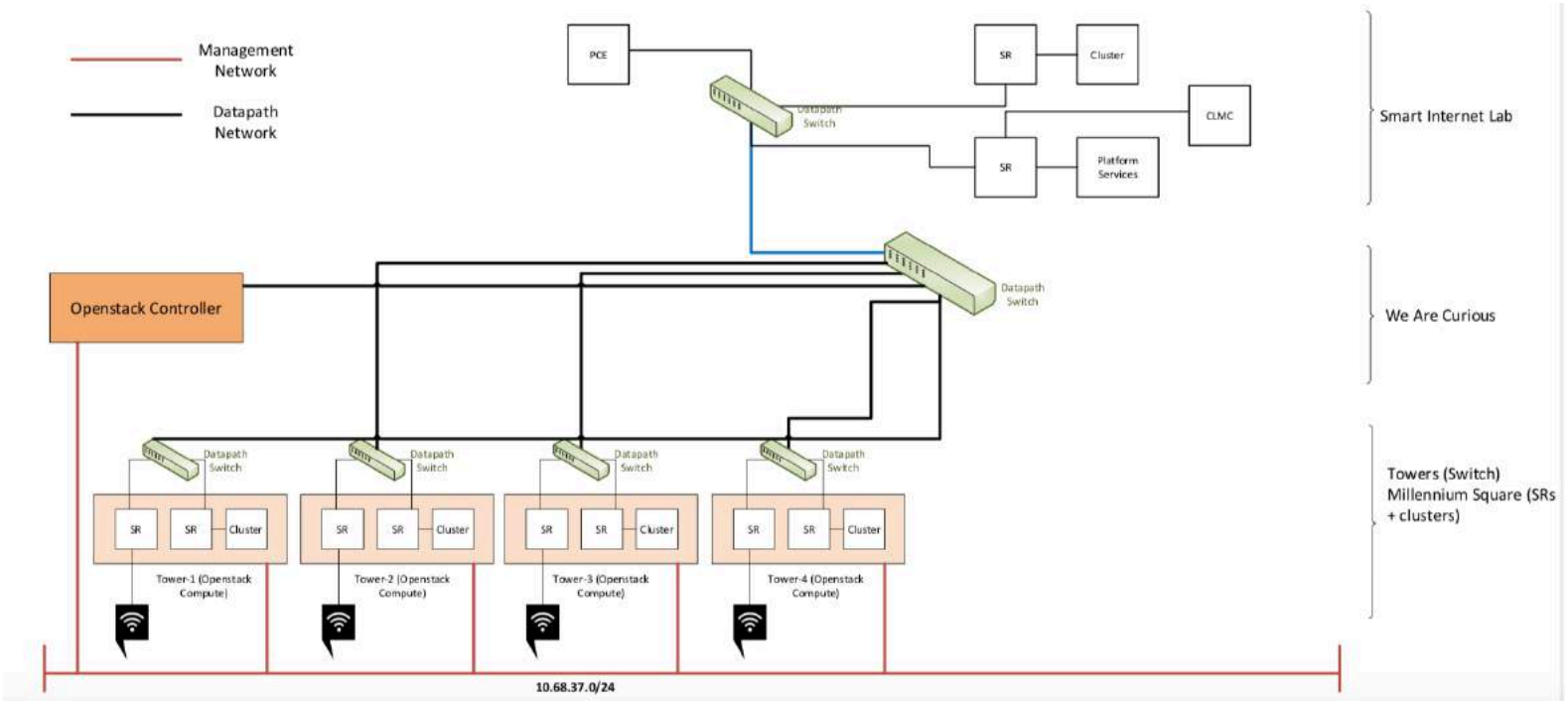
Bristol Replicator Infrastructure

- The purpose of the replicator infrastructures is to support experiments and user trials to explore the acceptance, viability and performance

- Deployed at UoB 5GUK Test Network Infrastructure

- Locations of MEC in the four towers, WiFi technology, and actual physical deployment location of the Millennium Square in Bristol

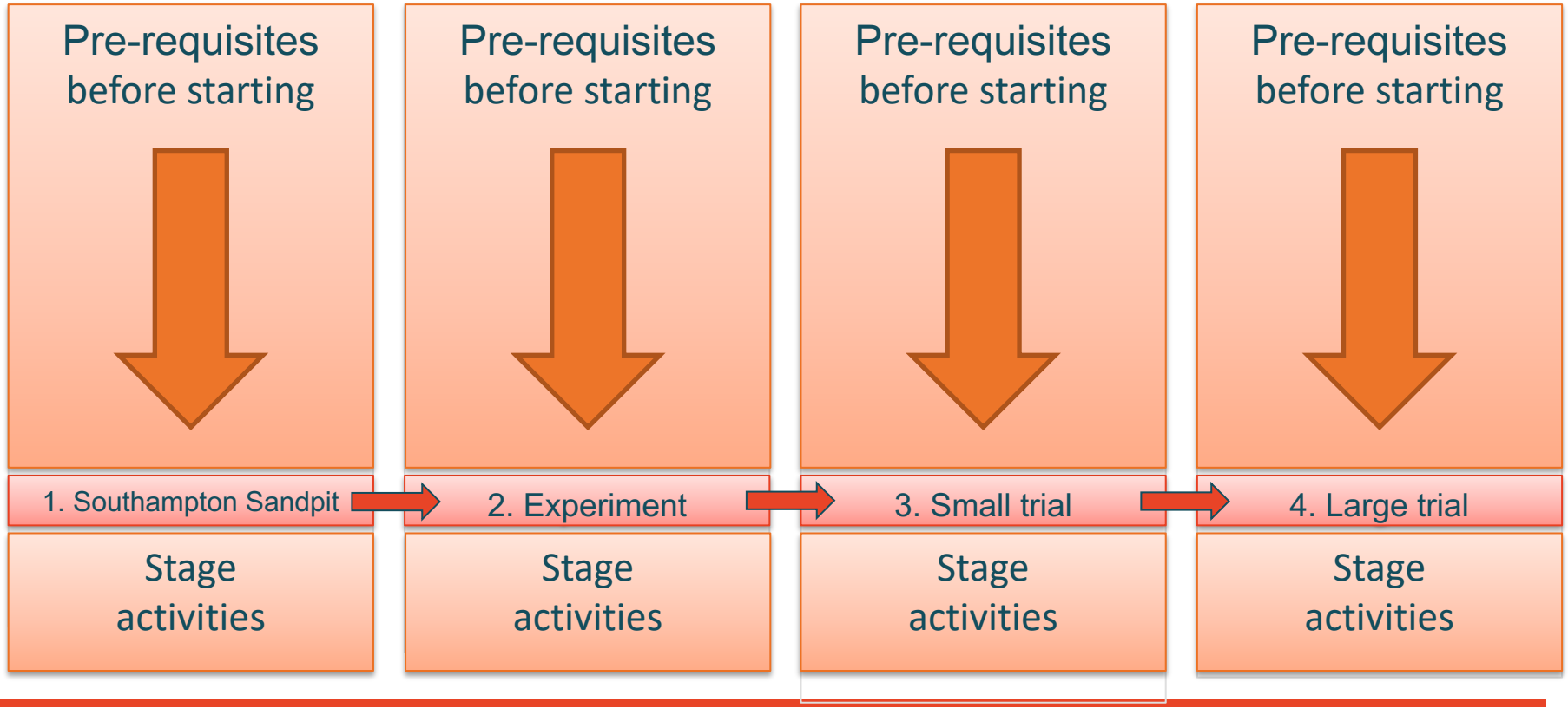
Bristol Replicator – Logical Topology



Bristol Replicator Capacity

Resource	Capacity	Availability Constraints
Compute	4 x OpenStack Compute Node with 15 core available.	These resources are dedicated to FLAME.
Storage	4 storage nodes with 900GB	These resources are dedicated to FLAME.
Networking	4x EdgeCore SDN switches 4 x Ruckus WiFi access points	These resources are shared across projects.

Workflow Stage Checklist



Workflow Stage Checklist

Urban Hacking

1. Southampton Sandpit	2. Experiment	3. Small trial	4. Large trial
Develop SF	Adjust TOSCA spec	**Obtain ethical approval (local / EIB)**	Publicity
(Unit) test SF	Define triggers	**Register with DPA**	Engage more participants
Integrate with CLMC monitoring		**Sign data sharing agreement**	Obtain consent
Integrate with WHOAMI	Define objectives	**Prepare participant info sheet**	
Test integration	Define test scenario	**Prepare consent form**	Anticipate issues with longer schedule
	Define metrics of interest	**Engage participants**	
Package SF		**Obtain consent**	
	Agree schedule	**Write data management plan**	Prepare for BYOD
Write TOSCA spec	Agree support		
Validate TOSCA spec		Prepare mobile devices	
Define triggers		Adjust TOSCA spec	Define triggers
		Define triggers	
Define objectives	Define objectives		Define objectives
Define test scenario	Define test scenario	Define objectives	Define test scenario
Define metrics of interest	Define metrics of interest	Define test scenario	Define metrics of interest
		Define metrics of interest	
Agree schedule	Agree schedule		Agree schedule
Agree support	Agree support	Agree schedule	Agree support
		Agree support	
Execute integration tests	Validate service	Execute trial	Execute trial
Explore monitoring and alerts	Validate usability	Observe and record	Observe and record
Examine data in Chronograf	Collect data for reuse	Debrief in person	Debrief online
	Disseminate	Examine data	Examine data
		Disseminate	Disseminate

Dev-Ops Pipeline

Increasing complexity, realism and cost

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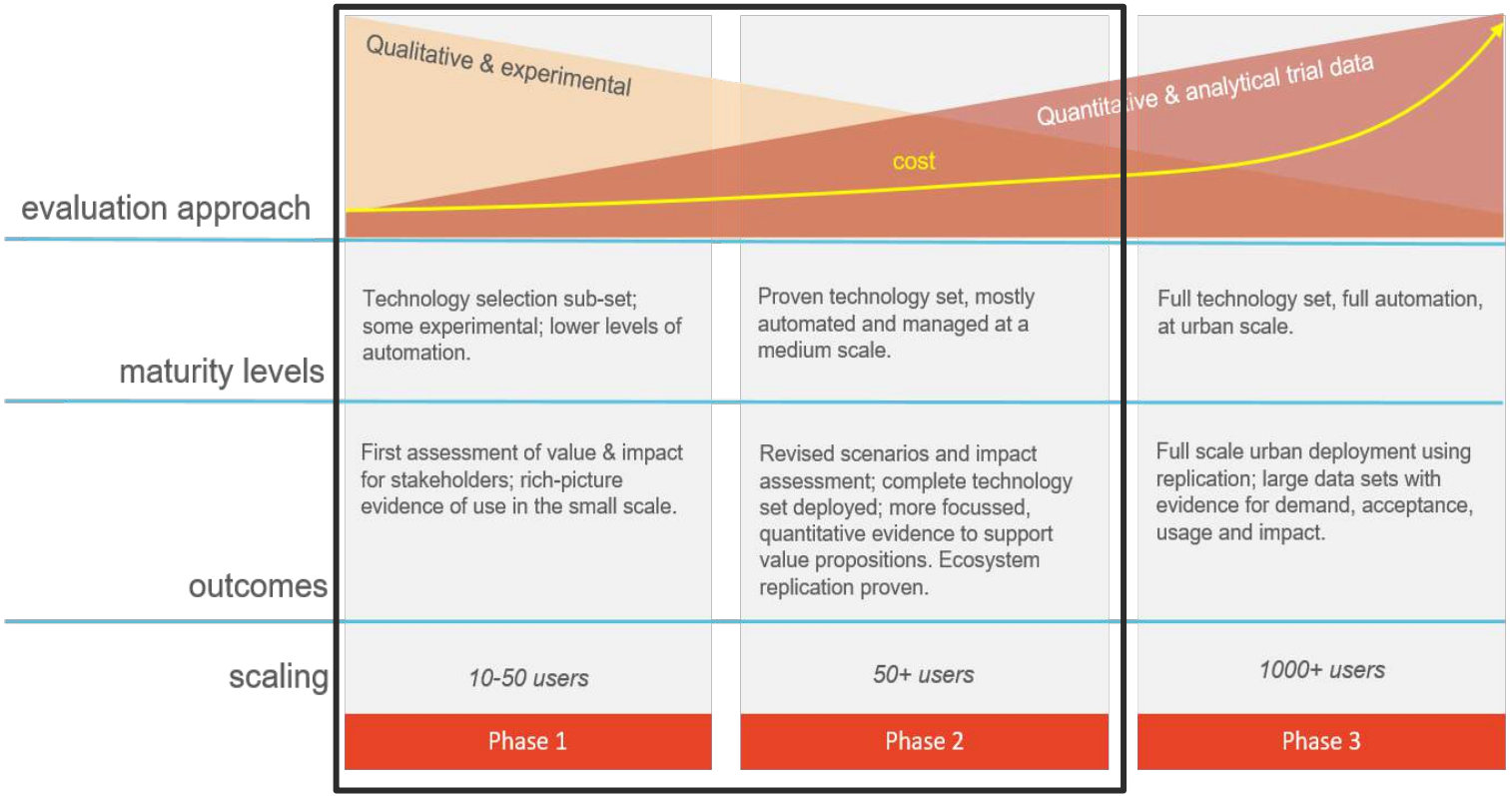
Experimentation Scale and Cost



GDPR

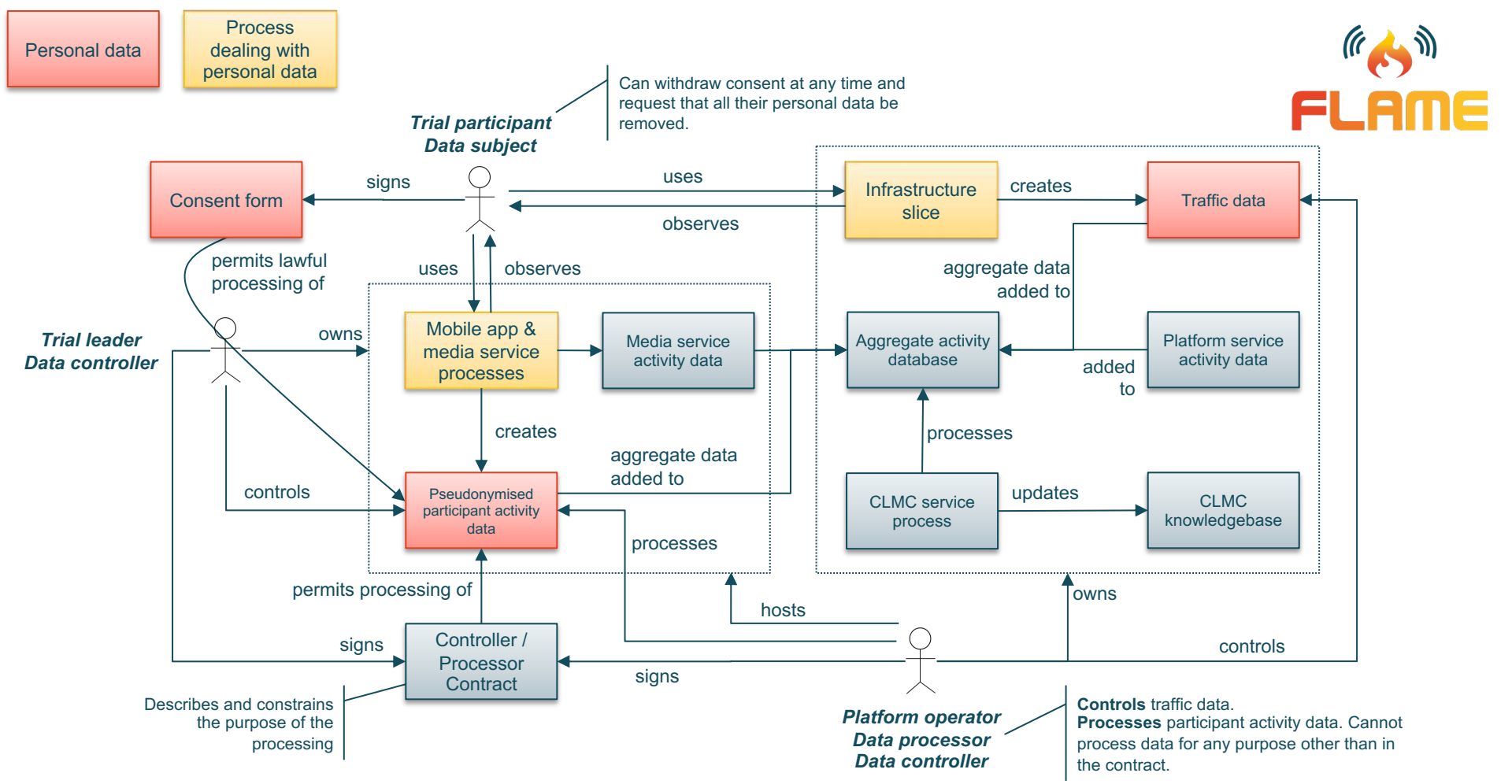
- Unifies data protection regulations across the EU
  - and in Switzerland
  - and in post-Brexit UK
  - and in countries dealing with EU data
- Comes into effect 25 May 2018
- Fines of up to 4% of annual worldwide turnover or €20m, whichever is greater, may be levied on both controllers and processors who are in breach of GDPR

Rights & Responsibilities Summary (1)

- FLAME will collect personal data from which sensitive data may sometimes be inferred
- Personal data:
  - will only be collected and processed when justified
  - will be pseudonymised as soon as possible
- Each trial will:
  - complete a data protection impact assessment
  - provide a participant information sheet
  - ask for explicit, informed consent for data collection

Rights & Responsibilities Summary (2)

- The platform and media services are:
  - being architected to enable Data Subject's rights
    - such as the right to have data deleted
  - using data protection by design and default principles
- Data Controllers and Processors will:
  - sign a standard contract to govern the data processing
  - keep detailed documentation on data control and processing activities
  - will each appoint a Data Protection Officer and will inform them of the project



Conclusions

- Verification, validation and evaluation of novel full stack 5G systems with users is complex
- FLAME provides a set of connected DevOps environments that are designed to:
  - address specific test objectives related to the level of resources available
  - control costs by incrementally increasing levels of realism at each stage
  - allow developers to seamlessly (as possible) transition between environments
- During the hackathon you'll experience the sandpit and replicator

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THANKS!

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