CCI Seminar

SLICES-DS Project and SLICES-RI Research Topics

Towards Hyperconverged Digital RI and Platform RI as a Service

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University of Amsterdam

Outline

- SLICES-DS Project and SLICES-RI ESFRI Proposal
  - Partners
  - Research topics
- Towards Hyperconverged Digital RI and Platform RI as a Service
  - Leveraging Platform concept for RI platform model
  - TMForum Digital Platform Reference Architecture (DPRA)
- Proposed Platform RI as a Service Architecture (PRIaaS)
  - Components and technologies

SLICES-DS H2020 Project

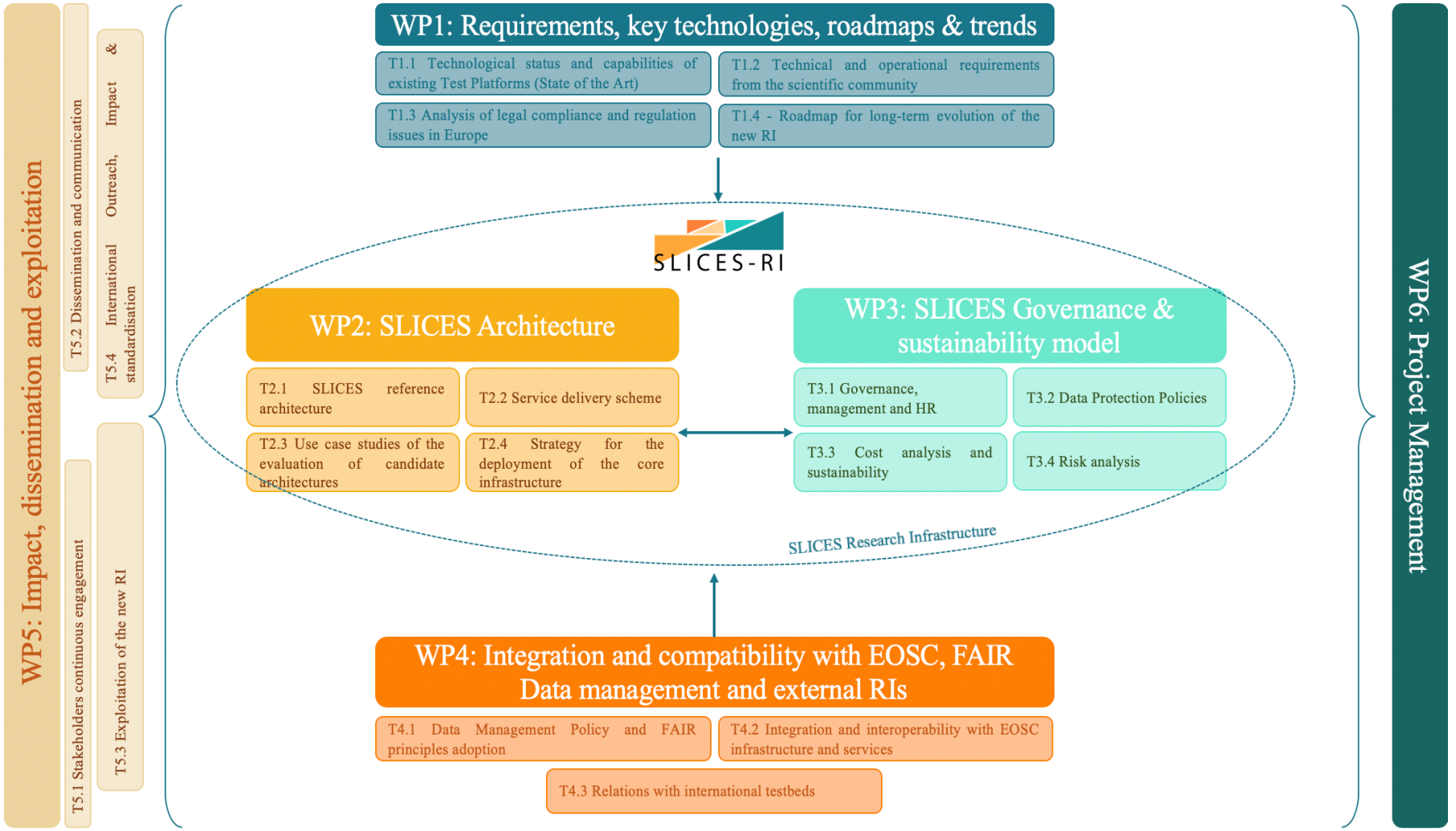
- Starts 1 Sept 2020 – Total 24 months
- 10 partners: Coordinator Uni Sorbonne
  - INRIA, PSNC, Uni Carlo III Madrid, UvA, others
- 2.9 Mln (UvA – 260K)
- Design Study for SLICES-RI project

- UvA Role – WP4 leadership, Task T4.2
  - Data Management and EOSC cooperation/alignment
  - Are critical aspects for current EU projects

Objectives: Focus on SLICES-RI

- Objective 1: To adequately design SLICES in order to strengthen research excellence and innovation capacity of European researchers and scientists in Digital Infrastructures
- Objective 2: To accomplish preparatory work and planning of the new Research Infrastructure
- Objective 3: To define governance and management of the new Research Infrastructure
- Objective 4: To define models for the financing of the new Research Infrastructure

SLICES-DS WPs Structure



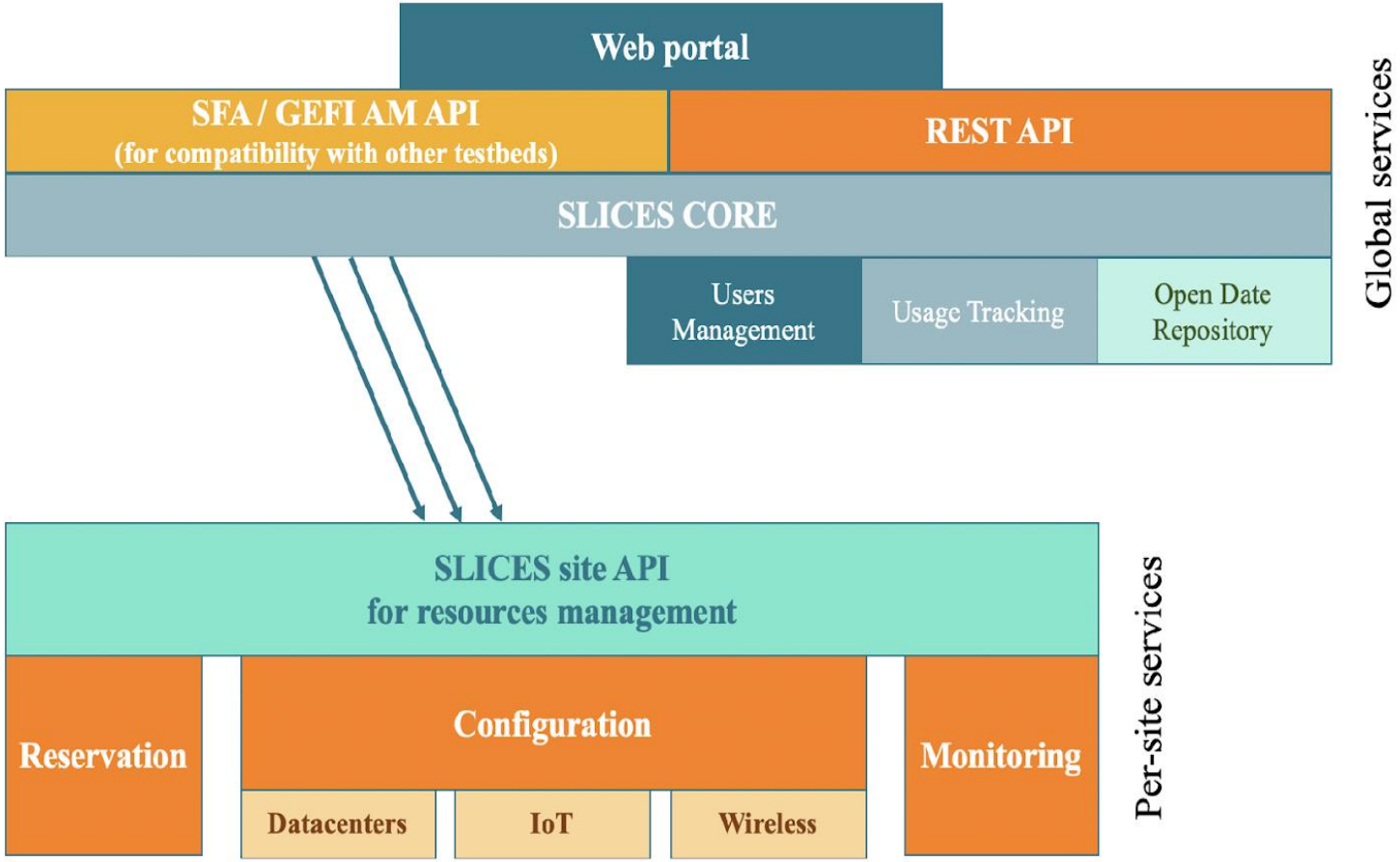
SLICES-DS WPs Structure

- WP1 - Requirements, key technologies, roadmaps and trends
  - Task 1.1 Technological status and capabilities of existing Test Platforms (SotA)
  - Task 1.2 Technical and operational requirements from the scientific community
  - Task 1.3 Analysis of legal compliance and regulation issues in Europe
  - Task 1.4 Roadmap for long-term evolution of the new RI
- WP2 - Roadmap for long-term evolution of the Research Infrastructure
  - Task 2.1 SLICES reference architecture
  - Task 2.2 Service delivery scheme
  - Task 2.3 Use case studies of the evaluation of candidate architectures
  - Task 2.4 Strategy for the deployment of the core infrastructure
- WP3 - SLICES Governance and sustainability model
- WP4 - Integration and compatibility with EOSC, FAIR and external RIs
  - Task 4.1 Data Management Policy and FAIR principles adoption
  - Task 4.2 Integration and interoperability with EOSC infrastructure and services
  - Task 4.3 Relations with international testbeds
- WP5 - Impact, dissémination and exploitation
- WP6 - Project Management

UvA in SLICES-DS

- WP4 Leadership
  - Task 4.2 Integration and interoperability with EOSC infrastructure and services
  - Deliverable D4.1 SLICES infrastructure and services integration with EOSC and Open Science (initial proposal) (M12)
  - Deliverable D4.5 SLICES infrastructure and services integration with EOSC, Open Science and FAIR: Recommendations and design patterns (final report) (M24)
- Other contributions
  - D2.1 Initial description of the SLICES architecture (M12)
  - D2.3 SLICES Reference Architecture
  - D4.1 Data Management Policy (M9)

SLICES-RI Architecture



SLICES-RI ESFRI Proposal

- SLICES Scientific Large-scale Infrastructure for Computing/Communication Experimental Studies
- ESFRI proposal
  - (To be) Endorsed by the ESFRI Roadmap
  - Funded approx 50/50 by National members and EU
  - Deadline 9 Sept 2020
  - 21 partners from 12 countries
  - Coordinator: University of Sorbonne
- Number of national preparation steps
  - Including into National NL ESFRI Roadmap
  - Commitment of cooperating organisations

SLICES-RI Research Areas

- **Advanced wireless networking**
  - New waveforms, higher frequencies up to THz
  - Spectrum and wireless management
  - Integrated sensing and communication
  - Heterogeneous radio management
- **Smart infrastructure operation and management**
  - Advanced protocols and architectures (virtualization, softwarization, programmability)
  - AI applied to infrastructure operation and optimization
  - Generation of data to train algorithms
  - Distribution of intelligence into (and beyond) the Edge of the network
- **Design and validation of new Digital Infrastructures and hyper-converged infrastructures**
  - Fog/Edge/cloud hyper converged infrastructures
  - Software component deployment
  - Distributed resource management & microservices
  - Geo-distributed data management
  - Federated deep learning
  - Datacentre infrastructures for distributed systems, applications and software stacks
- **Advanced functionalities**
  - New challenges arising from the verticals and the ubiquitous networks
  - Interoperability, composable infrastructure services on-demand (RI as a Service)
  - Seamless user experiences across technologies and domains
- **Energy efficiency and carbon footprint**
- **Security and privacy**

SLICES-NL Research topics (in the context of 5G)

- 5G Cloud Native Network infrastructure (CNNI) integration with cloud based applications
  - 5G with/for EOSC and GEANT
- E2E infrastructure slicing for secure and trusted data exchange/sharing
- Secure data containers and E2E trust management
  - Cyberinfrastructure security and key management
- Experimentation (and applications) on 5G CNNI with IoT and HPC applications

SLICES-NL Partners

- UvA (coordinator for NL)
- SURFnet and SURFsara
- VU
- TUDelft
- NLeSC
- TNO
- ASCI

SLICES-NL Research topics (UvA and partners)

- Cloud and Network Infrastructure research
  - Architecture and design patterns of the future RI Platform as a Service (PRIaaS)
  - Federated multi-cloud and inter-cloud infrastructure integration and management
  - Large scale experimentation on distributed hybrid cloud infrastructure involving public cloud providers
  - Decentralised network/compute optimisation in edge/fog environments
  - Sustainable cloud services with energy consumption monitoring and optimization
- Data Infrastructure
  - Big Data Infrastructure and Technologies (cloud enabled)
  - Trusted data exchange and processing with policy/rules enforcement, preserving data sovereignty and protecting data privacy
  - Data management and quality assurance aspects in Industry 4.0 experimentation and Digital Twins applications
- New security and compliance models for Complex Cyber Infrastructure
  - Distributed Cyber Security techniques and architectures
- Trustable and explainable Internet based on open networking technologies
- Federated Data Analytics and Deep Learning, in particular for predictive maintenance, logistics and smart cities
- Support of education on key technologies of the future data centric and cloud enabled infrastructures by provisioning educational platforms and resources for universities on demand

EU and NL involvement into 5G development

- EU and NL decided to actively participate and play leading role
- The following frequencies will be used in EU
  - 700 MHz, 3.5 GHz, and 26 GHz.
- Nederland will use 1.4 GHz and 2.1 GHz
  - https://stralingsbewust.info/2019/10/25/5g-waar-staan-de-zendmasten-voor-test-uitzendingen/

- TBD: Universities and research organisations working on 5G technologies

Timeline e-RI evolution and SLICES positioning

SLICES

RI Type (evolution stage)	Centralised 1994-1996	Interconnected 2004-2006	Distributed 2011-2012	Federated 2016-2018	EOSC-1 2020-2022	EOSC-2 (future)
Definition	Institutions based, centralised facility	Multi-institutions, interconnected	Large distributed facilities, domain or experiment oriented	Federated RIs supporting inter-domain cooperation and data exchange	Interoperable (European) RI, FAIR RI	Virtualised Pan-European RI platform as a Service and ecosystem (PRIaaS)
Network & Compute	Mainframe, variety of protocols, Advent of Internet, web, email	Interconnected data centers and experimental facilities, Internet TCP/IP as common protocol, remote access	Distributed interconnected computing facilities, SOA and webservices, Grid as cooperative and distributed computing	Cloud adoption, infrastructure services on-demand Federated facilities and network access, Federated access and Identity management, 3G->4G	Distributed scalable computing, cloud based Big Data technologies, high performance networks, 5G technologies, wireless access, IoT sensor networks	Composable virtualized RI provisioning on demand, common federated computing and networking platform/environment, Cloud, DevOps and AI enabled, Digital Twins
Data	Proprietary formats, system or experiment specific	Standard format for data exchange, proprietary metadata	Domain/RI based data/metadata interoperability, custom data models, distributed storage, directories	Interoperable data, domain based metadata	FAIR data, Data Factories, Metadata registries, Interoperable/common Data Management model	Fully adopted FAIR principles, Semantically enabled scientific data lakes, secure/trusted data exchange, full data value chain
Infrastructure Management Technologies	Local management	Local management, management information exchange	Common Management Model, Distributed management, 3G Roaming	OSS/BSS, Automated deployment, adaptation, monitoring	Integrated Operation and Automation, Automated identity provisioning	Fully automated RI and services provisioning, management and operation, optimisation

From EOSC-1 to EOSC-2: Four Technology Aspects

RI Type	EOSC-1 (2016-2018)	EOSC-2 (future) (2020-2022)	Beyond 2025	
Definition	Interoperable Federated (European) RI, FAIR RI	Virtualised Pan-European **RI platform as a Service and Ecosystem (PRIaaS)**		
Network & Compute	• Distributed scalable computing • Cloud based Big Data technologies • High performance networks • 5G technologies, wireless access • IoT sensor networks • **Portal and Services Catalog** • Industry standards and IDSA adoption	• Composable virtualized RI provisioning on demand (including for services integration) • Common federated computing and networking platform/environment, enabling virtual RIs • Cloud based and cloud enabled • DevOps and AI enabled services • Digital Twins • Interoperability and Integration with Industry infrastructure (e.g. IDSA+, Industrial Internet)		
Data Infra	• FAIR data • Data Factories and PID • Metadata registries • Interoperable/common Data Management model	• Fully adopted FAIR principles, extended to ontologies • Semantically enabled scientific data lakes, common vocabularies • Secure/trusted data exchange (data markets) • Full data value chain supported (cross-domain)		
Security	• Federated Identity Management, Federated Access Control • Automated identity provisioning	• Zero trust security, Trust Bootstrapping • Homomorphic encryption and data processing • Quantum ready encryption, Quantum enabled key management • Federated Identity Management, Federated Access Control • Automated identity provisioning		
Infra Managnt Technolog	• Integrated Operation and Automation	• Fully automated RI and services provisioning, management and operation • Optimisation of infrastructure and operation • DevOps and AI enabled (re-usable design patterns)		

Future Platform Research Infrastructure as a Service (PRIaaS) – Adopting TMForum DPRA

- TMForum DPRA (Digital Platform Reference Architecture) defines a telecom services provider platform that allows delivering a fully functional service platform/infrastructure for customers
  - IG1157 Digital Platform Reference Architecture Concepts and Principles v5.0.1, 21 July 2020 [online] https://www.tmforum.org/resources/reference/ig1157-digital-platform-reference-architecture-concepts-and-principles-v5-0-0/
  - Actualisation Platform is defined as the main DPRA component that enables creating customer/tenant service ecosystem
  - Implements platform economy concept
- Part of the TMForum Open Digital Architecture
  - IG1167 TM Forum Exploratory Report ODA Functional Architecture, 31 Jan 2020 [online] https://www.tmforum.org/resources/exploratory-report/ig1167-oda-functional-architecture-v5-0/

Platform Concept and Platform Economy

- "The platform business model enables interactions between producers and consumers of value. It achieves this goal through two mechanisms**. First, a platform provides a plug and play infrastructure** which encourages open participation by an external ecosystem of producers and consumers. **Second, it lays out the rules of governance for the interactions** that ensue."
  - Source: Sangeet Paul Choudary , http://platformthinkinglabs.com/start here/
- "A platform is a business based on **enabling value creating interactions between external producers and consumers**. The platform provides an open, participative infrastructure for these interactions and sets governance conditions for them. The platform's overarching purpose: to consummate matches among users and facilitate the exchange of goods, services, or social currency, thereby enabling value creation for all participants
  - Source: Choudary , Sangeet Paul; Van Alstyne , Marshall W.; Parker, Geoffrey G.; Platform Revolution: How Networked Markets Are Transforming the Economy and How to Make Them Work for You
- Example platform based businesses: Airbnb, Alibaba, Amazon, Azure (Microsoft), eBay, Facebook, Instagram, KAYAK, Pinterest, YouTube, Twitter, Wikipedia, Uber, Upwork
- This is in contrast to pipeline based businesses with linear value chains.

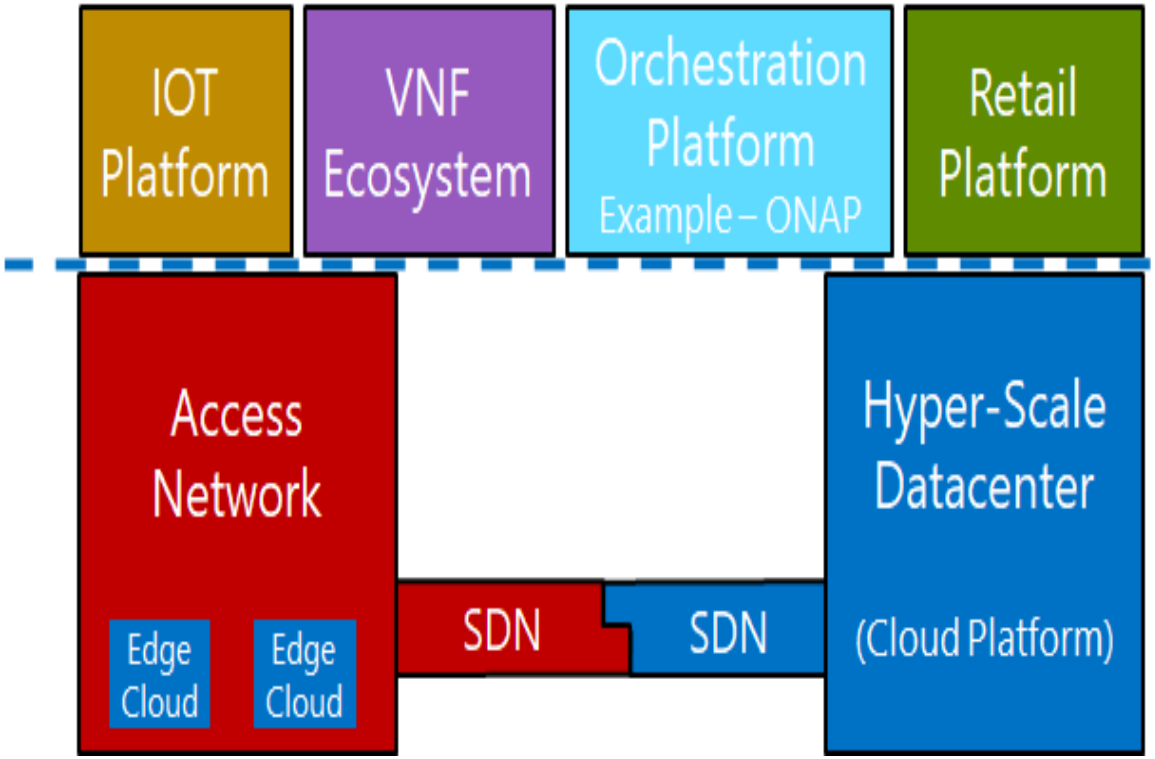
Platform vs Pipeline Model

- Source: Choudary , Sangeet Paul; Van Alstyne , Marshall W.; Parker, Geoffrey G.; Platform Revolution: How Networked Markets Are Transforming the Economy and How to Make Them Work for You
  - "Platforms beat pipelines because platforms scale more efficiently by eliminating gatekeepers." Example: Coursera vs. a college / university
  - "Platforms beat pipelines because platforms unlock new sources of value creation and supply." Example: Airbnb vs. an hotel chain
  - "Platforms beat pipelines by using data based tools to create community feedback loops."
    - For virtualized functions, objective metrics could also be used, in addition to subjective consumer feedback.
  - "Platforms invert the firm"

Applying Platform Concept to RI

- There is a need for defining and building new type of infrastructure for EOSC projects
  - Current EOSC pilot projects successfully demonstrated inter-/multi-domain data integration
  - However, each pilot project built own underlying infrastructure
- Future EOSC infrastructure should provide functionality
  - (1) automate deploying specialized RIs with focus on scientific data integration
  - (2) create a repository of infrastructure/services design patterns and common templates
  - (3) facilitate cooperative/business relations between partners
  - (4) apply governance and compliance policies by-design
- Learn from and leverage best industry practice and infrastructure development trends
  - Hyperconverged Infrastructure and 5G e2e network slicing
  - Industry developed platform and cloud native models
  - DevOps and DevSecOps

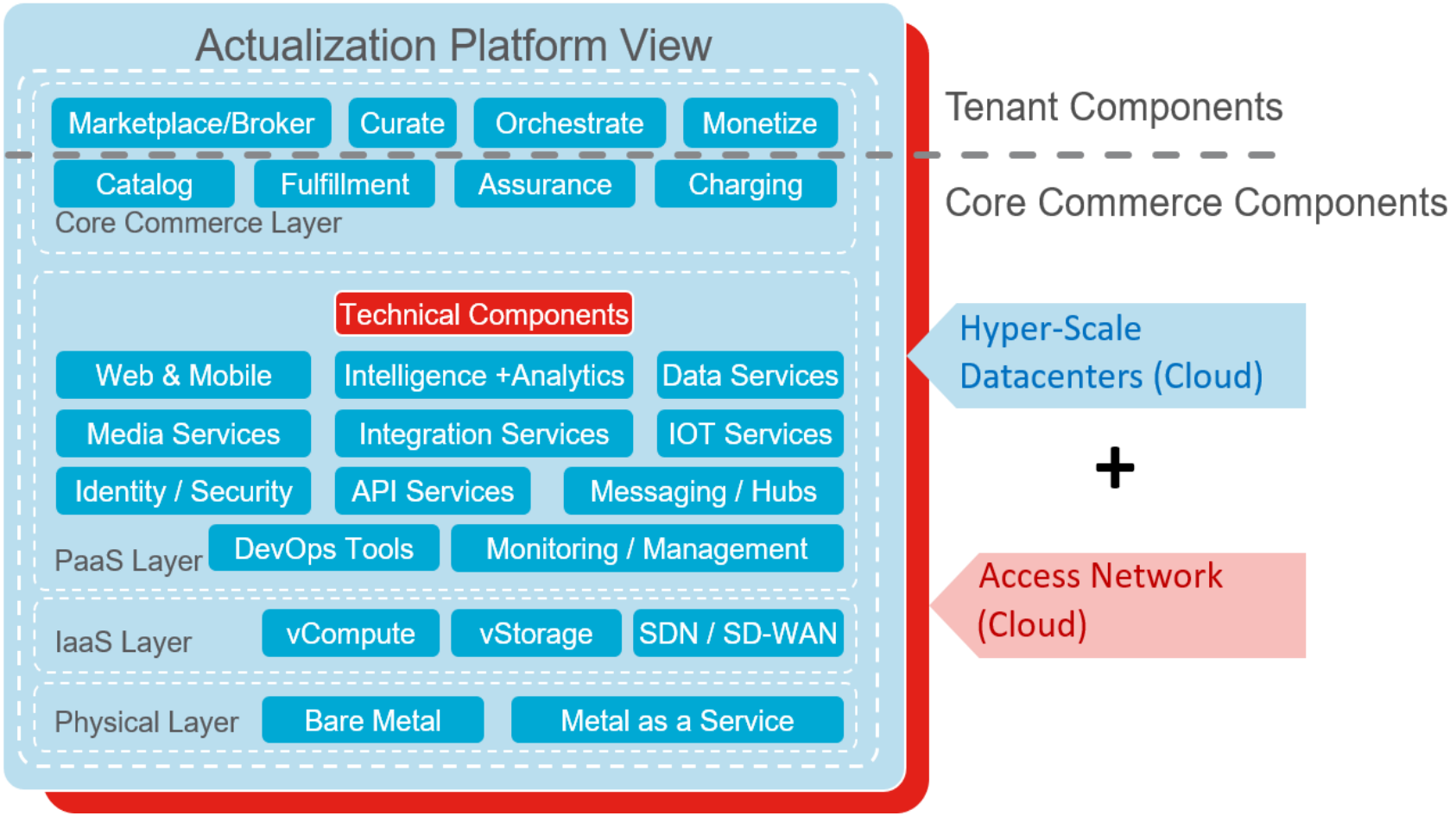
TMForum: Actualization Platform View across Access Network and Hyper-Scale Datacenter



- TM Forum has successfully driven Communications industry-wide convergence on best practices to operate, manage and monetize communications services that, for decades, have been delivered under a Service

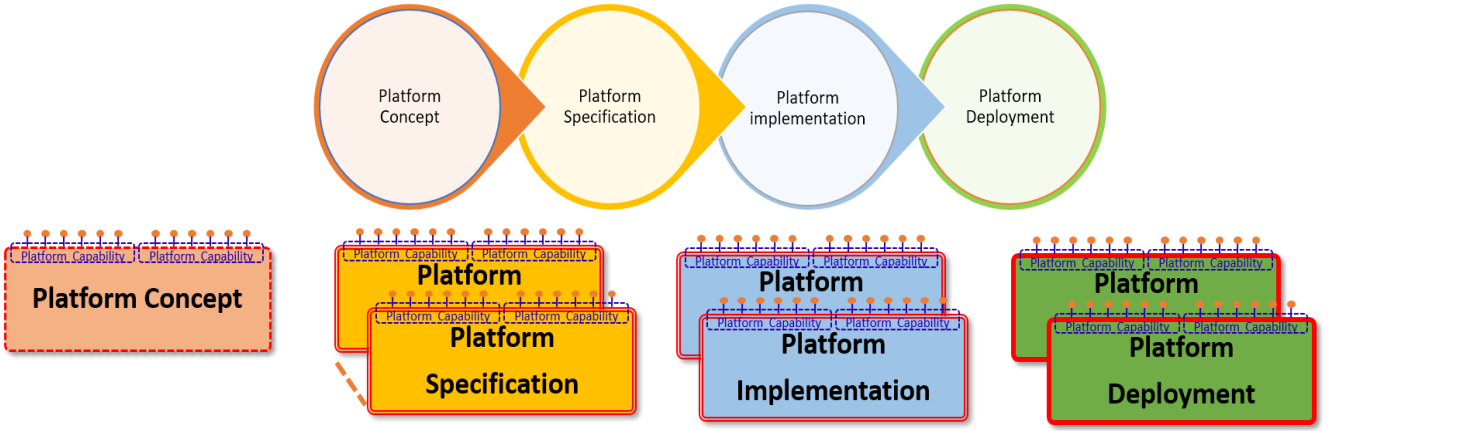
- The current platform-driven economic transformation is expect to evolved and spread across the entire world economy.
- The lack of open standards will lead to either an unmanageable proliferation of platforms and APIs, or a massive consolidation around a few competing de facto standards.
- In either case, as additional platform-based ecosystems become connected and as more value is created across multiple platform based ecosystems, there will be increased interoperating costs and reduced agility with regard to value creation. This will eventually inhibit innovation.

TMForum: Actualisation Platform View



- TM Forum Actualization Platform View The underlying infrastructure of edge to hyper scale datacenters and networks that host the software components that make up the Business Platform, enabled by reusable technical capabilities that are required to operate in an agile and efficient manner.

TMForum: DPRA Lifecycle Agility



Concept Definitions e.g.
- Platform
- Platform governance
- Platform Capabilities/ services
- Open APIs
- Curation (Marketplace as one example)

Platform Specification
Reuse of
- Business capabilities e.g marketplace concept
- Platform capability specifications
- Open API specifications
- Framework (e.g SID terms)
- Spec. of Platform relationships e.g compostion

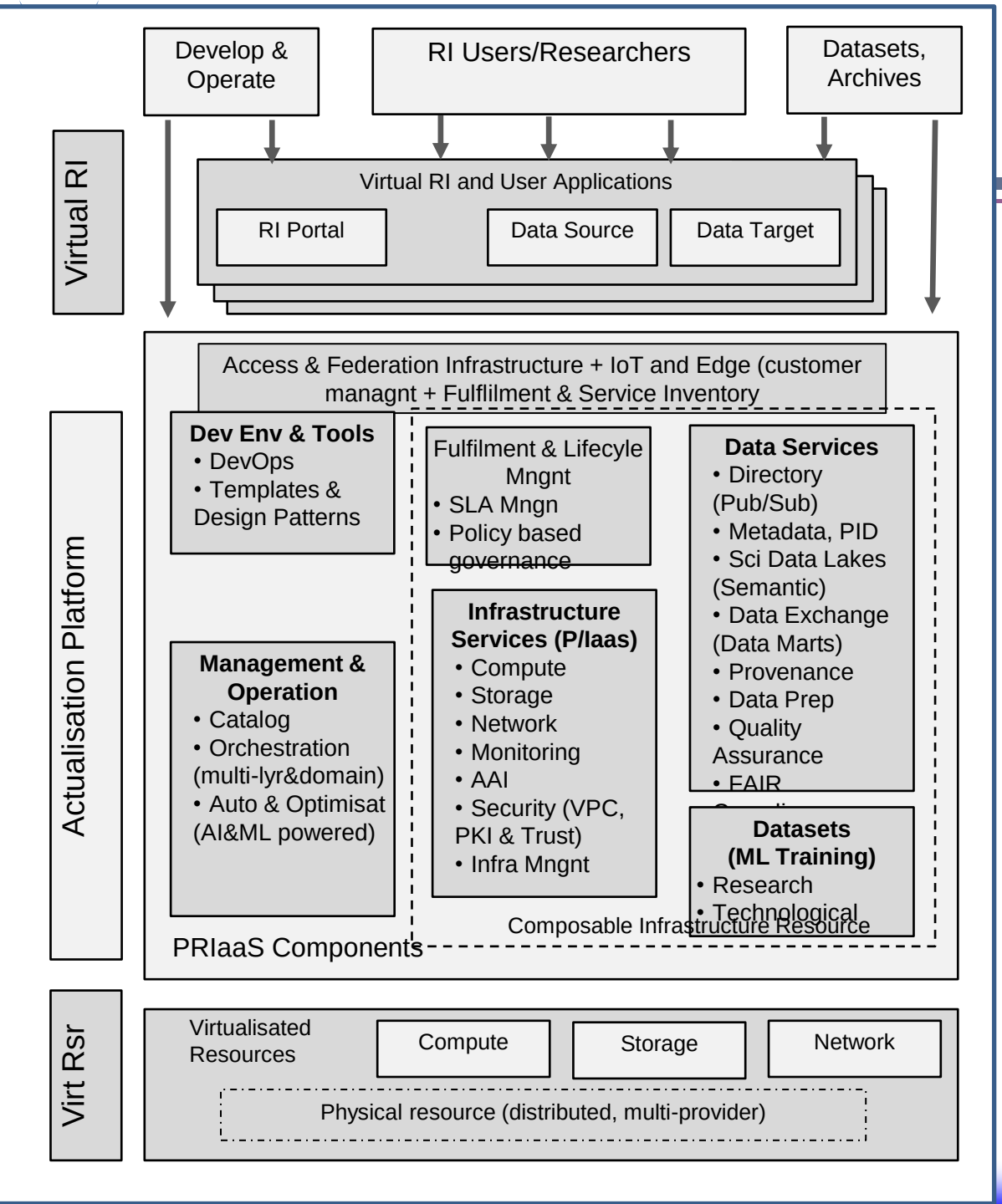
Platform implementation
Platform Impl. Spec. on one or more IT platforms i.e. realization of SaaS on PaaS/Iaas e.g.
- Azure
- AWS
- Open Source e.g Open stack
- ....

Defn. Deployment descriptors

Platform Deployment
- S/w image deployed on IT platforms
- Instantiation of deployment descriptors e.g. Realization Deployment descriptors Defining run time for Platforms and their composition (relationships)

- ***Platform Concept:*** i.e. modelling the things that comprise a Platform, how Platforms expose capabilities and how Platforms are interconnected.
- ***Platform Specification*** for one or more platforms to realize a solution.
- ***Platform Implementation*** in code with the supporting operations processes, policies etc. Note that for each platform specification there may be multiple implementations on what are called Actualization Platforms (defined later) e.g. Microsoft Azure, AWS, OpenStack, etc.
- ***Platform Deployment*** of instances of those Platforms on Actualization Platforms with a configuration that realizes the business solution.

PRIaaS Architecture Model (in progress)



Actualisation Platform Components

- Core Infrastructure Services (IaaS & PaaS)
- Data Services
- Management and Operation
- Development Environment and Tools
  - DevOps
  - Templates and Patterns
- Workflow and Lifecycle Management
- Access and Federation Infrastructure + IoT and Edge

PRIaaS Technology Aspects and Linked Projects

- GEANT GN4-3 Research WPs and Tasks
  - Operation, Automation, Virtualisation Architecture (OAV) and Service Provider Architecture (SPA)
- EOSC
  - EOSC Architecture and FAIR data principles
- Former projects
  - GN4-1 Open Cloud eXchange (OCX) and Big Data Architecture Framework (BDAF)
  - GN4-2 ZeroTouch Provisioning, Operation and Management (ZTPOM)
  - GN3 Composable Services Architecture (CSA)
  - GEYSERS Intercloud Architecture Framework (ICAF)

SLICES-DS Activities and Actions

- Kick-off meeting 17 Sept 2020 (Virtual)
- D4.1 Data Management Plan and Open Data – 6M
- Need to plan NL consolidation event
  - Collect contribution for SLICES-DS
  - Plan activities for SLICES-RI (in case of successful proposal)
- Possibly include into SURF Program for 2021-2022
  - Present at SURF Days 2020

Discussion