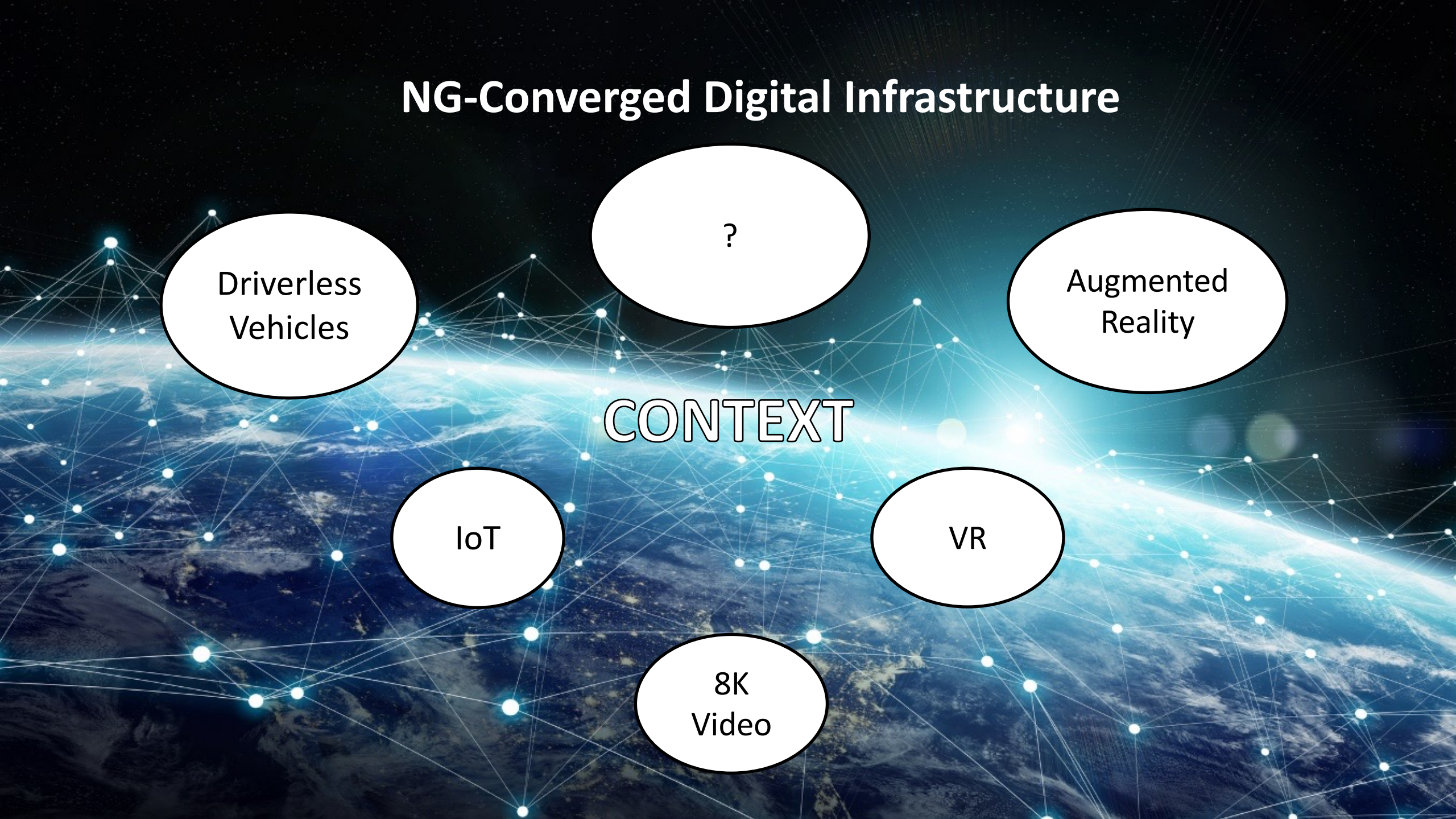

NG-CDI
NEXT GENERATION • CONVERGED DIGITAL INFRASTRUCTURE
UKRI Engineering and Physical Sciences Research Council
BT
Nicholas Race, Lancaster University
UK Spectrum Policy Forum
Technology Enablers for Spectrum & Energy Efficient Wireless Access
26th May 2021
University of BRISTOL
UNIVERSITY OF CAMBRIDGE
Lancaster University
UNIVERSITY OF SURREY


NG-Converged Digital Infrastructure
?
Driverless Vehicles
Augmented Reality
CONTEXT
IoT
VR
8K Video

Project Overview

- £5M EPSRC **Prosperity Partnership** over 5 years (Nov 2017 – Oct 2022)
  - Funding: £2.5M BT, £2.5M EPSRC

- Developing next-generation data-driven methods and technologies for the resilient, autonomic digital infrastructure of the future.

- Multi-disciplinary research programme involving four Universities:
  - **Lancaster** (Networking, Mathematics & Statistics)
  - **Cambridge** (Industrial Automation, Organisational Behaviour)
  - **Surrey** (Networks – 5G/6G)
  - **Bristol** (Wireless Systems)

NG-CDI Objectives

- Developing a completely **new architecture** for digital infrastructures, composed of **highly- dynamic network functions** based on a micro-NFV approach that are collectively able to **adapt to the real-time requirements** of future digital services.
- Creating a new **autonomic framework** for digital infrastructure to equip the nodes of the infrastructure network with the ability to **understand** their state, **detect and diagnose** disruptions to service, and take **autonomous** actions.
- Implementing approaches for the **successful integration** of these technologies **within the business functions** with an aim to **improve service assurance** and organisational value.

An architecture which…

- Deals economically with complexity and scale
- Manages multi-party requirements
- Greater agility; supporting new products, trials and models
- Focusses on service levels: customers, balanced investment timescales
- Connects with existing and new processes: information & control interfaces. People & culture
- Provides mechanisms to create and flex managed risks

Architectural

Domain owners
Service providers
Content Providers
Infrastructure operators

Multi-party negotiation & definition

Functional | Non-functional | Cost-risk

Knowledge and control layer

Converged infrastructure

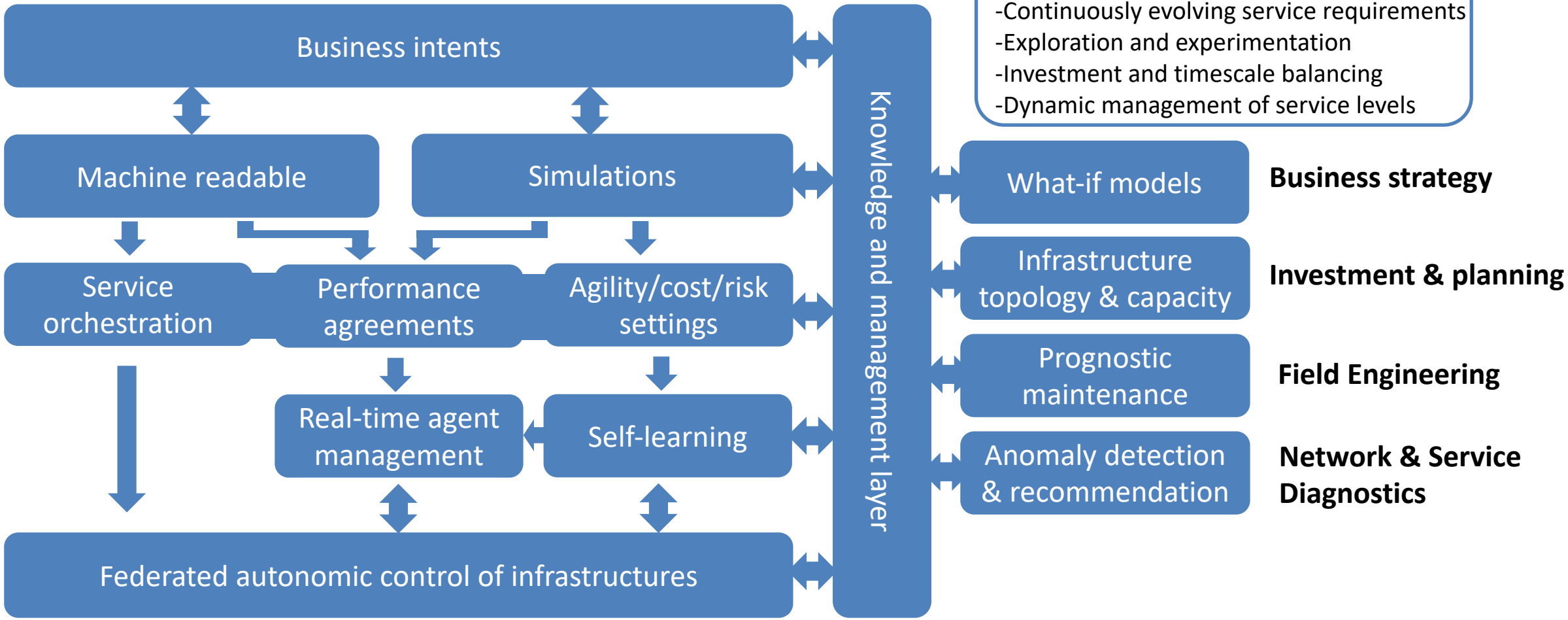
environment

demand

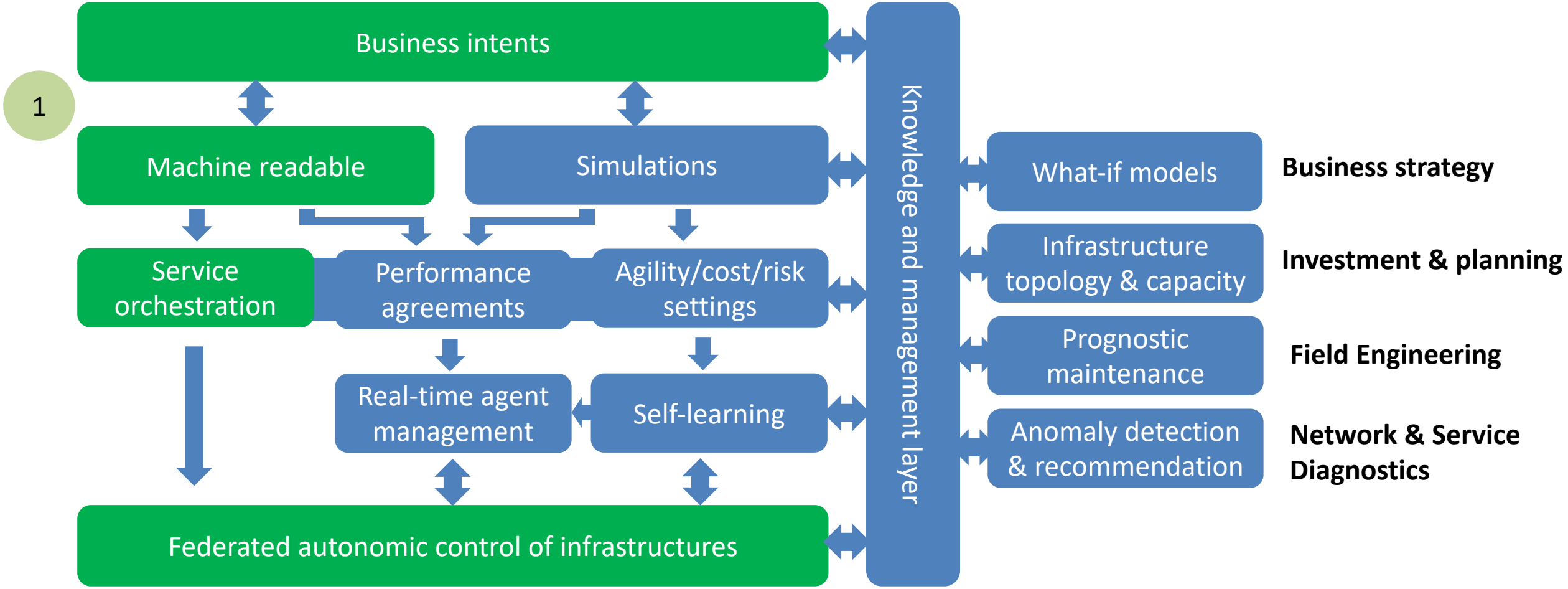
Service users

Processes
Field Force
Operations Centres
DevOps
Analysts

NG-CDI - the full lifecycle

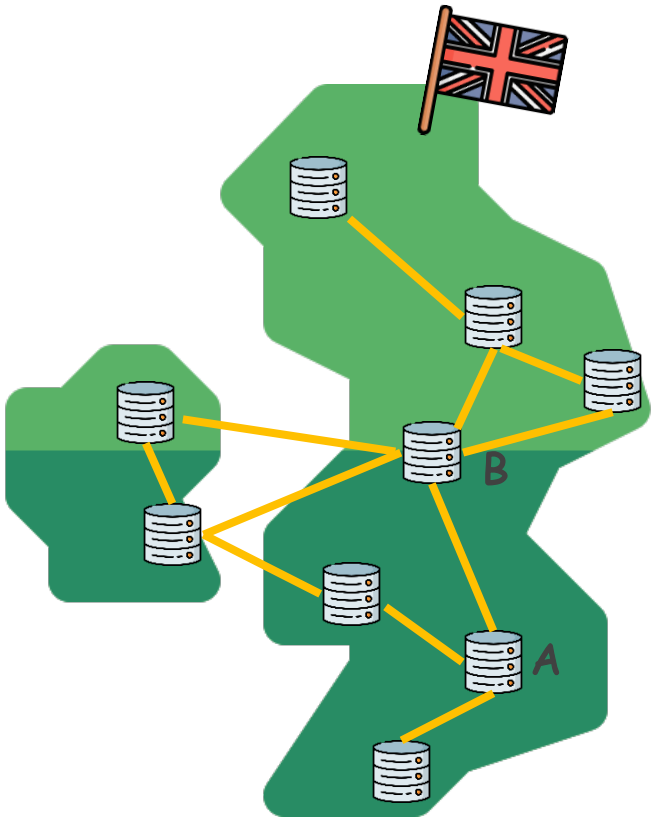


NG-CDI Highlights:
Intent Based Networking



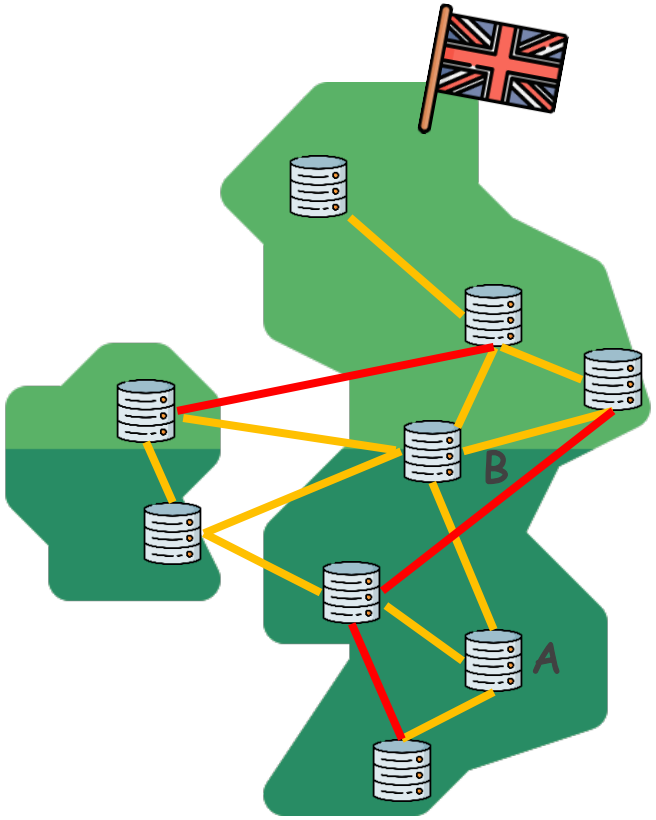
Automating router s/w upgrade

Nowadays



- Manually migrate traffic away from switch A & B
- Update each switch s/w separately
- Manually reroute the traffic

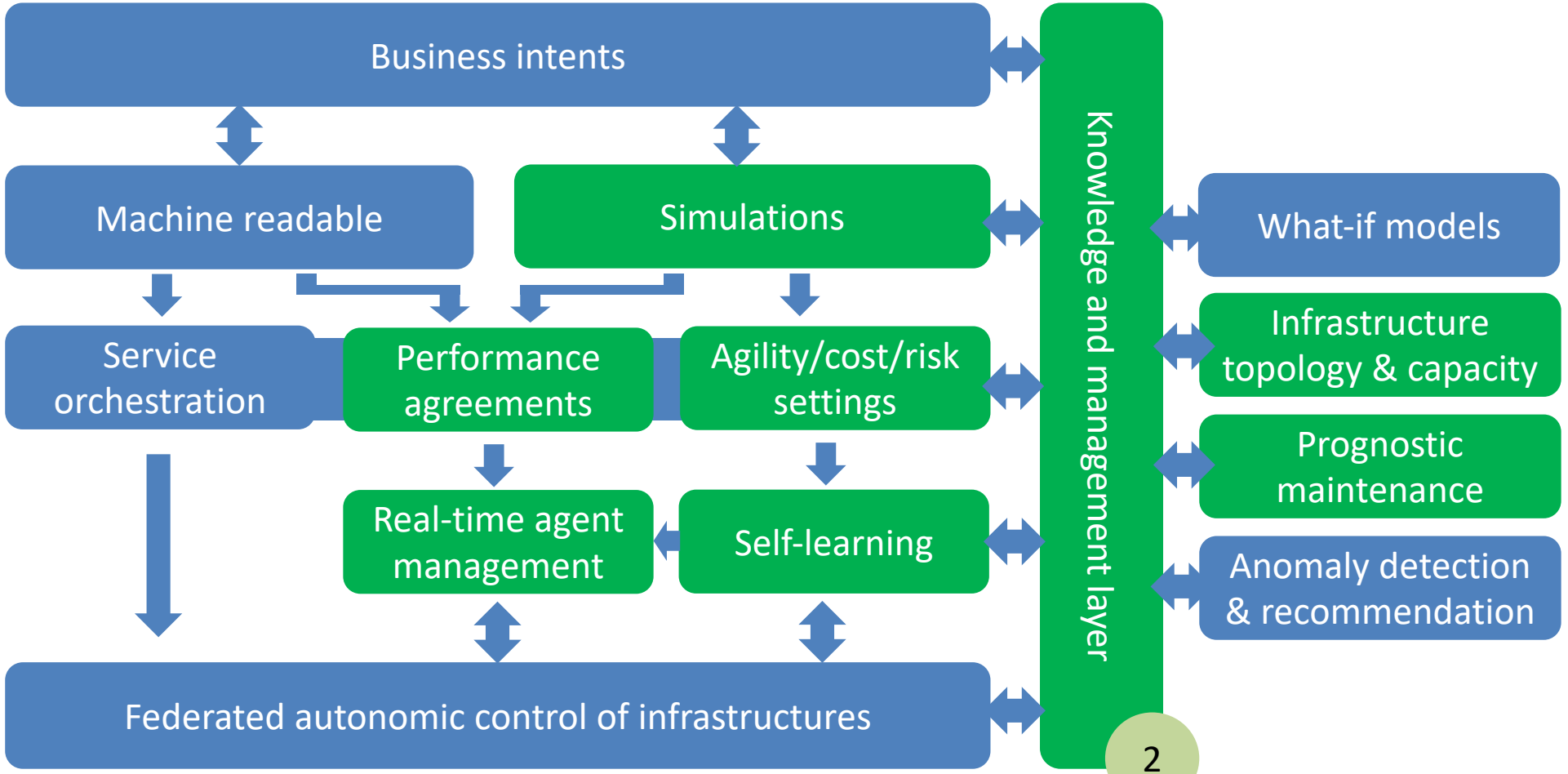
IBN approach



Upgrade switch A and B!

- Automatically migrate the traffic from switch A and B
- Update all the switches with tested configuration (CI/CD)
- Automatically reroute the traffic back

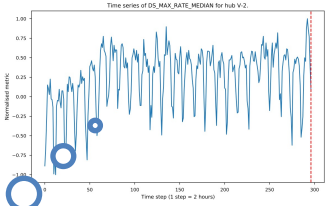
NG-CDI Highlights: Service Assurance



Service Assurance: Approach

- Generation and analysis of asset condition and perf. data

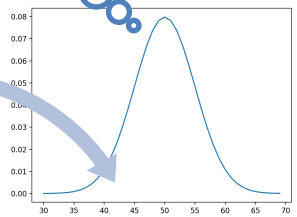
Data



Anomaly detected!

Status

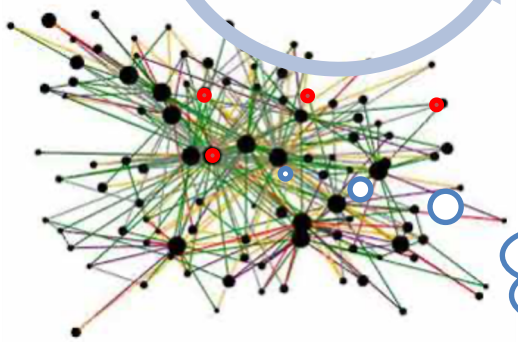
- Identify what is happening to the assets



DP failure in 1 day!

Behaviour

- Predict asset and network behaviour



Major Service Outage in 20 mins!

DP needs to be replaced in 8 hrs

Decisions

- Decide optimal interventions and timing

Reconfigure service provision and schedule repair

Actions

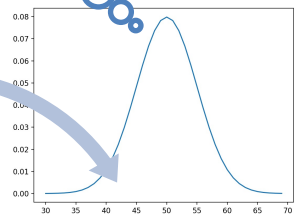
- Autonomous action/Manual intervention

Service Assurance: Approach

- Generation and analysis of asset condition and perf. data

Data

DP failure in 1 day!



Status

- Identify what is happening to the assets

- Predict asset and network behaviour

Behaviour

DP needs to be replaced in 8 hrs

Decisions

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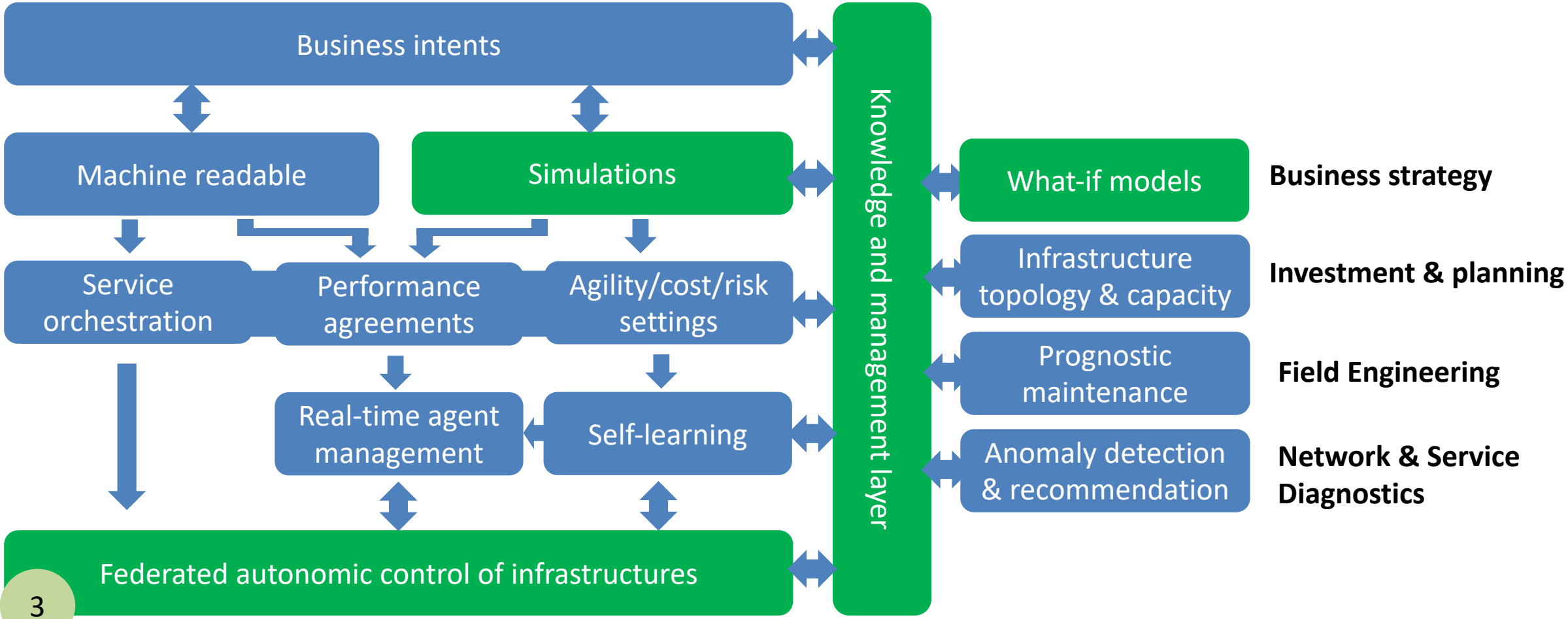
Reconfigure service provision and schedule repair

- Autonomous action/Manual intervention

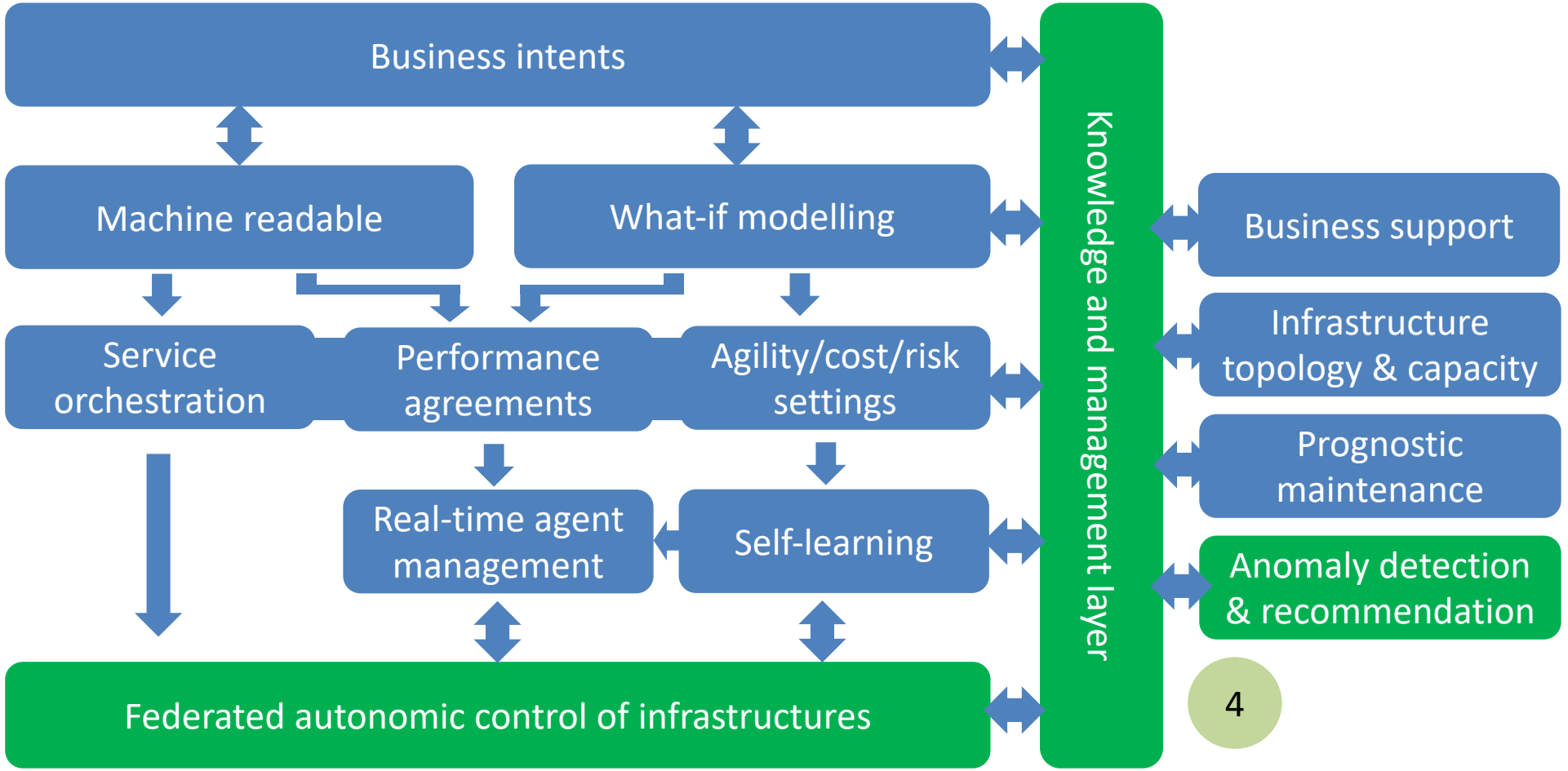
Actions

Feedback, Learning, and Redesign

NG-CDI Highlights: Simulations & Autonomic Control



NG-CDI Highlights:
Real-Time Anomaly Detection



Organisational Transformation

- Emerging challenges
  - Algorithmic systems can be complex, hard to investigate and hard to understand (even without machine learning elements)
  - Machine learning introduces significant unpredictability
  - Machine learning can reproduce human bias and prejudice
  - When machines become more autonomous, humans are less routinely involved – so they know less about what to do when they are needed
  - GDPR, etc.
  - The economic and social problems of inequality and work insecurity driven by growth of technology businesses
- Design approaches to consider
  - Systems should be "enquirable-into" without being intrusive (Anderson et al)
  - Systems should involve the user in a timely and meaningful way
  - Systems should have "explanation engines" (Doshi-Velez et al, 2017)
  - Design to optimise the human operator with automated support?
- Legal and regulatory changes needed
  - Change to tort law to cover unpredictable system behavior
  - Accuracy, fairness, explainability and stability to be regulated?

More Information ….

- BT Thought Leadership presentations, available from:
  - https://www.ng-cdi.org/video-archive

  - Next Generation Converged Digital Infrastructure (Nick Race)
  - Intent Based Networking (Ning Wang, Harris Rotos)
  - Intelligent Asset Management for Service Assurance & Infrastructure Management (Ajith Parlikad)
  - Network Assurance through Massive on-line Anomaly Detection (Idris Eckley)
  - Technology, Risk and Organisations (Philip Stiles)
  - World Models and Digital Networks (Rob Piechocki)

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