

Selected use cases from the FG-AN deliverables.

ITU-T Focus Group on Autonomous Networks


Vishnu Ram

Vishnu.n@ieee.org

FG-AN



Where to find



INTERNATIONAL TELECOMMUNICATION UNION
**TELECOMMUNICATION
STANDARDIZATION SECTOR**
STUDY PERIOD 2017-2020

**FOCUS GROUP ON AUTONOMOUS
NETWORKS (FG-AN)**

AN-O-013-R1
Original: English

Question(s): N/A
Source: Editors
Title: Use cases for Autonomous Networks

OUTPUT DOCUMENT
Virtual, 1-3 September 2021

International Telecommunication Union

ITU-T Technical Specification
TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

(28 October 2021)

Technical Specification
Use cases for Autonomous Networks

FG-AN

ITU-T Focus Group on Autonomous Networks was established by ITU-T Study Group 13 at its virtual meeting, 17 December 2020. The Focus Group will draft technical reports and specifications for autonomous networks, including exploratory evolution in future networks, real-time responsive experimentation, dynamic adaptation to future environments, technologies, and use cases. The Focus Group will also identify relevant gaps in the standardization of autonomous networks.

The primary objective of the Focus Group is to provide an open platform to perform pre-standards activities related to this topic and leverage the technologies of others where appropriate.

ToR: **Terms of reference**

Parent group: **ITU-T Study Group 13**

Deliverables

Link to use cases

- **Use cases for Autonomous Networks**
- **Architecture framework for Autonomous Networks**
- **Trustworthiness evaluation for autonomous networks including IMT-2020 and beyond**
- **Proof of Concept (PoC)**
- **Gap analysis**
- **Definitions glossary**

<https://www.itu.int/en/ITU-T/focusgroups/an/Pages/default.aspx>



Process: Editing Use cases deliverable (1/2)

- “Document (FGAN-I-157) is a collection of use cases presented and elaborated during FG-AN meetings. These use cases have been collated into a draft use case deliverable submitted to SG13 along with a request to create a work item in SG13.”
- 40 Use cases
- 30 mentors across the world
- 143 requirements in total
- 90 pages
- 10 months of weekly agile editing
- Output transmitted to ITU-T SG13, and published as ITU-T Y.Suppl 71, “Use cases for Autonomous Networks”

07/2022

1. FG AN use case Contributions

2. Call for mentors

3. Refine the use case, derive requirements

4. Publish in template

5. Review and finalise

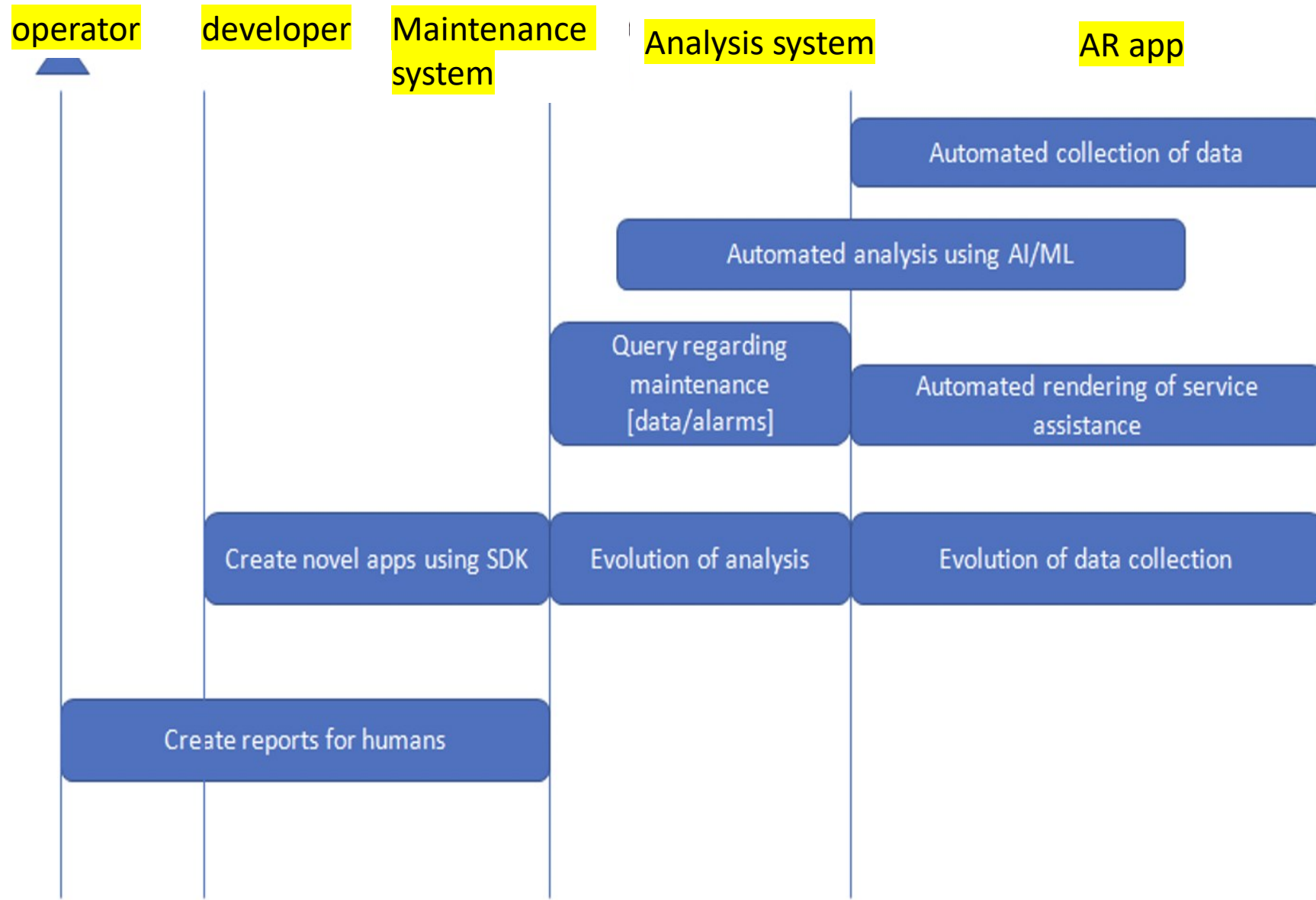
How to read the Use cases deliverable

Use case id	
Use case name	
Created by	
Mentor	
Creation date	
Use case context	A very short description on the context in which the use case was created.
Use case description	A detailed description of the use case. May include figures, Description of the relation (if any) of the use case with autonomous behaviour or the key technical enablers.
Open issues (as seen by the proponent)	<ul style="list-style-type: none">• At this point, open issues helps to understand the view of the proponent better and on a case-by-case basis invite/request details from other bodies via LS.• At a later point, open issues may point to “gaps” in existing work in related areas which may point to a need to study them further.
Notes on use case category	<ul style="list-style-type: none">• Cat 1: describes a scenario related to core autonomous behaviour itself.• Cat 2: describes a scenario related to application of autonomous behaviour in the network.
Notes on priority of the use case	
Reference	Articles, papers, etc

FG-AN-usecase-006: Evolution of data collection

- enable collection of **environment data** related to network operation and maintenance using automated techniques such as augmented reality (AR) glasses.
- enable **analysis** of environment data related to network operation and maintenance using cloud and AI techniques link Tasks: A task corresponds to a worker utilized in the workflow.
- provide intelligent assistance, **rendered** using automated techniques such as AR, for network operation and maintenance.
- **update** the data collection mechanisms and data analysis mechanisms along with the result rendering mechanisms based on the analysis by AI/ML on the collected data from AR and the evolution of the underlay networks
- enable exposure of **programming** capabilities to 3rd party developers for creation of novel applications

FG-AN-usecase-006: Evolution of data collection



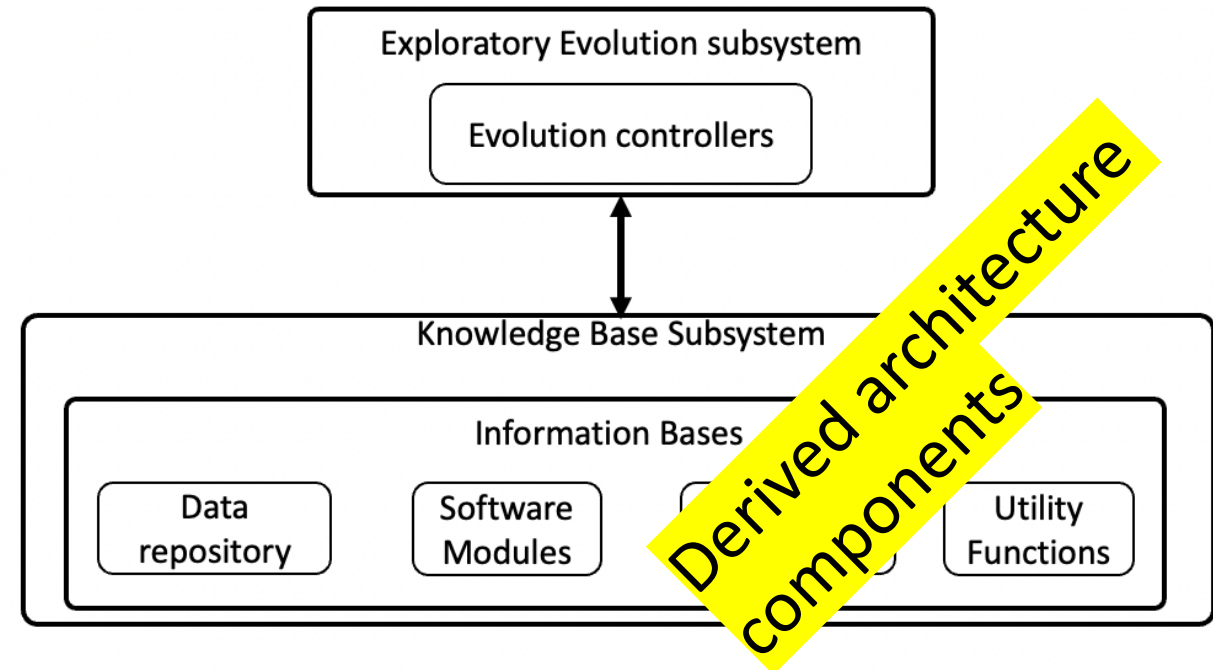
FG-AN-usecase-006: Lessons learnt

- **Critical** requirements

- AN-UC06-REQ-001: It is critical that AN enable the **discovery** of problems in underlay networks, the analysis of root cause, and the formulation of solutions.
- AN-UC06-REQ-003: It is critical that AN enable the capturing and use of the **knowledge** from domain experts including use of AI/ML mechanisms for **recommendation** of solution based on root cause analysis.

- **Added value** requirements

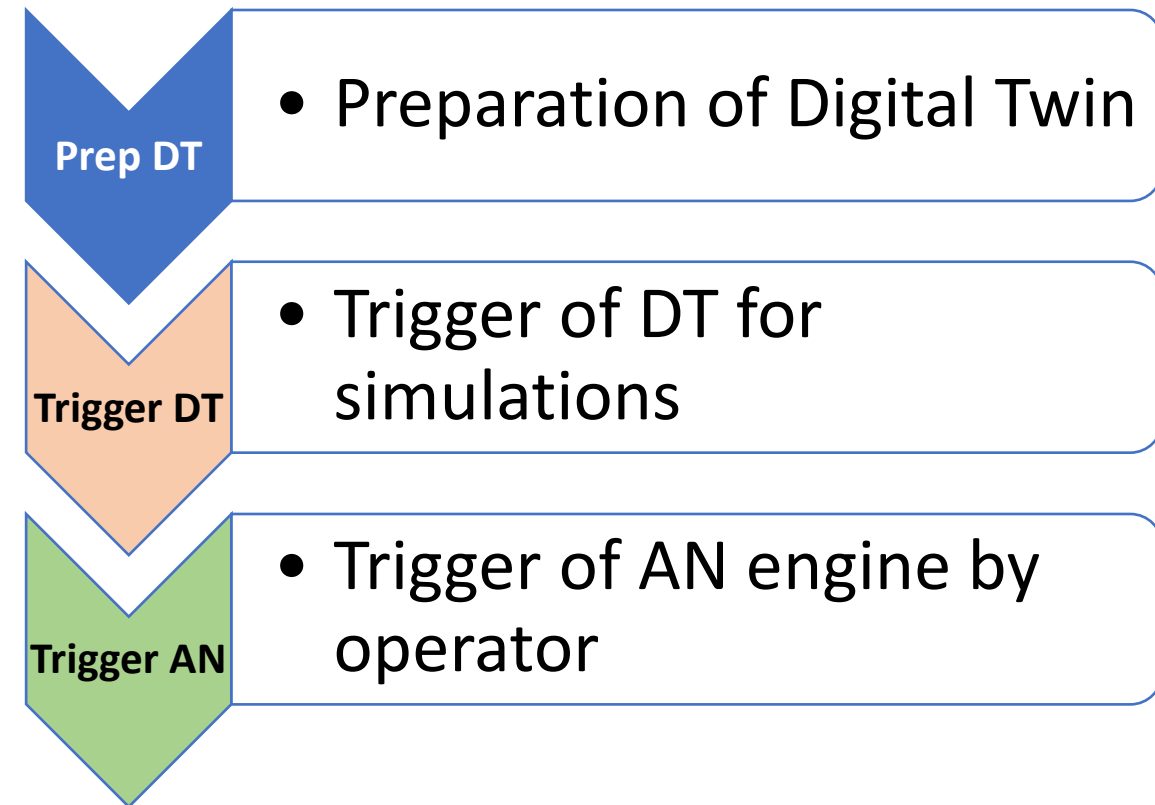
- AN-UC06-REQ-005: It is of added value that AN **monitor** varied sets of KPIs to identify faults.
- AN-UC06-REQ-006: It is of added value that AN solutions may be monitored, optimized and **continuously improved**.



FG-AN-usecase-27

- “Digital twins as platforms for experimentation”

- to build Digital Twins of Computer Network infrastructures. Some examples of the (hypothetical) questions which could be answered using digital twins were listed as: Which is the best network upgrade given a budget? Which is the best link upgrade to accommodate a new customer? What is the method to support a new customer SLA with the current network capacity?
- What-if Analysis were described in [b-FGAN-O-013-R1]. This makes digital twins a perfect environment for experimentation in the context of autonomous networks.
- using graph neural network (GNN) [b-Scarselli] was described. It generalizes to unseen topologies, routings and traffics.
- to validate in advance that their products will operate successfully in the target customer networks, before they are actually deployed.



FG-AN-usecase-027: "Digital twins as platforms for experimentation"

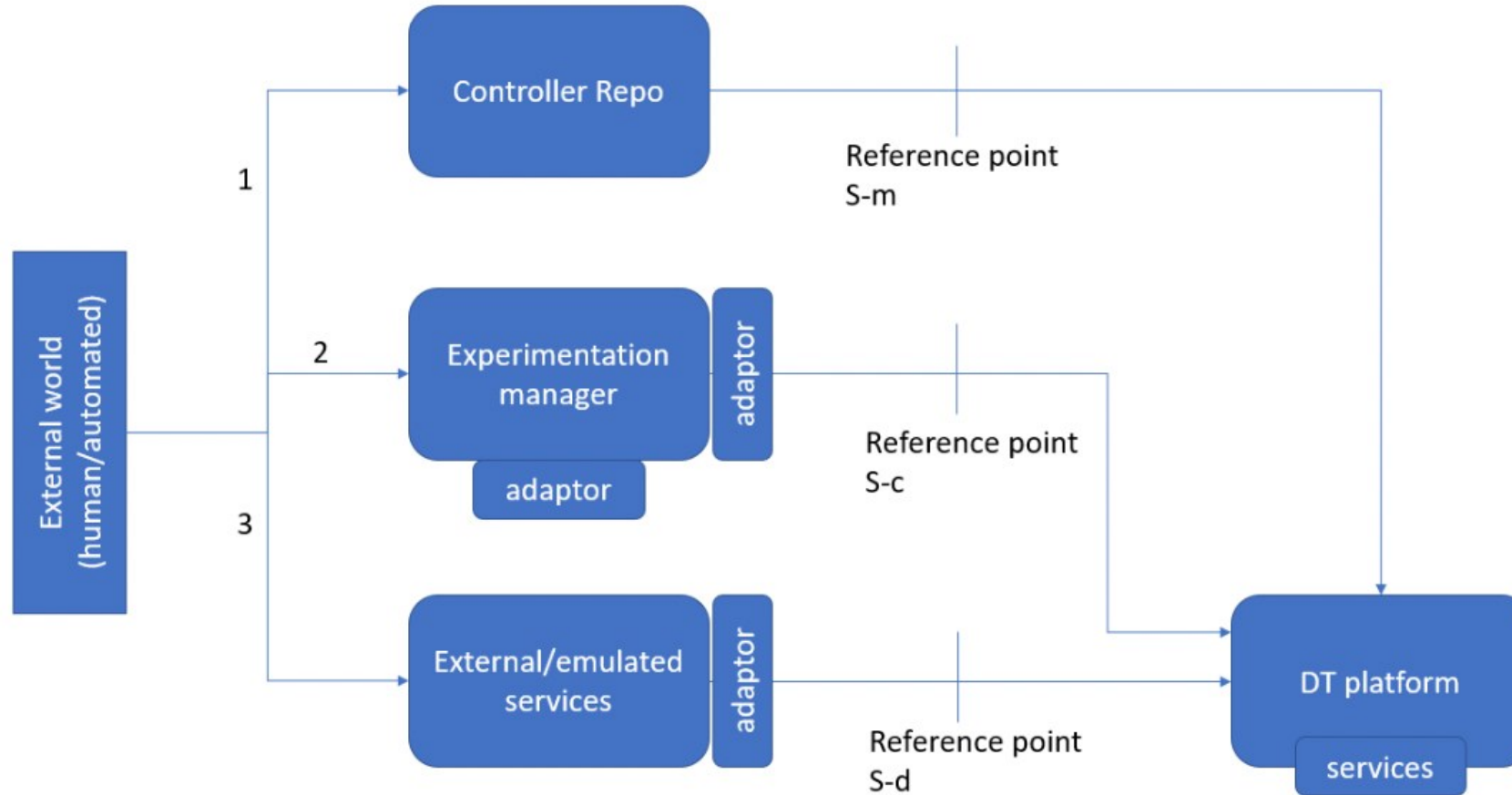


Figure 18: Possible components for experimentation as a service

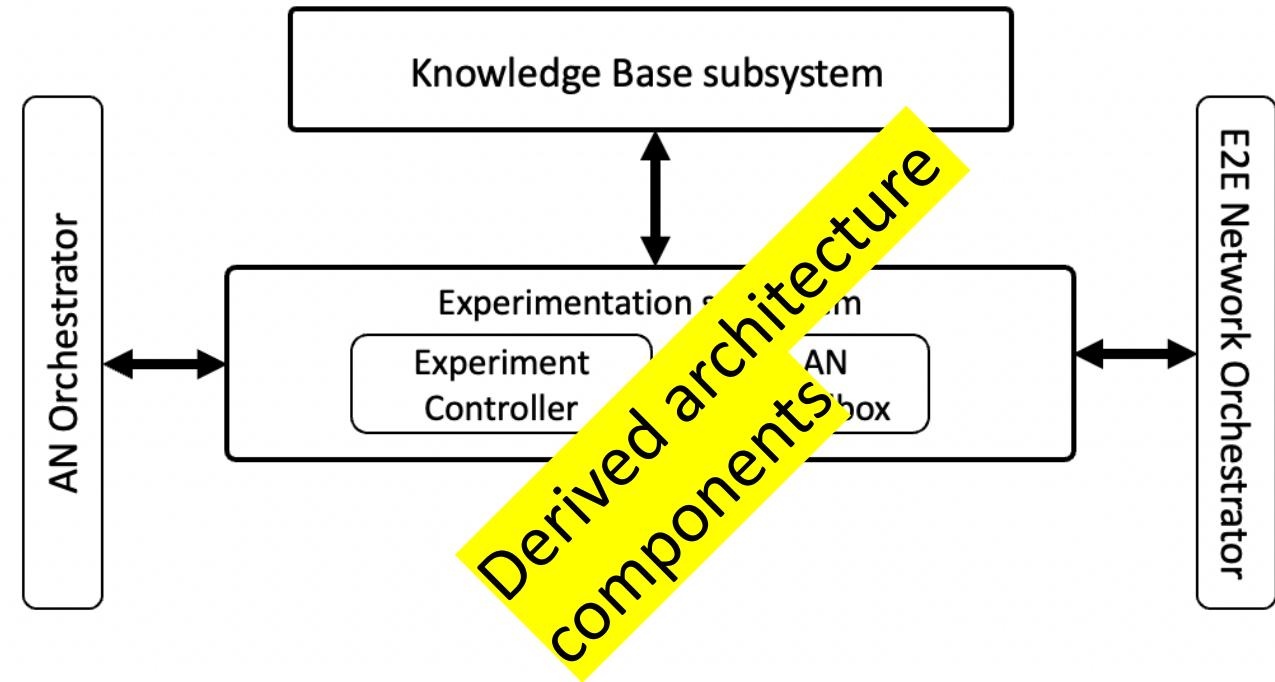
References:

[[FGAN-O-013-R1](#)]

FG-AN-usecase-027: Lessons learnt

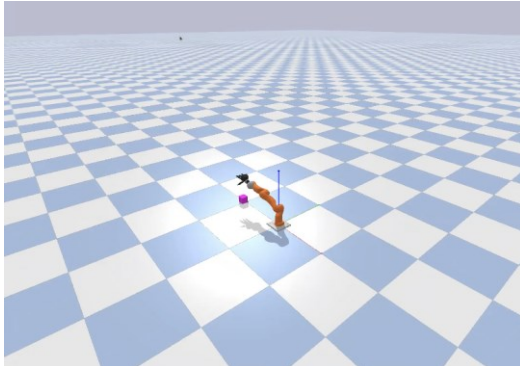
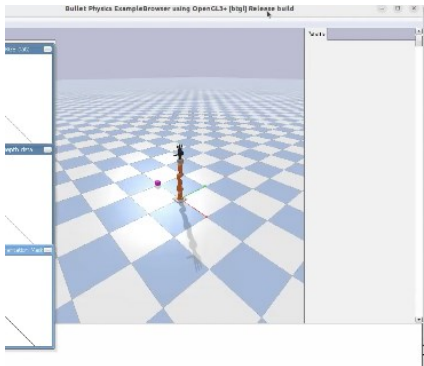
- **Critical** requirements

- AN-UC027-REQ-002: *It is critical that AN-triggered experiments and adaptations are **tested** using corresponding simulator settings in DT and the **impact** in simulated environment is **evaluated**.*
- AN-UC027-REQ-001: *It is critical that AN enable **import** of simulation environment into DT, **trigger** simulations in DT and validate the results, especially the **use case specific closed loops**.*

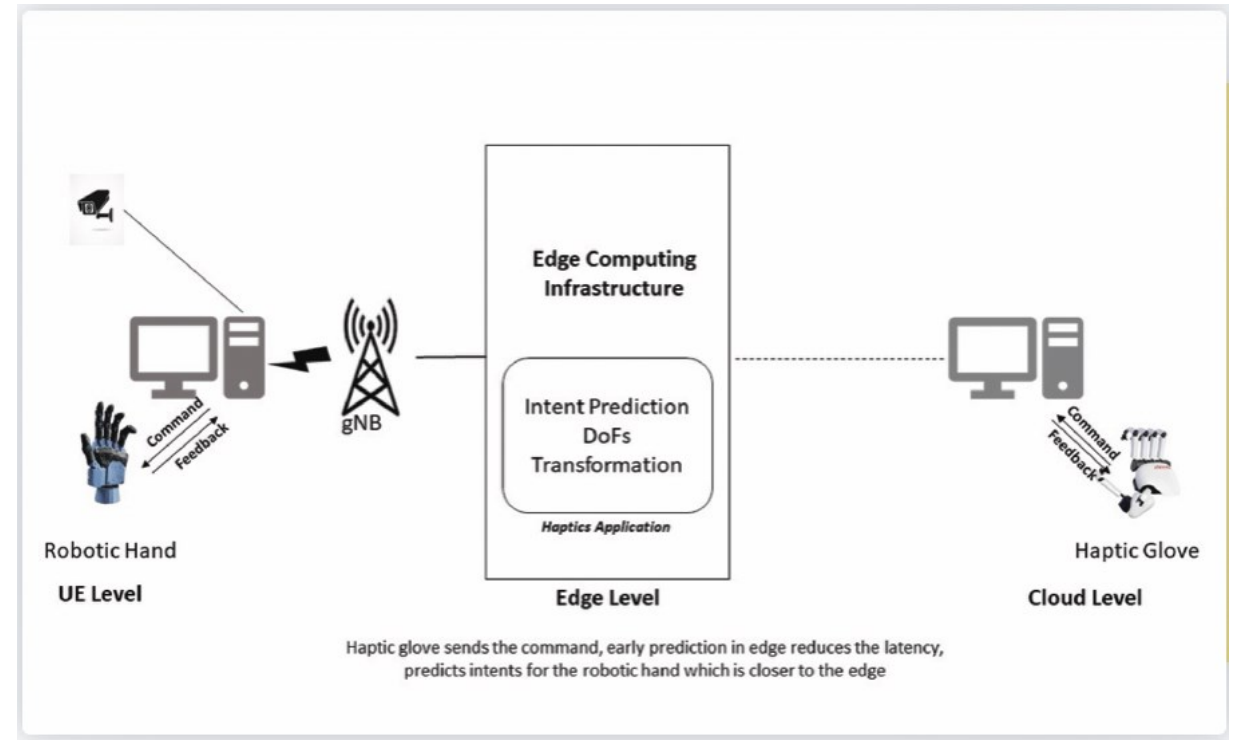


FG-AN-usecase-027- Build-a-thon PoC

- MEC Test Bed integrated with 5G Core conforming ETSI standards
- Time series Labeled Datasets will be provided
- tested on the Test-Bed with actual hardware (Allegro Hand and Haptic glove)
- APIs for the test bed are already there and Test-Bed Team will help the contestants to integrate it with the Test-Bed
- funding and supporting the PoC with Experts from EU and award for the winning Team (study tour to EU)



https://bhartischool.iitd.ac.in/build_a_thon/index.html



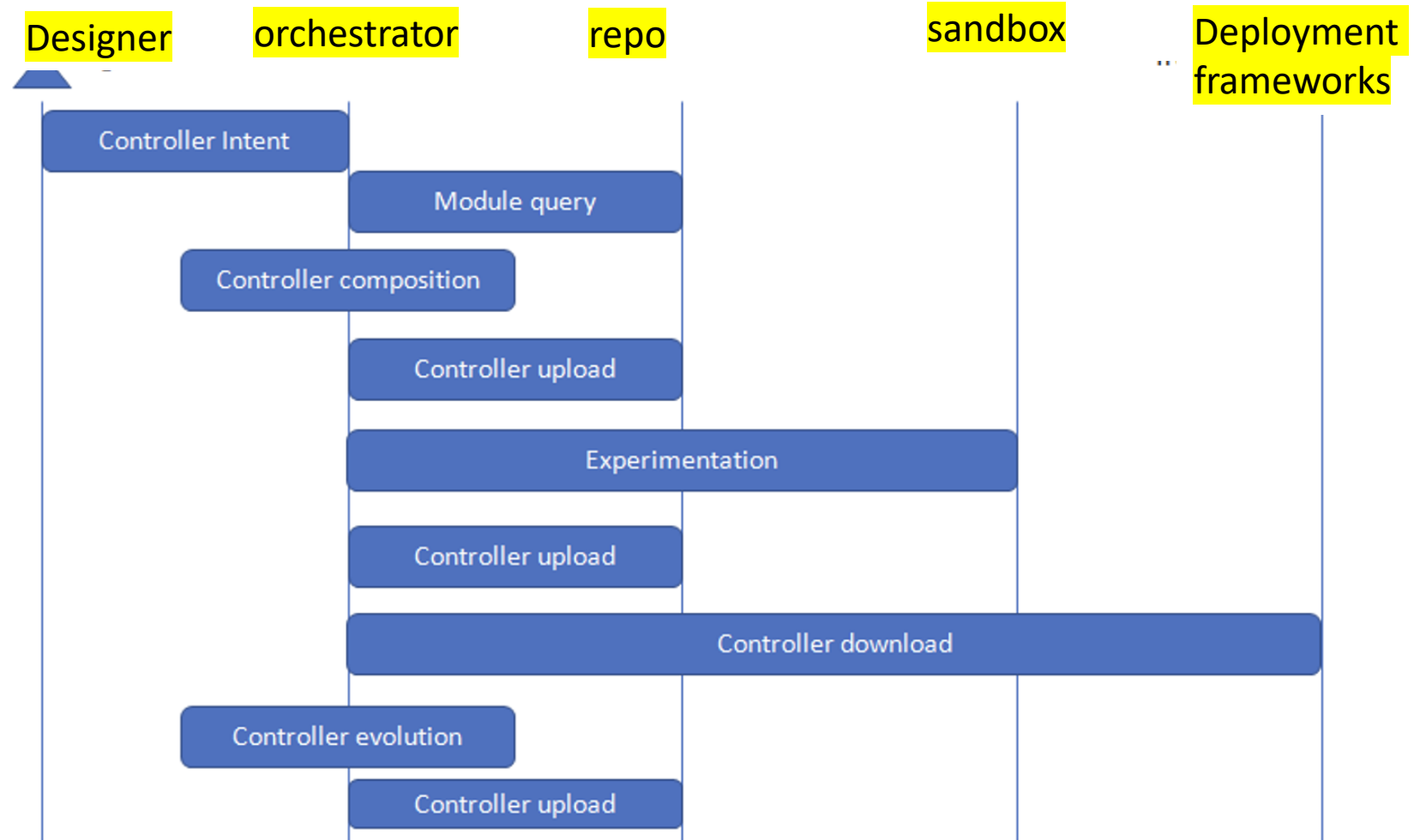
References:
[FGAN-I-289-R5]

FG-AN-usecase-031 : Workflow "repos"

- Initial version of a workflow formed from **intent or composition** from modules These may be stored in the repo labelled as "untested" or candidate controllers
- **Experimentation** (Ex) manager pulls the candidates from the repo and (uses a sandbox to) evaluate and test and compare the modules and workflows
- **Evolution** strategies are applied on the workflows and modules
- pulled and **deployed** in networks

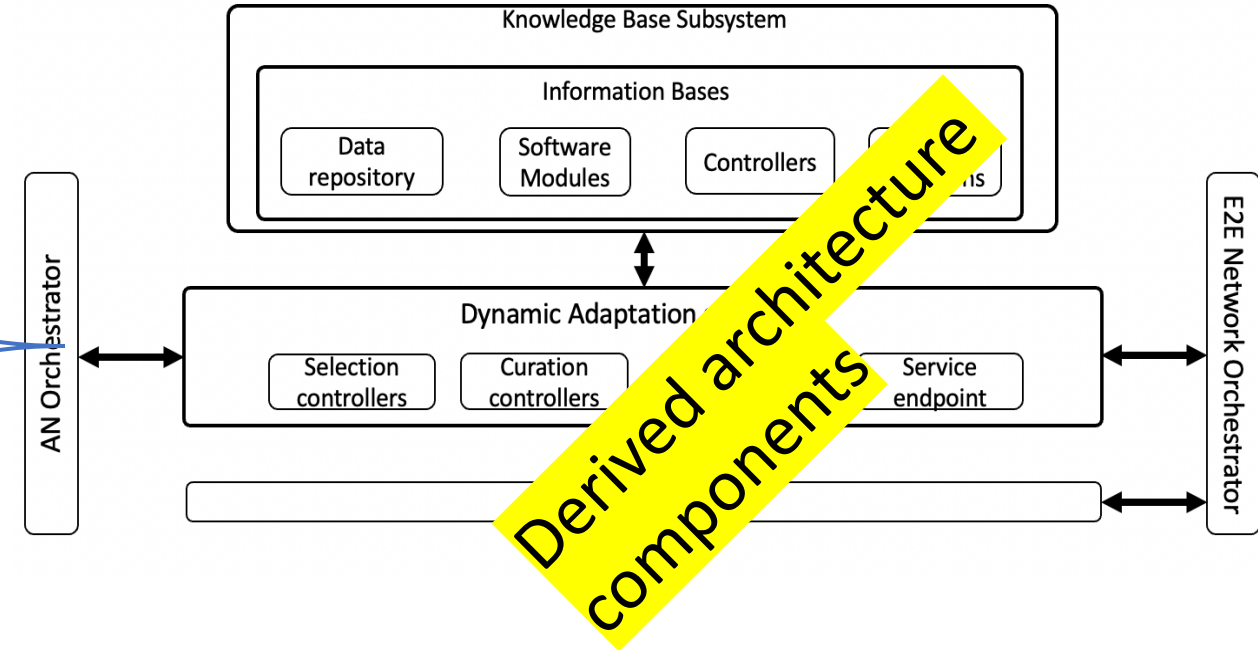
References:

[\[FGAN-O-013-R1\]](#)



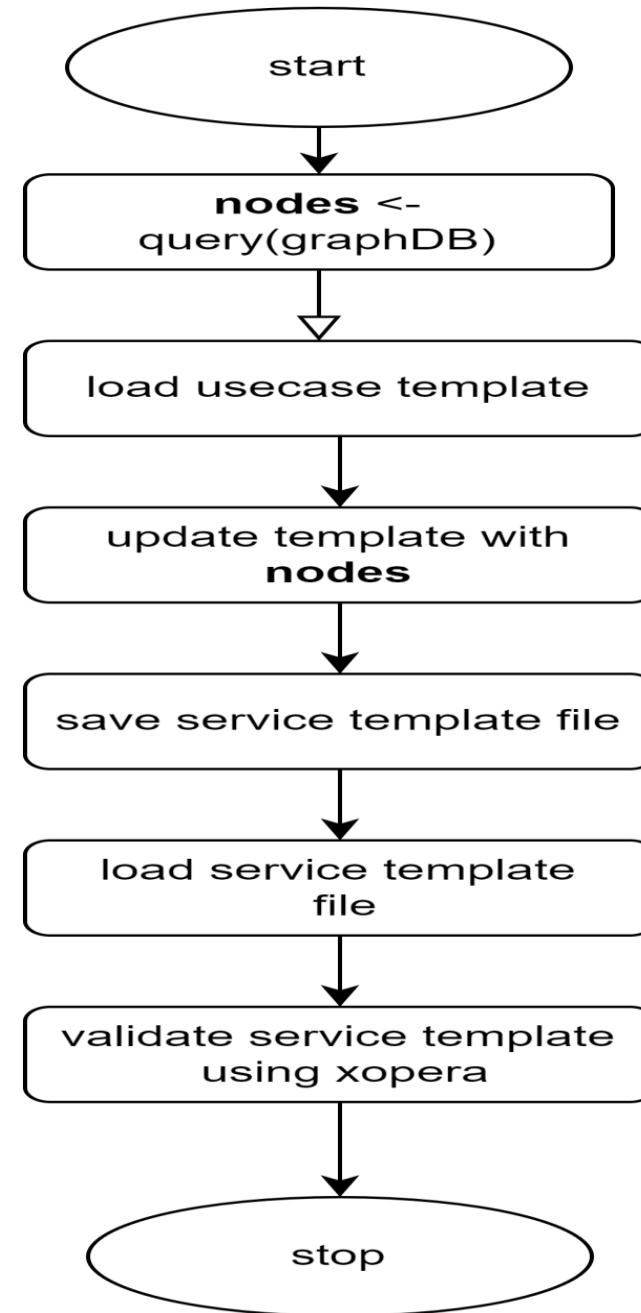
FG-AN-usecase-031 : Lessons learnt

- Steps in the use case are as follows:
 - Initial version of controllers are formed from intent or **composition** from modules (by evolution controllers)
 - These may be stored in the repo labelled as “untested” or candidate controllers
 - Experimentation (Ex) manager pulls the candidates from the repo and (uses AN sandbox to) evaluate and **test and compare** the controllers
 - Evolution (Ev) manager uses the open repo to pull and apply evolution strategies
 - Operational (Op) controllers are stored in the open repo and **pulled and deployed** in underlay networks by various closed loop automation frameworks.
- **Critical** requirements
- AN-UC031-REQ-001: *It is critical that AN enable **storage of controllers** in an open repository.*



FG-AN-usecase-031 : Build-a-thon PoC

- (a) Analyse the use case (manual step)
- (b) Create graph based design
- (c) Create YAML specification
- (d) Parse and deploy the YAML using xOpera



Upcoming... (in the following presentation)

Derive architecture components

Overall architecture framework

PoC

New use cases ...continued...

Thank
you!