“Approaches for Intent based closed loop management in FG AN”

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Aim of presentation

1. Describe the intent based approaches for closed loop (controller) management investigated in ITU-T focus group autonomous networks
2. Describe certain cherry-picked use cases (from FGAN-O-013-R1)
3. Describe the lessons from a PoC implementation (Build-a-thon)
4. Call for information exchange and look for collaboration opportunities

References:

- FG AN Home: https://www.itu.int/en/ITU-T/focusgroups/an/Pages/default.aspx
- FG AN Collaboration site: https://extranet.itu.int/sites/itu-t/focusgroups/an/SitePages/Home.aspx
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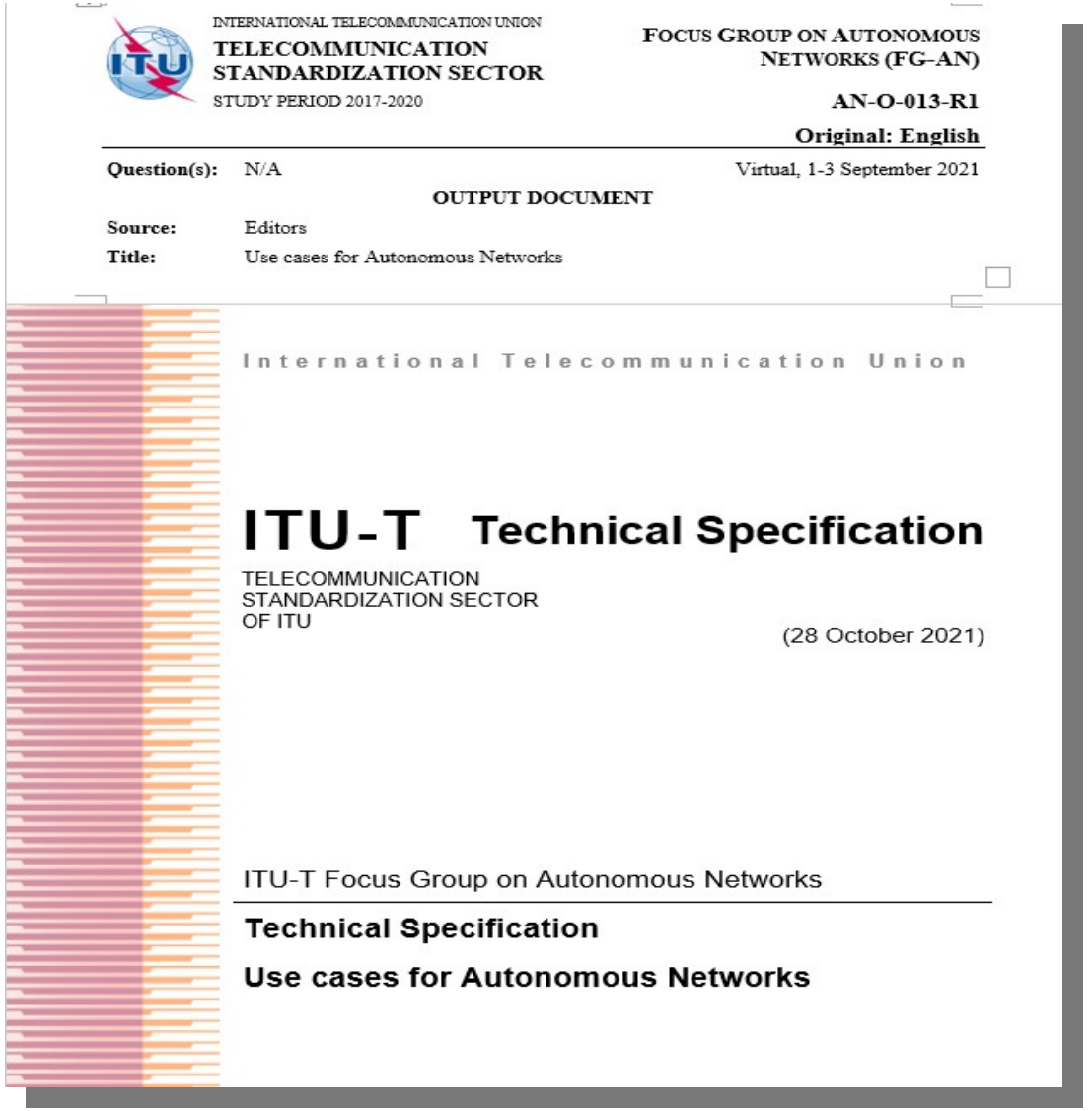
FG-AN: Overview

- 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.


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 — Virtual, 1-3 September 2021

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Title: Use cases for Autonomous Networks

International Telecommunication Union

ITU-T Technical Specification

TELECOMMUNICATION STANDARDIZATION SECTOR OF ITU

(28 October 2021)

ITU-T Focus Group on Autonomous Networks

Technical Specification

Use cases for Autonomous Networks

The primary objective of the Focus Group is to provide an open platform to perform pre-standards activities related to AN.

Use case-1: closed loop ”repo”

- Initial version of controllers (closed loops) 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 ev strategies
- Operational (Op) controllers are stored in the open repo and pulled and deployed in underlays by various closed loop automation frameworks.

NOTE- Standardized intent formats may be used for storing controllers.

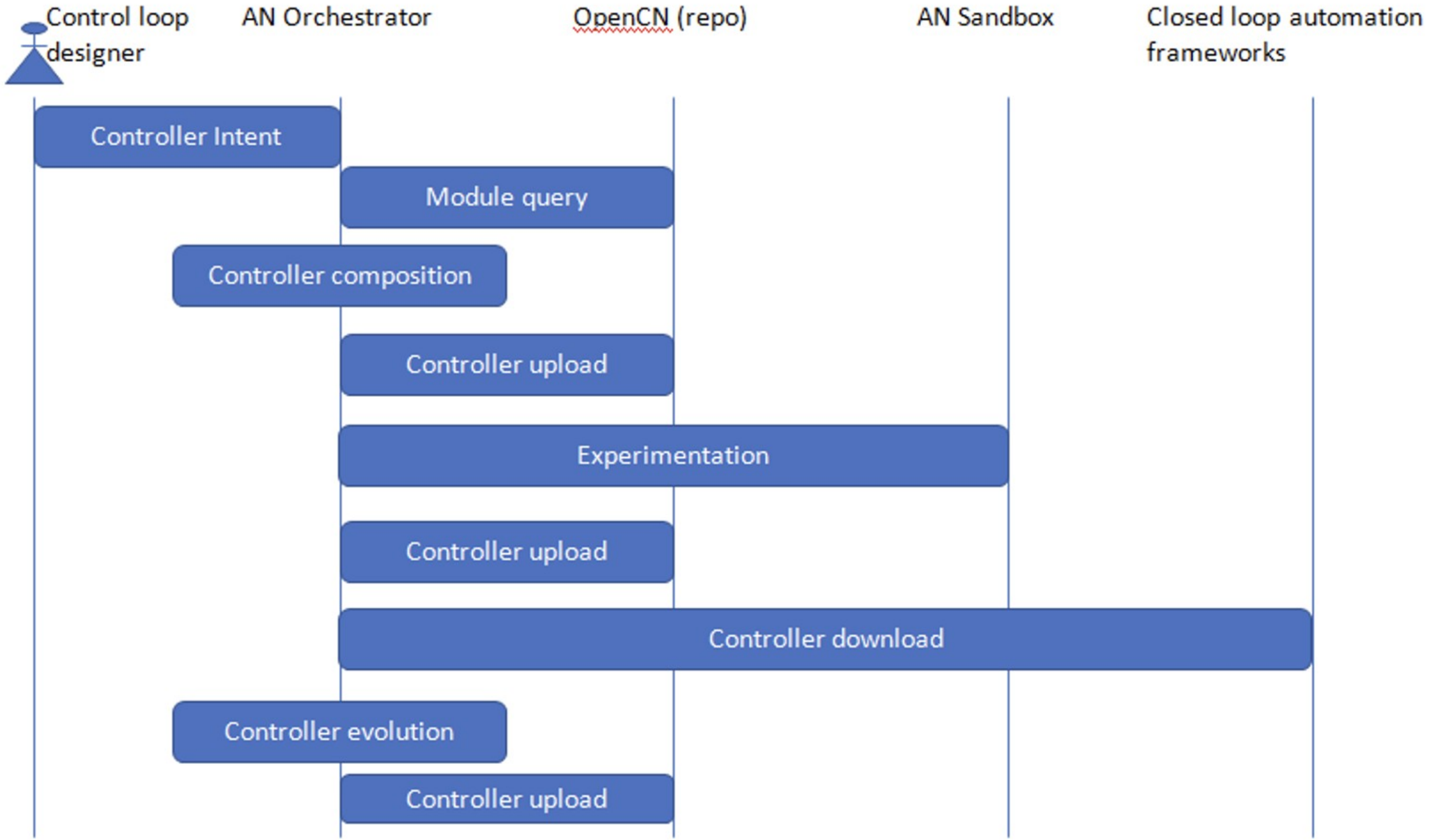
Open issues:

- there is no unified standard format for intents for closed loops

- there are no opensource solutions to convert intents to closed loops.

References:

- Fig 7.30.2 [FGAN-O-013-R1]


Control loop designer
AN Orchestrator
OpenCN (repo)
AN Sandbox
Closed loop automation frameworks
Controller Intent
Module query
Controller composition
Controller upload
Experimentation
Controller upload
Controller download
Controller evolution
Controller upload

Use case-2: Service automation using workflows

- create or compose workflow
- store in Resource database: workflow specification and execution data are stored in a resource database.
- link Tasks: A task corresponds to a worker utilized in the workflow.
- deploy workflows: Workflows may be deployed on simulated underlays and their performance and benchmarking may be tested and monitored.
- Monitor workflows.

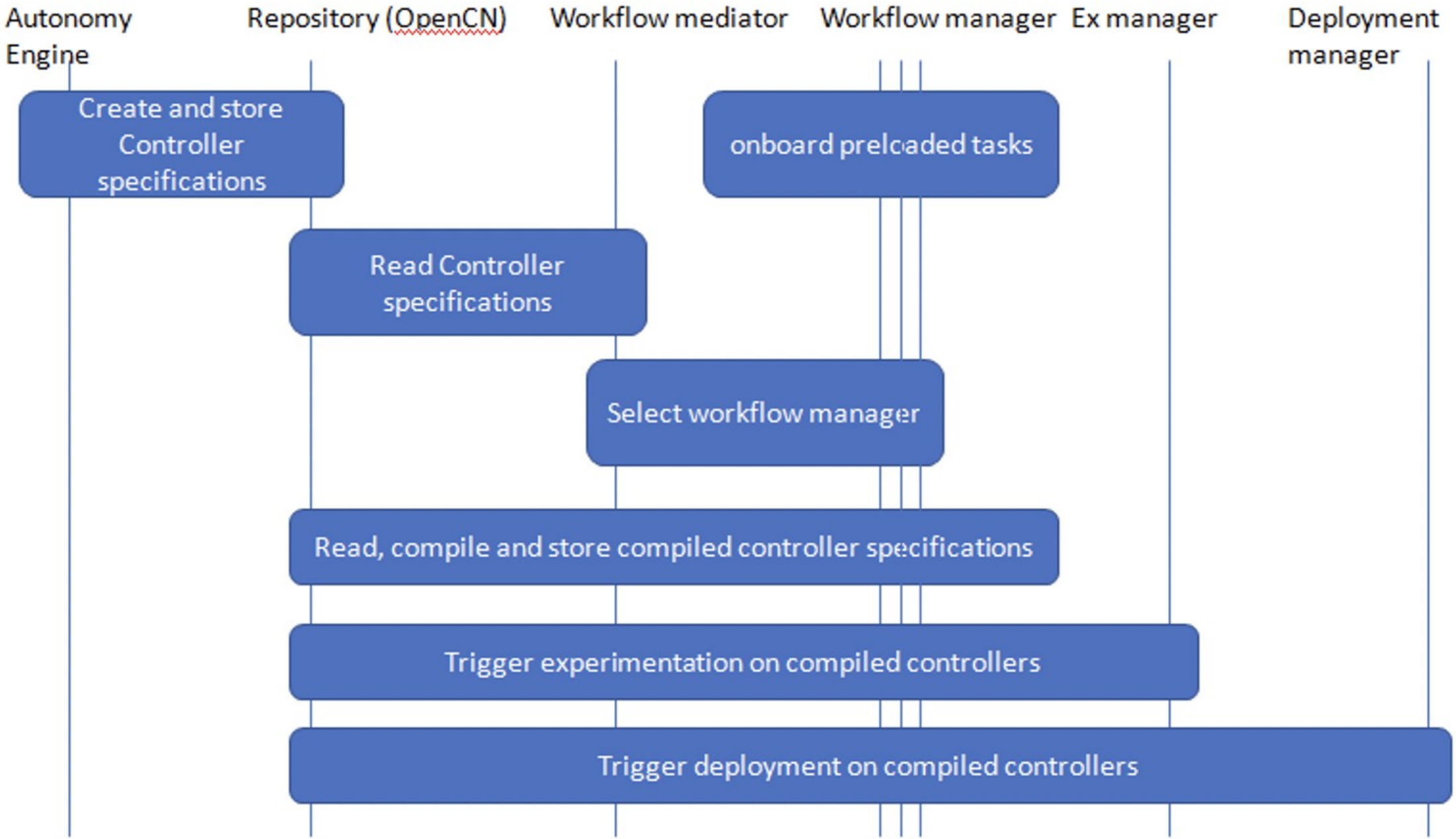
NOTE- controllers (closed loops) are represented as workflows. Modules are modelled as tasks.

Open issues:

- How to plug-in workflow managers?
- Translation of generic to underlay-specific representation of controllers

References:

- Fig 7.33.2 [FGAN-O-013-R1]

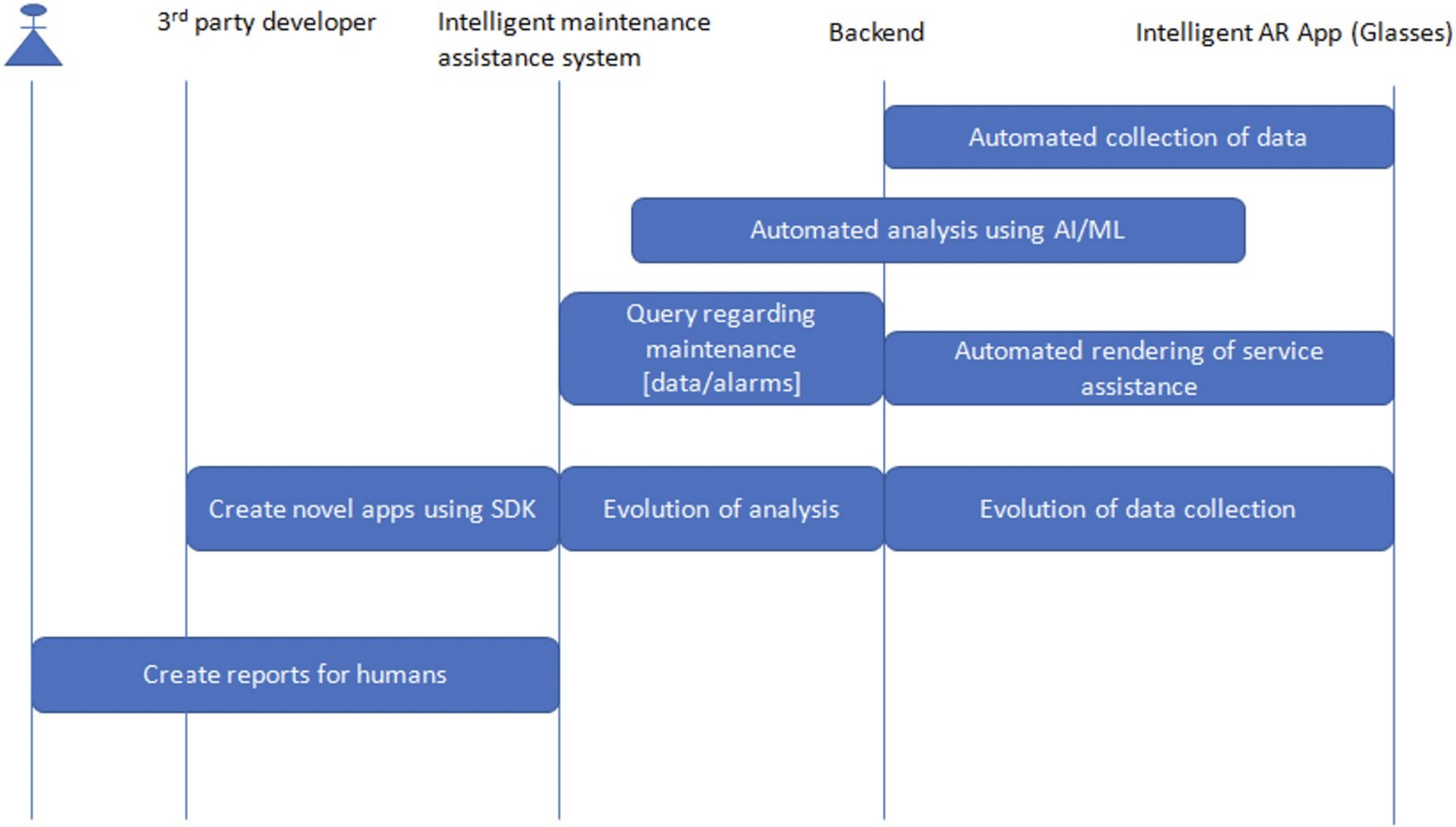

Autonomy Engine
Repository (OpenCN)
Workflow mediator
Workflow manager
Ex manager
Deployment manager
Create and store Controller specifications
onboard preloaded tasks
Read Controller specifications
Select workflow manager
Read, compile and store compiled controller specifications
Trigger experimentation on compiled controllers
Trigger deployment on compiled controllers

Use case-3: Evolution of data collection

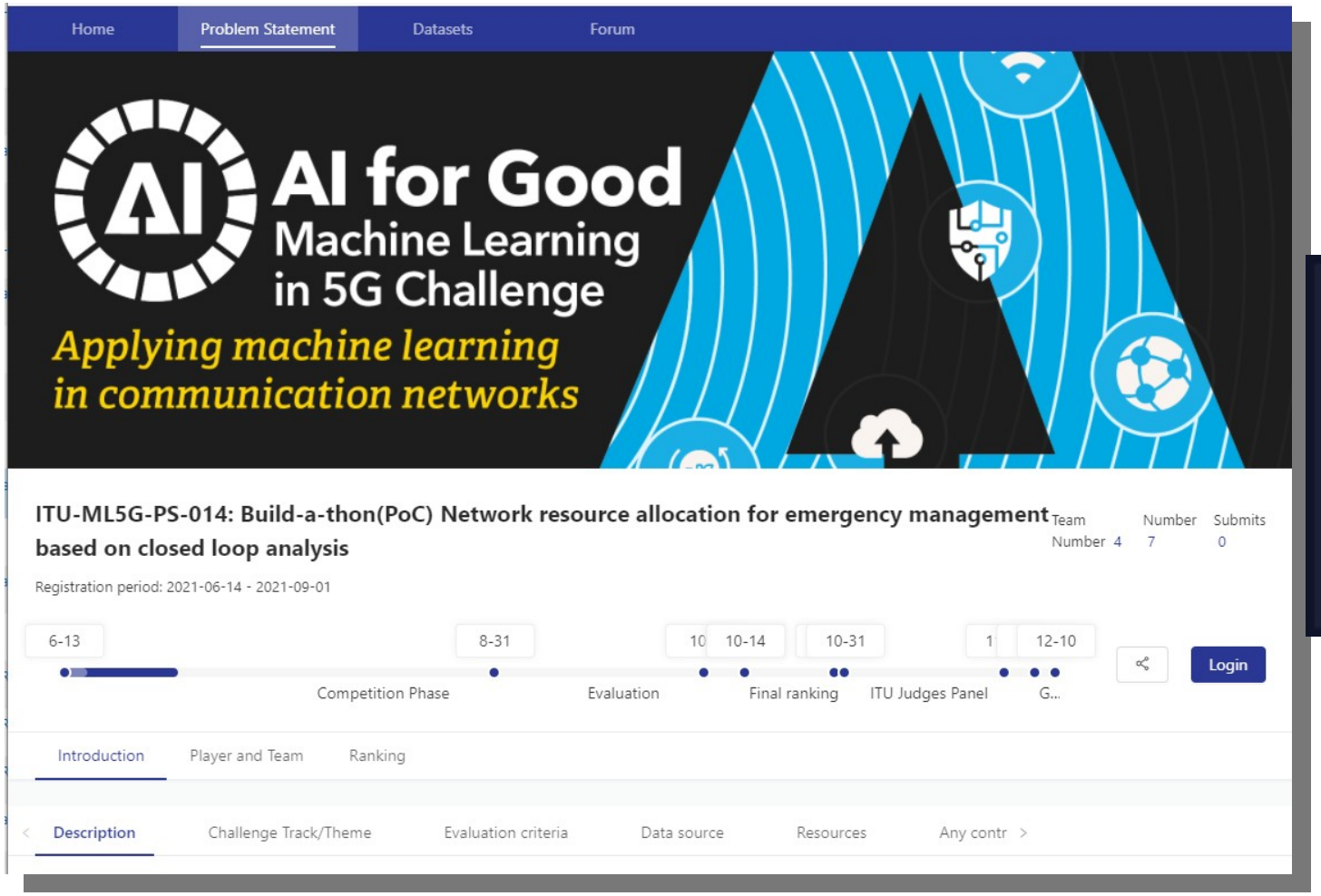
- enable collection of environment data related to network operation and maintenance using automated techniques such as augmented reality (AR) glasses.
- enable analysis of environment data related to network operation and maintenance using cloud and AI techniques link Tasks: A task corresponds to a 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

References:

- Fig 7.29.2 [FGAN-O-013-R1]


3rd party developer
Intelligent maintenance assistance system
Backend
Intelligent AR App (Glasses)
Automated collection of data
Automated analysis using AI/ML
Query regarding maintenance [data/alarms]
Automated rendering of service assistance
Create novel apps using SDK
Evolution of analysis
Evolution of data collection
Create reports for humans

FG-AN: Build-a-thon (PoC) - background



- Code for ITU FG AN Build-a-thon!
- Win prizes!
- FG AN will provide mentoring for participating students.

References: https://challenge.aiforgood.itu.int/match/matchitem/45

FG-AN: Build-a-thon (PoC) – key learnings

- Usage of TOSCA as a meta-language for Intent for closed loops: - limited support for Abstraction of nodes in open source orchestrators

- E2E workflow with integration to testbed will need interaction with the SDN controller and the VNF placement functions to attend different network requirements. This may need integration with ONAP based implementations of MANO.

- Use of simulators (e.g. simu5g) for traffic pattern generation and analysis - requires APIs exposed by the simulator for control.

- Creating a closed-loop with several modules brings communication and computation problems. Overall integration including A1/O1/E1 interface integrations is critical and which parts of this integration can be realized in an autonomous manner is a question to be addressed.

References:
[FGAN-I-187], [FGAN-I-160]
[FGAN-I-186], [FGAN-I-170-R1]
[FGAN-I-166], [FGAN-I-151-R1]
From https://extranet.itu.int/sites/itu-t/focusgroups/an/SitePages/Home.aspx

Collaboration opportunities

1. Pick 1-2 use cases which are of mutual interest
2. Develop the use cases jointly : requirements, architecture, design
3. Joint PoCs – to prove specific problems/solutions in such use cases.

Working methods:

4. Joint meetings [e.g. FG AN had a joint meeting with ETSI ZSM on Nov 30, 2021]
    1. Review comments on documents
    2. Inputs with specific perspectives.

5. Invitations to virtual meetings
    1. **6th Virtual meeting**
       26-28 January 2022
       12:00 – 16:30 (CET) on each of the three days
    2. https://www.itu.int/en/ITU-T/focusgroups/an/Documents/Meeting_announcement%20_2022.pdf

6. LS – to keep each other updated.