

NMRG IETF #119

Network Digital Twin : Concepts and Reference Architecture

draft-irtf-nmrg-network-digital-twin-arch-05

March 22, 2024

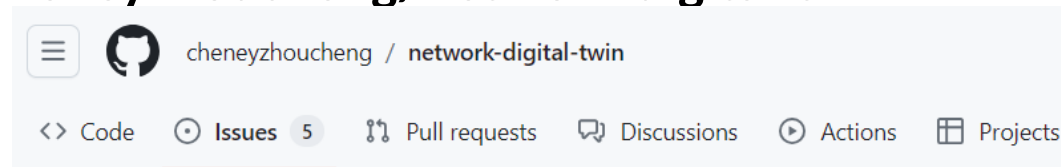
Recap Since NRMG Interim

- NDT architecture and defining characteristics have been revisited
- Two relevant topics have been discussed
 - NDT: Concepts and Reference Architecture
 - Proposed Modifications to NDT Concept and Architecture draft
- Thanks Chris Janz, Albert, Daniel King, Dan YANG, Marco Liebsch, Sebastian Rieger, Thierry Coupaye and other for valuable inputs
- Some open issues raised:
 - On Control (in/out of scope)
 - Interaction Bound, Bi-directionality, Real/Near real time
 - Generic aspects, requirements/Characteristics vs specific aspects/requirements/ Characteristics
- It was agreed to setup “series of online meetings (à la design team)” to address these open issues

Action is being taken

- Github Repository for NDT has been created for better co-design.

- <https://github.com/chenezhoucheng/network-digital-twin>



- Co-authors, experts are collaborators

- 17 issues/pull requests raised: 12 closed, **5 remaining open**

- welcome join us

Filters

Clear current search query, filters, and sorts

5 Open 12 Closed

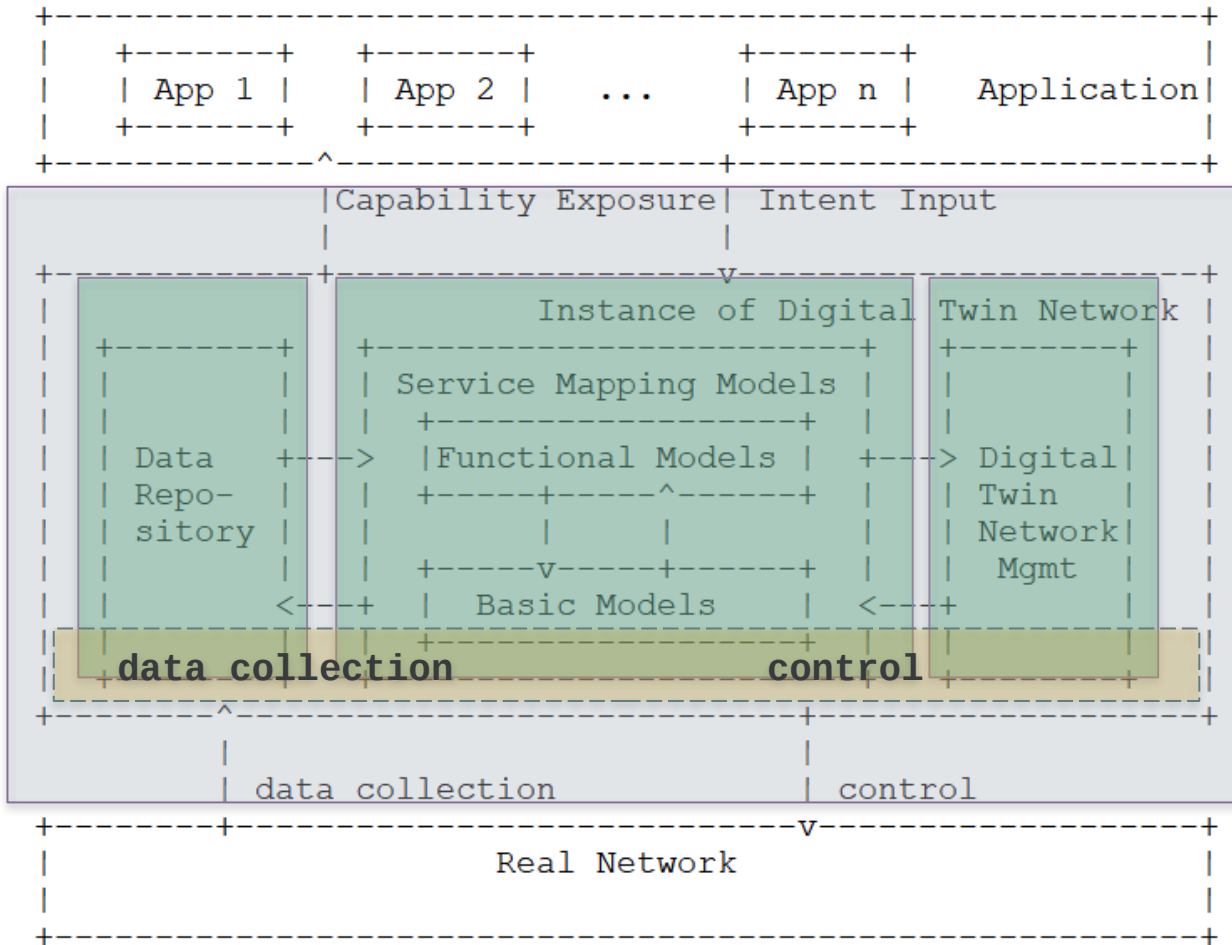
- Architecture update on Figure 2
#10 opened 2 weeks ago by chenezhoucheng
- Clarification on Bi-directional interaction
#9 opened 2 weeks ago by chenezhoucheng
- NDT characteristic vs NDT elements
#7 opened 3 weeks ago by billwuqin
- NDT scope
#6 opened 3 weeks ago by billwuqin
- Sample Application Scenarios
#3 opened last month by boucadair

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Document Status Update

- The latest update is -05, changes compared to the previous versions:
 - Change the term from digital twin network to network digital twin
 - Network Digital Twin related definitions Update
 - Change the title of section 4 to Characteristics of Network Digital Twin
 - Clarify the relation between the network digital twin and the network management system in the introduction
 - Clarification on Bi-directional interaction
 - Clarification on real time interaction

Open Issue 1: Architecture update

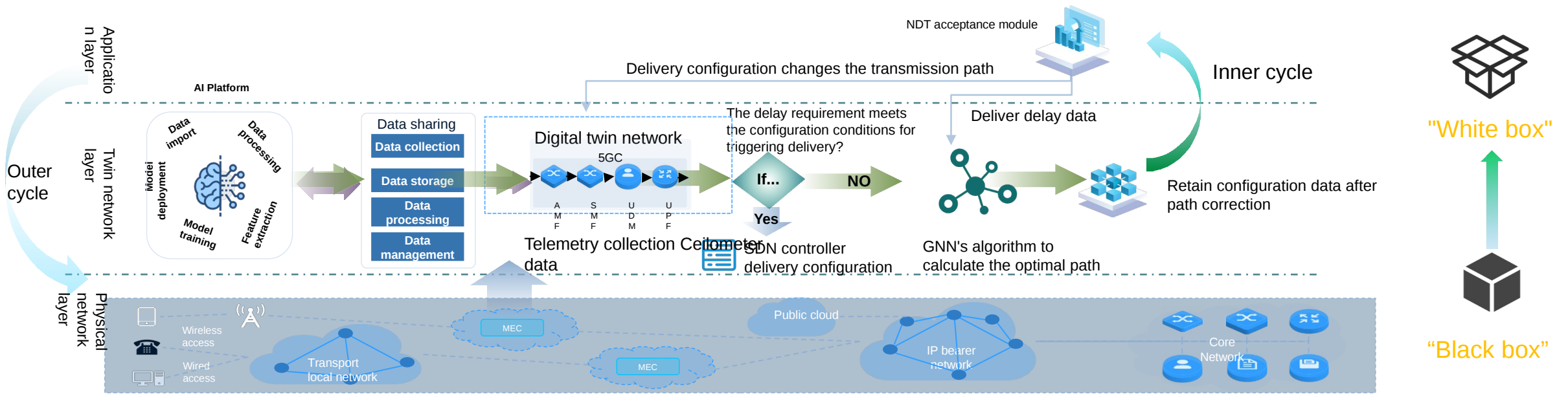


- **NDT is a 'double closed loop' system.** 'inner closed loop' emulation and optimization based on the data models , and 'outer closed loop' based on feedback from real networks and application.
- **Questions:** Where do the Scenario Generation and Scenario Evaluation components reside? Are they within “twin management Repository” or currently missing from the architecture?
- **Points to enhance**
 - ① Inner closed-loop: iterative simulation and verification in twin layer.
 - ② Outer closed-loop validation and optimization.
 - ③ Orchestration for models and resources should be included in NDT mgmt module
 - ④ Optional sub-layer: for data collection and control; or embedded in NDT mgmt module.

Open Issue 2: Deep into sample scenario

An example on Low-latency implementation logic for 5G network slicing

- The goal is to give priority to **guarantee the delay**. Using the network digital twin capability can ensure that the transmission stability of network slices can be changed from "best effort" to "**complete assurance**", and the performance such as network delay can be improved
- The dynamic routing and forwarding path logic is using the ability of the digital twin system to transform the "**black box**" into a "**white box**" through the AI model.



Open Issue 3: Scope of NDT draft

- **NDT focuses on twin layer and interfaces**, real network and applications are out of research scope of this draft.
- **Prioritize generic aspects of NDT concepts and architecture in this draft.**
 - Including definitions, benefits, functionalities, architecture, etc.
- **Consider new RG draft studying specific aspects?**
 - including emerging technologies, innovative cases, etc;
 - specifying how NDT can be integrated into the management system.
- **Consider separating engineering from research?**
 - including mature technologies, interfaces, operational procedures, etc;

1. Introduction
2. Terminology
 - 2.1. Acronyms & Abbreviations
 - 2.2. Definitions
3. Introduction of Concepts
 - 3.1. Background of Digital Twin
 - 3.2. Digital Twin for Networks
4. Characteristics of Network Digital Twin
5. Benefits of Network Digital Twin
 - 5.1. Optimized Network Total Cost of Operation
 - 5.2. Optimized Decision Making
 - 5.3. Safer Assessment of Innovative Network Capabilities
 - 5.4. Privacy and Regulatory Compliance
 - 5.5. Customized Network Operation Training
6. Challenges to Build Network Digital Twin
7. A Reference Architecture of Network Digital Twin
8. Enabling Technologies to Build Network Digital Twin
 - 8.1. Data Collection and Data Services
 - 8.2. Network Modeling
 - 8.3. Network Visualization
 - 8.4. Interfaces
 - 8.5. Twinning Management
9. Interaction with Intent-Based Networking (IBN)
10. Sample Application Scenarios
 - 10.1. Human Training
 - 10.2. Machine Learning Training
 - 10.3. DevOps-Oriented Certification
 - 10.4. Network Fuzzing
 - 10.5. Network Inventory Management
11. Research Perspectives: A Summary
12. Security Considerations
13. IANA Considerations
14. Open issues
15. Informative References

Next Steps

- **Research Directions**
 - Use Cases
 - Category
 - How can NDT integrate and evolve with legacy network management system?
 - How can 'knowledge' be injected to network digital twin to help achieve vision of 'autonomous network' ?
 - More assessment to quantify the gain brought by NDT to Network management?
 - etc.
- **Record all open issues and track them on GitHub**
 - <https://github.com/chenezyhoucheng/network-digital-twin>
- **Design Team Meeting Schedule Request**
 - Call for 'Design Team' members
 - Set the goal to make this draft ready for publication by IETF #120