

Performance-Oriented Digital Twins for Carrier Packet and Optical Networks

draft-paillisse-nmrg-performance-digital-twin-01

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From version 00 to version 01

draft-paillisse-nmrg-performance-digital-twin-00 (IETF 114):

- Introduced performance digital twin for carrier networks (NDT)

draft-paillisse-nmrg-performance-digital-twin-01 (IETF 115):

- Generalizes performance DT concept: “Performance-Oriented Digital Twins” (PODTs)
- Reframes original NDT as specific to packet networks
- Introduces optical performance DT (OPDT) – specific to optical transmission networks – as second PODT example
- Considers OPDT use cases, showing significant congruency with NDT use cases
- Considers OPDT architecture, interfaces and implementation challenges

Performance-Oriented Digital Twin

PODTs predict (replicate, ...) the behaviours of a physical network

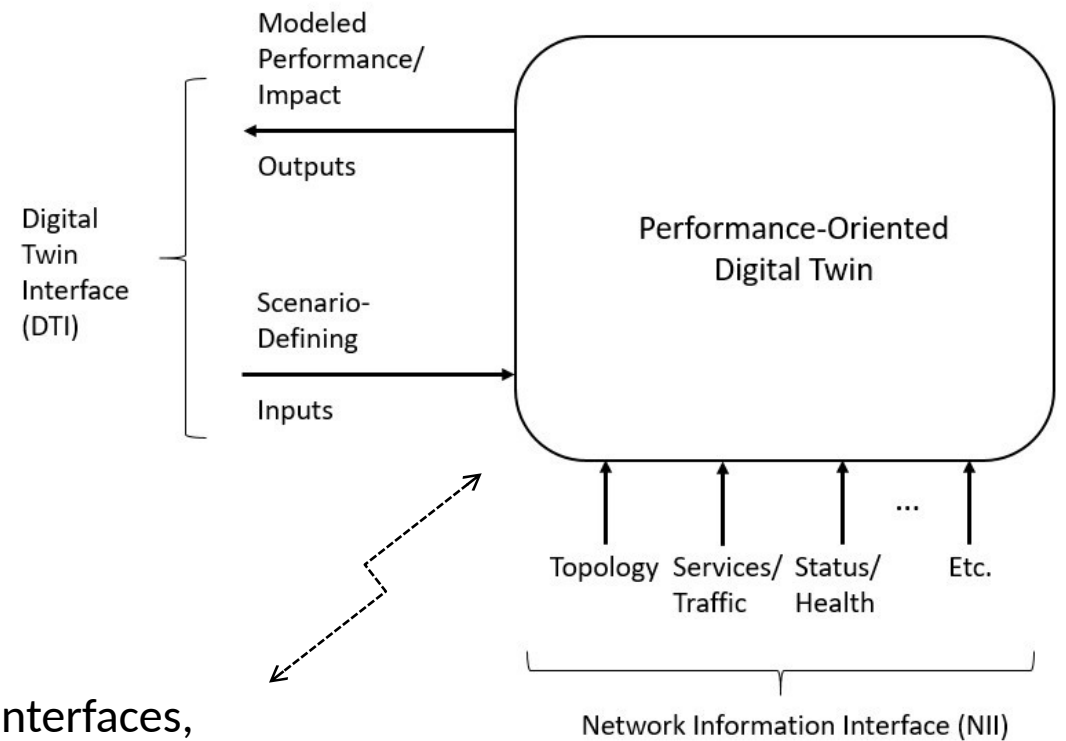
- Particular behaviours of interest are determined by use case requirements, 'rendered' by appropriate functional models

NII = "twinning" interface (optional)

- Data from physical network and/or management plane, re. network, services, traffic, environmental conditions, etc.

DTI = "run-time" interface:

- Inputs: define scenario for behavioural assessment
 - Select, replace, and/or complement data from NII
- Outputs: modeled behavioural parameters



data, models, interfaces,
management (of these, functionally)

OPDT: Interfaces & Models

DTI:

- Inputs: depend on the use case
- Outputs: channel powers, channel generalized SNRs/margins, ...

NII:

- From Management Plane: network & service topology, ...
 - ACTN (TEAS) and related YANG models (CCAMP, OPSAWG, ...)
- From physical network: inventory, device parameters & status, instrumentation data, alarms, ...

Behavioural Models:

- B2B channel performance, EDFA gain/noise, NL impairments, PDL, filter shaping...

OPDT: Use Cases (I)

Optical Services Planning:

- OPDT finds negative- and excess-margin prospective optical services, given postulated service topologies & channel parameters (DTI inputs)
- Findings (DTI outputs) used to guide search for service solutions that are functional and possibly also 'efficient' (embedding optimization as that is described in draft v00)

Optical Network Planning:

- OPDT finds negative- and excess-margin prospective optical services, given postulated service topologies & channel parameters, AND new/modified network topologies (DTI inputs)
- Findings (DTI outputs) used to guide search for conjoint service-network solutions that are both functional and 'efficient' (embedding optimization as that is described in draft v00)

OPDT: Use Cases (II)

Optical Services (Re-)Provisioning:

- OPDT predicts optical channel powers and margins resulting from prospective provisioning operational steps (DTI inputs: optical service topologies, channel parameters)
- Results (DTI outputs) guide optimization of operational steps - batching & sequencing, power optimizations etc. - to assure 'safe' (re-)provisioning

Risk Mapping, Dynamic Restoration Planning:

- Prospective event scenarios analyzed to identify potential transmission performance issues
- For example, planned restoration responses to prospective fibre cuts etc. can be assessed to identify possible performance risks. Where such risks are identified, new dynamic restoration responses can be planned and checked

Two NDT conceptions. Must there be?

1. “Information NDT”:

- Provides information (behavioural predictions) given data (physical network, scenario specifics)
- PODT is an example (behaviours of interest = ‘performance’)

2. “Action NDT”:

- Encompasses full closed-loops: data to information, information to decisions, decisions to action
- A collection of functions – but necessarily including an “information DT”
- Such a larger scope of function starts to become difficult to distinguish from control or management planes featuring automation

Perhaps (1) suffices as a general conception of NDT functional scope?

Thank You
