Knowledge Graphs for Enhanced Cross-Operator Incident Management and Network Design

draft-tailhardat-nmop-incident-management-noria
IETF NMOP interim meeting

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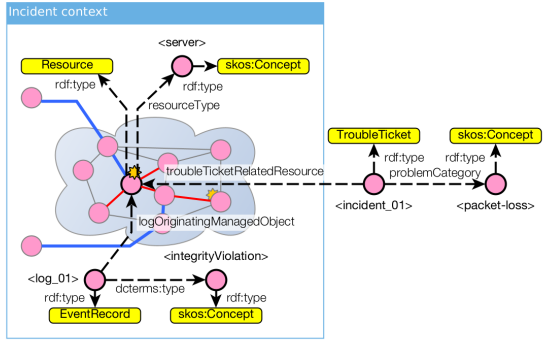
Context & motivations: abstracting networks & sharing behavioural models



Goal Learn incident signatures and remediation procedures, and be able to share them.

Data Knowledge graph as a combination of a Digital Map [i-D] with operational data and OSS data.

Opportunity YANG-based configuration data can be converted to build a Digital Map, thereby connecting the DSSs with network production.

Challenge How to integrate these different facets while ensuring the stability of the interpretation layer?

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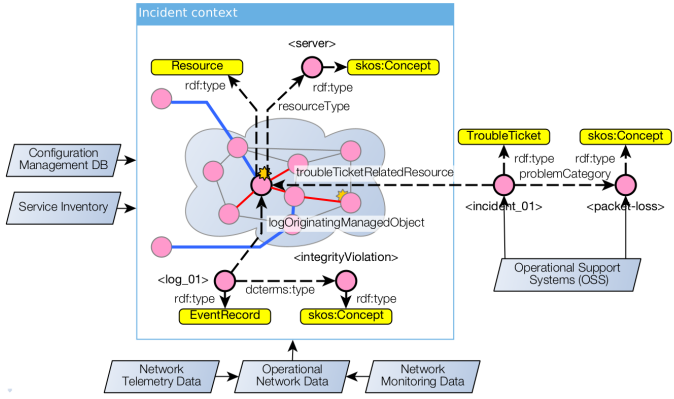

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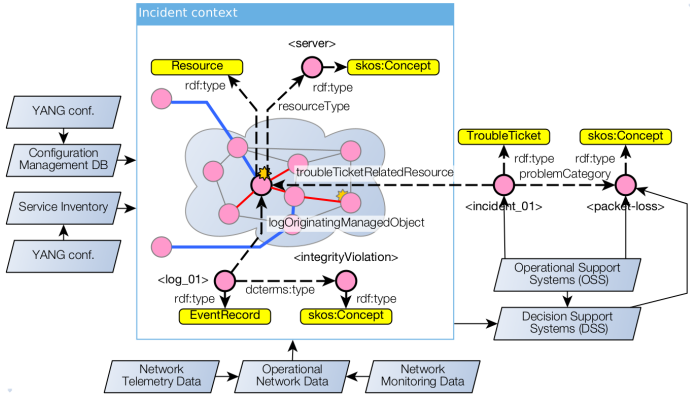

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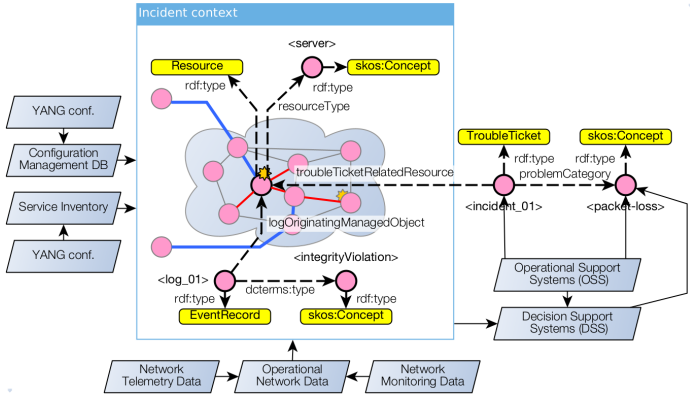

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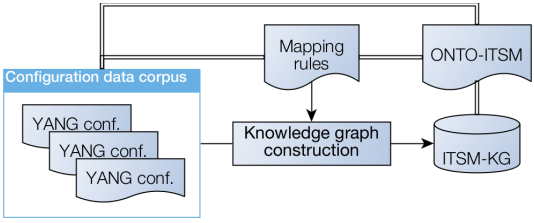
Having a comprehensive and integrated view of ICT systems for anomaly detection and decision support?

- The concept of Digital Map is an interesting basis to describe and operate networks.
- YANG conf can be converted to build a Digital Map, notably considering knowledge graphs, thereby forming some proto IT Service Management Knowledge Graph (ITSM-KG) structured by an adequate ontology (ONTO-ITSM).



YANG-KG-SEMANTIC-EQUIVALENCE The ontology structuring the target knowledge graph is an exact equivalence of the many YANG models organizing the configuration data.

YANG-KG-SEMANTIC-GENERALIZATION The ontology structuring the target KG is a generalization of the YANG models organizing the configuration data.

The sharing of information involves a public ontology satisfying all stakeholders.

→ The YANG-KG-SEMANTIC-EQUIVALENCE case entails a knowledge engineering effort involving all potential users and the establishment of version control with quorum validation for changes.

A Digital Map is not sufficient to compute behavioral models, we need additional knowledge facets.

→ The YANG-KG-SEMANTIC-GENERALIZATION case has modularity and abstraction properties, but also involves implementing alignment with some meta model.

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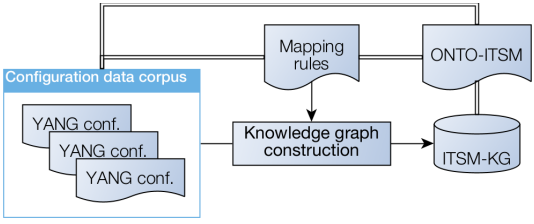

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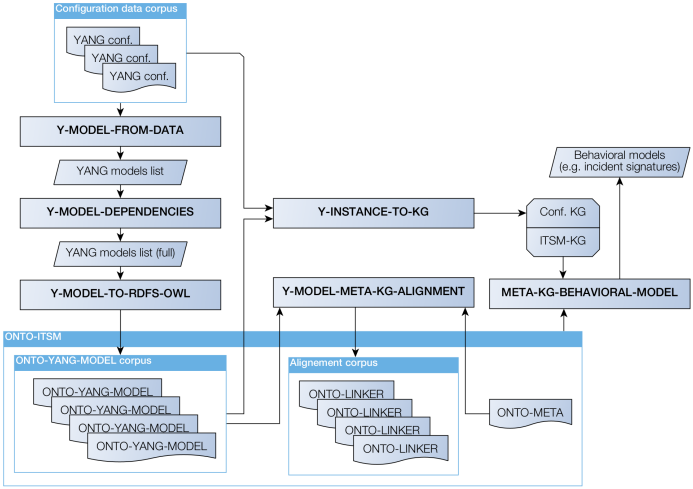
Experimental plan with the YANG-KG-SEMANTIC-GENERALIZATION case



A data processing pipeline that performs the following use cases:

- **Y-MODEL-FROM-DATA**
  Extracting the list of models involved for their conversion to their RDFS/OWL equivalent.
- **Y-MODEL-DEPENDENCIES**
  Identifying and retrieving all the YANG models that the model refers to, in order to build a complete corpus of models for their conversion to their RDFS/OWL equivalent as a coherent set.
- **Y-MODEL-TO-RDFS-OWL**
  Producing a semantically equivalent RDFS/OWL representation, e.g. using projection algebra.
- **Y-INSTANCE-TO-KG**
  Constructing a knowledge graph from the configuration data, with the knowledge graph structured by the (set of) ONTO-YANG-MODEL.
- **Y-MODEL-META-KG-ALIGNMENT**
  Querying of the configuration entities present in the graph through the concepts of the reference ontology.
- **META-KG-BEHAVIORAL-MODEL**
  Learn behavioral models in a formalism that can be interpreted through the lenses of ONTO-ITSM and shared with other stakeholders with minimal discrepancies in the underlying configuration data.

Summary & future work

Problem Building an ITSM Knowledge Graph that uses YANG-based configuration data while abstracting network details for learning and sharing behavioral models.

Approach Knowledge representation using SemWeb technologies, generalization of YANG models for configuration data, an extended Digital Map combining configuration with operational and OSS data, and a data processing pipeline for experimentation.

Next Call for experiments and contributions on the “draft-tailhardat-nmop-incident-management-noria” proposal, notably considering the YANG-KG-SEMANTIC-GENERALIZATION case.

Internet Draft

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https://datatracker.ietf.org/doc/draft-tailhardat-nmop-incident-management-noria/