

IAB NEMOPS Position Paper : Knowledge Graph Framework for Network Operations

Authors:

Thomas Graf, Swisscom

Holger Keller, DT

Dan Voyer, Bell Canada

Paolo Lucente, NTT

Diego Lopez & Ignacio Dominguez Martinez-Casanueva, Telefonica

Brad Peters, NBN

Paolo Fasano, Telecom Italia

Pang Ran, China Unicom

Weiqiang Cheng, China Mobile

Benoit Claise, Michael Mackey, Huawei

Reference : <https://datatracker.ietf.org/doc/draft-mackey-nmop-kg-for-netops/>

Network operations face a series of challenges:

- Data Overload from Network Operations
- Difficulties in Data Analysis and Insight Extraction
- Complex Data Correlation Requirements
- Service and Customer Correlation
- Data Storage and Format Disparities
- Contextual Understanding and Relationship Mapping
- Loss of Context in Data Collection
- Data Collection Methods and Interpretation
- Organizational Silos
- Multiple Sources of Truths
- Machine Readable Knowledge

There are different disparate set of data sources:

- MIB modules [RFC3418] for monitoring
- YANG models [RFC7950] for configuration and monitoring
- IPFIX information elements [RFC7011] for flow information
- syslog plain text [RFC3164] for fault management,
- TACACS+ [RFC8907] or RADIUS [RFC2865] in the AAA (Authorization, Authentication, Accounting) world,
- BGP FlowSpec [RFC5575] for BGP filter,
- BMP - BGP Monitoring protocol [RFC7854]
- BPG-LS for IGP monitoring

This implies a difficult and costly data models integration with different silos protocol & data models, as we are reaching the limits of YANG as THE model language. Some of the protocols listed are network protocols or contain information from network protocols where semantics are described in IETF documents in a human but non machine-readable form.

It's crucial that we find a way to expose this information and link it together in a machine-readable way. Note that business targets cannot be achieved with human centric knowledge management!

We believe the solution might reside in knowledge graph, where all the explicit knowledge about a domain is stored, usually represented in a structured and formalized manner to facilitate easy access and manipulation. The only format for Knowledge Graph that is open and FAIR (Findable, Addressable, Interoperable and Reusable) is one based on the Semantic Web Stack (RDF/RDFS/OWL). Being able to define networking knowledge in this format is crucial to ensure the Knowledge is FAIR for the applications that access it. It's important to note, the authors are not proposing creating a new model for the network, there is much work being done in all of the existing SDOs with numerous models managing all aspects of the network and business. The authors are proposing ways to connect all of this data and through those connections find the semantic of the information and allow it to unlock the knowledge already being generated by the network.

To this end, the industry must come together to define ways to describe the connections between data (either at the instance level or at the schema level). Agree on formats for importing existing protocol schemas into the Knowledge System e.g. in IETF: YANG, IPFIX, BMP but also other models in different SDOs

IETF requirements:

- While the world of ontologies and knowledge graph is not new, it's actually new for the networking domain. We believe that the IETF, as the primary networking SDO, must play a role here, as we are convinced that the knowledge graph technology is the logical next step in operations
- It's important to specify a basic ontology that the networking world with agree upon, serving as a basis for knowledge graph. This is not defining new terms but choosing/leveraging the wealth

of definitions/models that already exist inside of all of the key IETF documents to agree key reference points and potential relationships. This need not be exhaustive but instead be a starting point that can evolve later.

- Define a format for the Knowledge System. The Semantic Web Stack (RDF/RDFS/OWL) is a standard based approach to knowledge but how information is translated to these standards is open to interpretation. IETF should agree a mapping of the existing information to this format.

IETF recommendations:

- As this networking ontology requires collaboration and an iterative process (as we will make mistake), the opensource way of working is the solution.
- This implies that publishing ontologies as an RFC will simply not work. The IETF will have to adapt its process to point to an opensource ontology, where the stability and adoption of it will not depend on the IETF consensus process. Without such a change, we fear that the networking ontologies will simply happen outside of the IETF, which would be a pity.