Toward Building a Context-Aware Data Aggregation Framework for Network Monitoring

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Introduction

Main Ideas

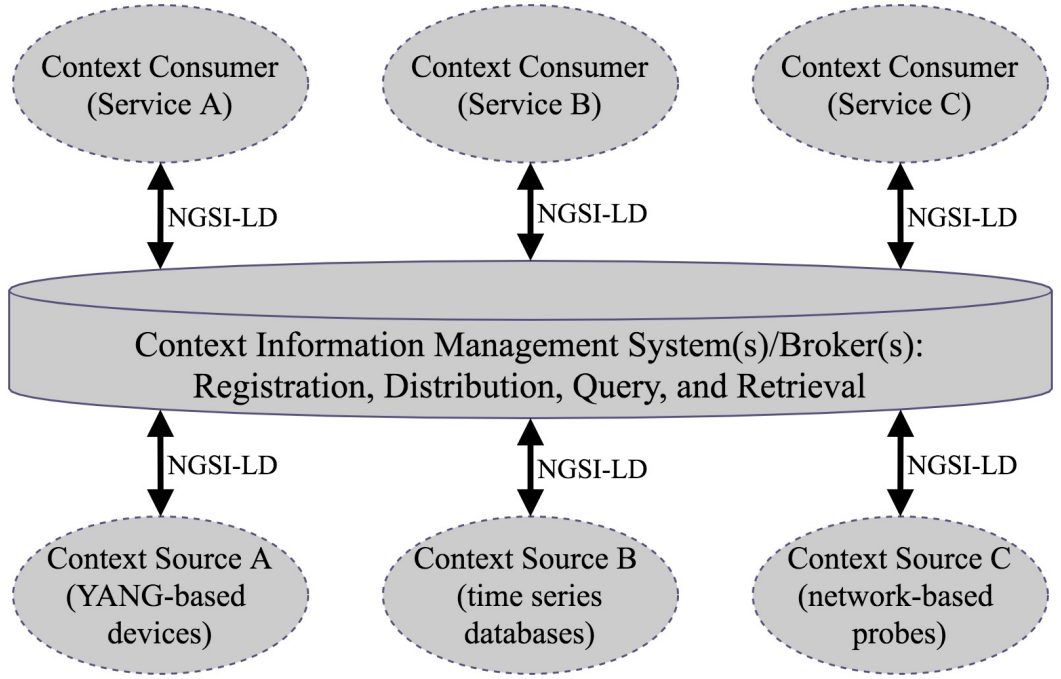
- Deal with **heterogeneous** data sources
  - Multi-domain, multi-technology, multi-…
  - Transport protocols
  - Encoding formats
  - Subscription mechanisms (pull vs push)
- Metadata to characterize the data sources
  - **Context information management** based on **ETSI CIM**
- Semantic framework for network monitoring
  - Applies **streaming telemetry** techniques
  - Leverages metadata for configuration/description of **data pipelines**
  - **Transformation** between data models

ETSI ISG CIM

- Focused on mechanisms to deal with context information
  - Information shared through data publication platforms (Context Brokers)
- Standardizes the **NGSI-LD protocol** for exchanging context information:
  - NGSI-LD information models describing entities, properties, and relationships (property graphs)
  - Definition of NGSI-LD API based on REST
- Mainly applied to IoT scenarios

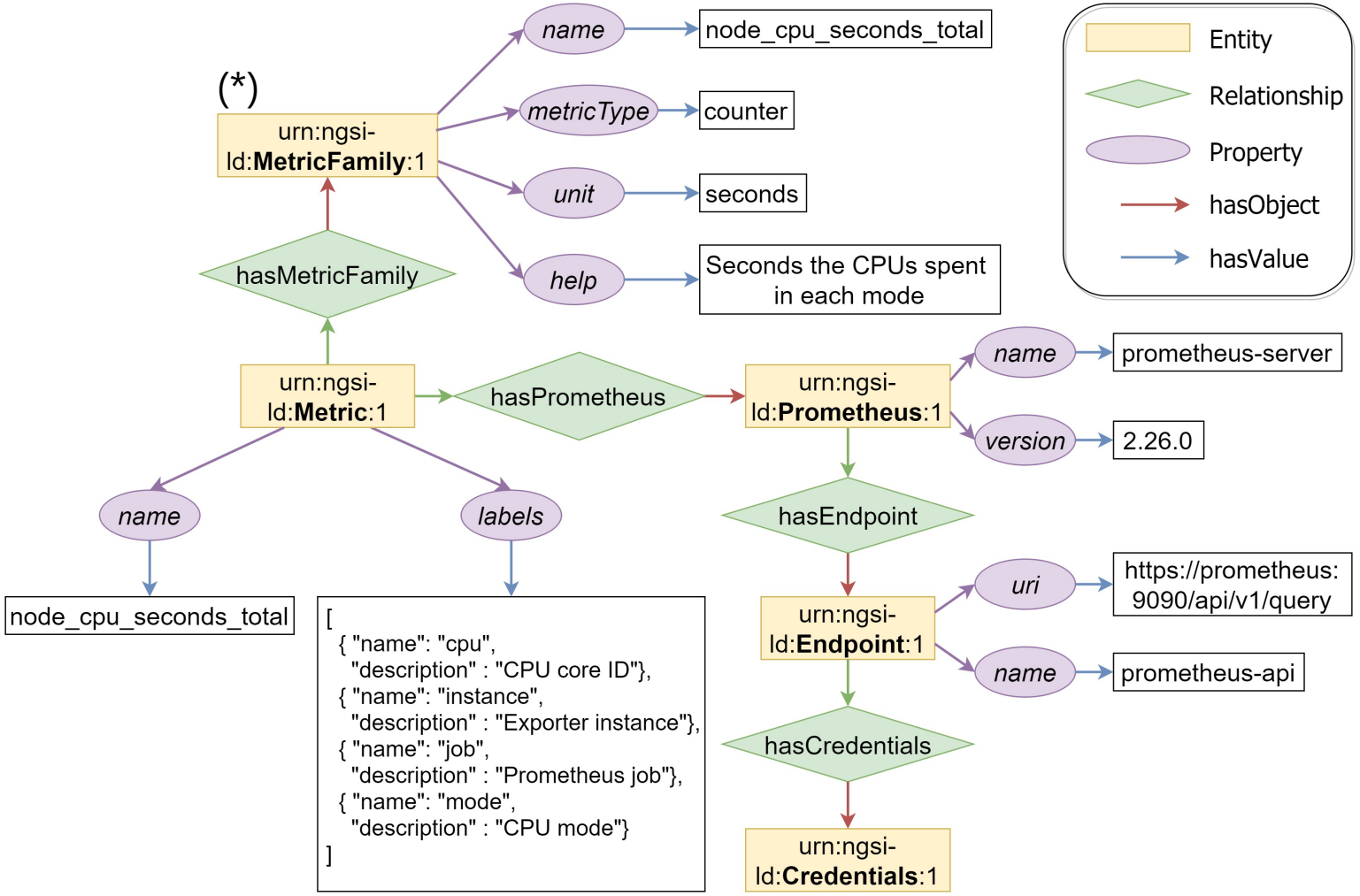
Context Components

- **Context Brokers** → Store and exchange context information
- **Context Sources** → Provide context information to the Context Broker (e.g., YANG-based devices)
- **Context Consumers** → Request and subscribe to context information from the Context Broker (e.g., database services)



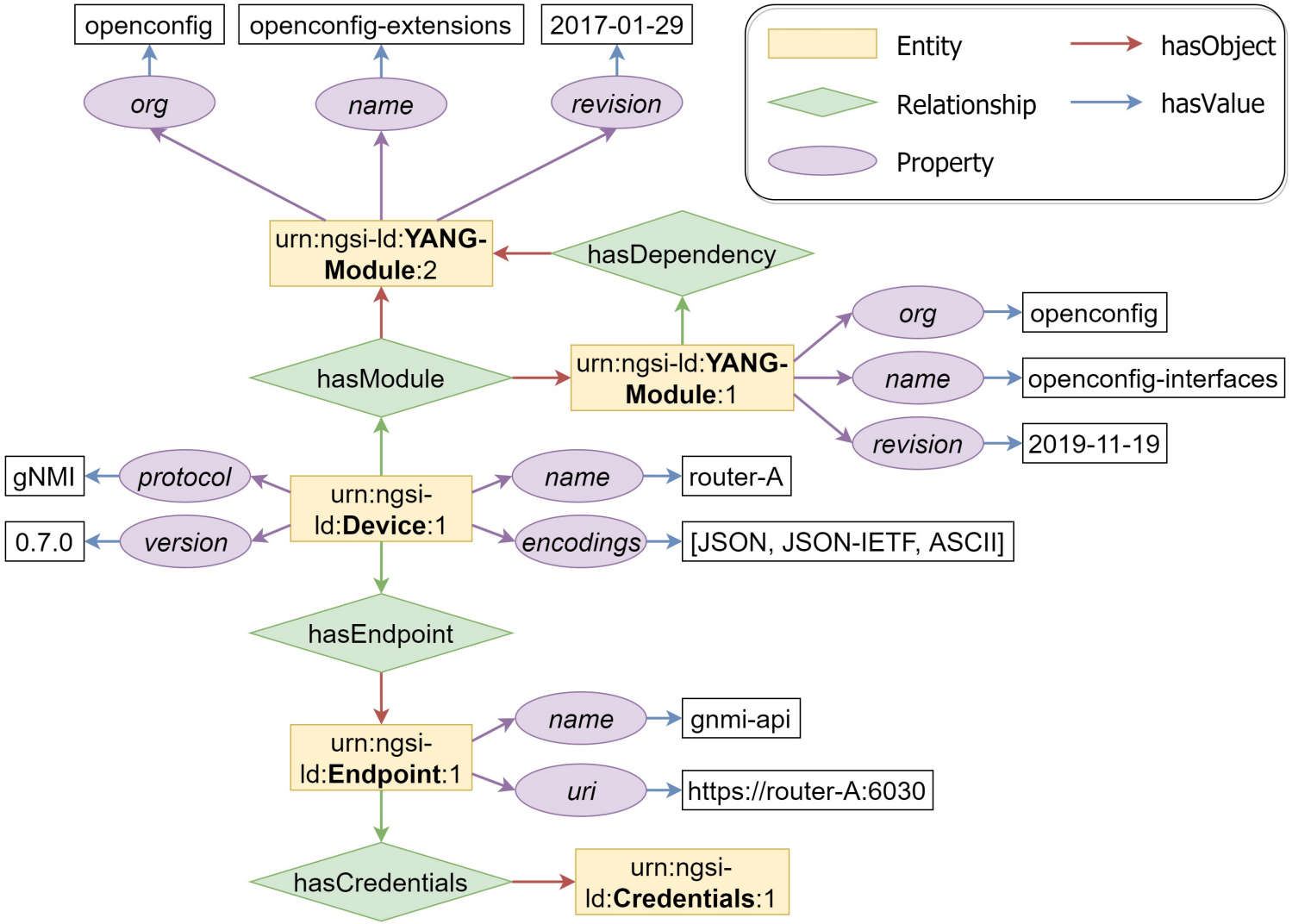
Context Modeling

Prometheus-based Data Source



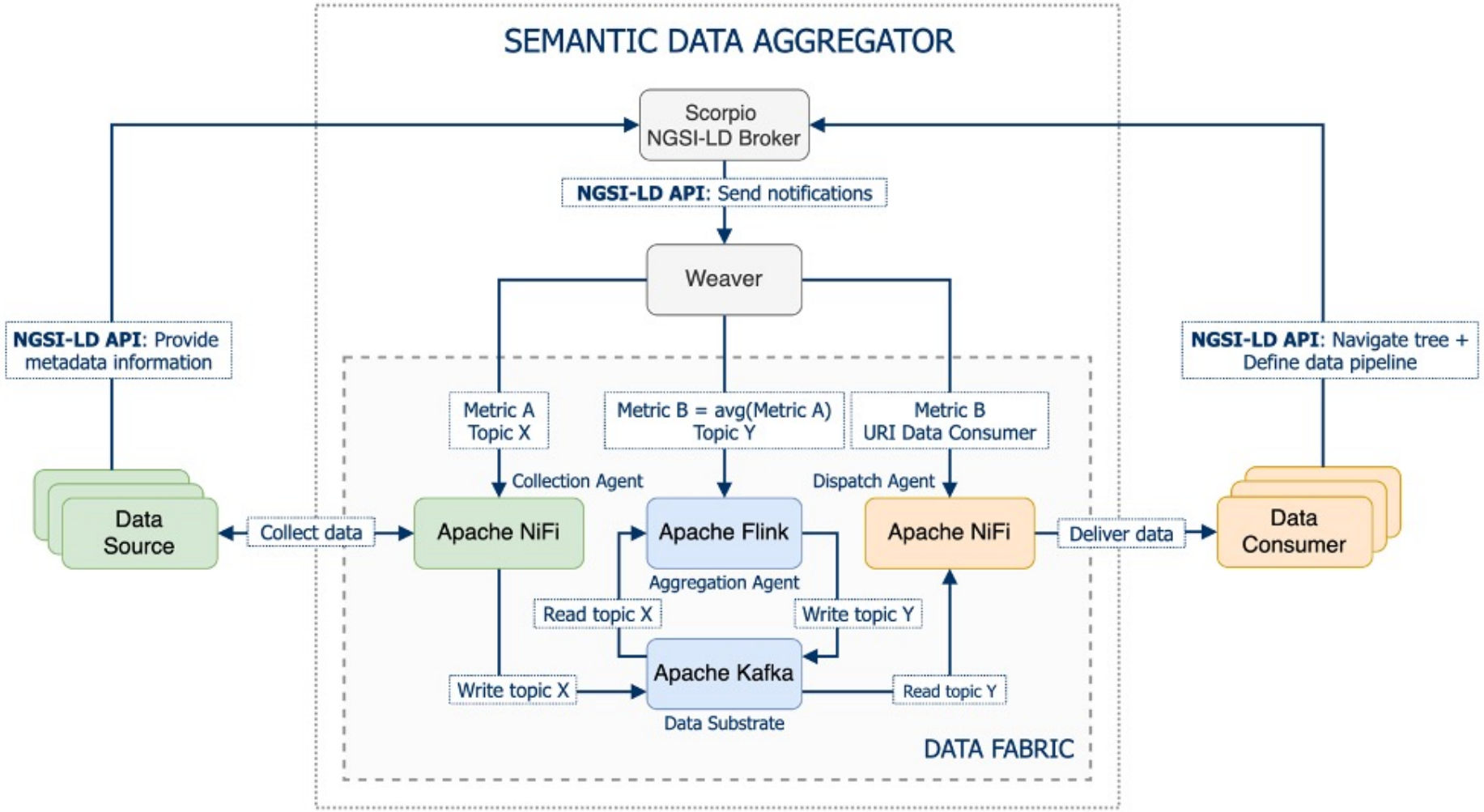
* *MetricFamily* NGSI-LD entity aligned with OpenMetrics initiative (https://openmetrics.io/)

Telemetry-based Data Source

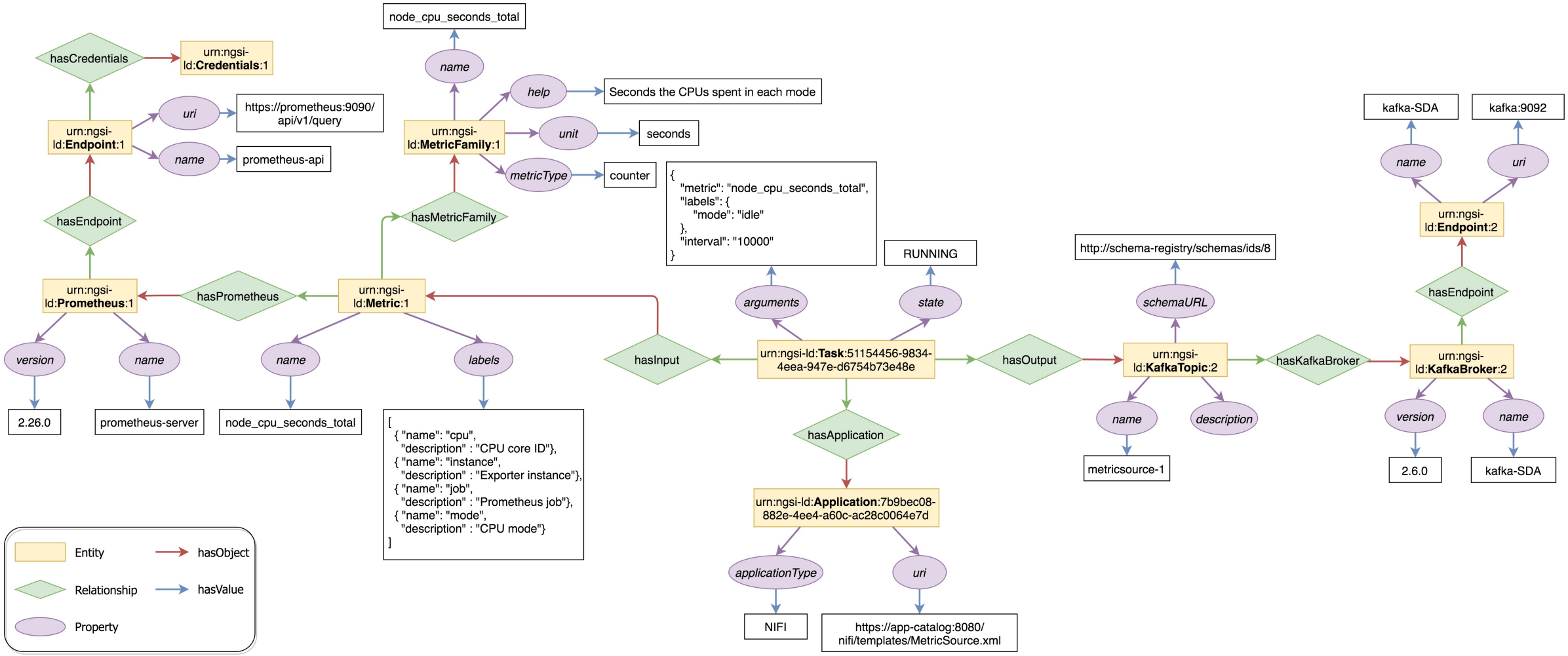


Semantic Data Aggregator (SDA) Framework

SDA Architecture Overview



Context Modeling of Data Pipelines



Real Use Case

Anomaly Detector (I)

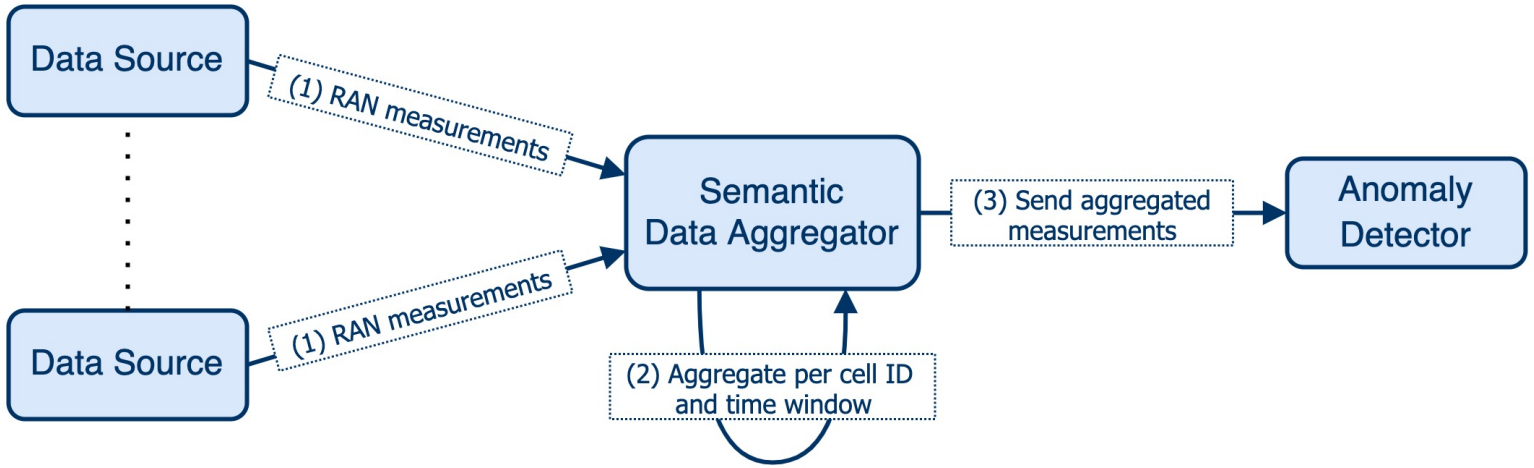
Module that analyzes the status of a RAN cell:

- Learns from data traffic patterns and mobility patterns
- Identifies and predicts anomalies based on RAN KPIs
- Exposes REST API for ingesting streams of events
- Provides a future notification/alert system

Field Name	Data Type	Description
ul_delay	Float	Uplink delay (ms)
dl_delay	Float	Downlink delay (ms)
lost_packets	Integer	# of lost packets, per service per user
rsrp	Float	RSRP (dB)
transfer_protocol	Boolean	TCP or UDP encoded [0,1]
urlx_cell	Integer	UE Bytes received from the cell
timestamp	Datetime	Measurement timestamp (datetime format - "yyyy'-'MM'-'dd' 'HH':'mm':'ss")
cell_id	Integer	RAN cell ID

Anomaly Detector (II)

- Context describes which data source provides which RAN KPI measurements
- SDA collects measurements and aggregates per cell ID and time window
- Aggregated data combined and transformed into the data model of the Anomaly Detector module
- SDA delivers data through the Anomaly Detector's REST API



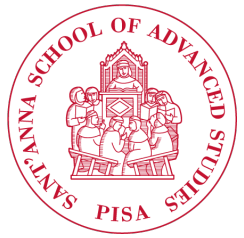
Conclusions

Summary

- Data-driven network management requires the integration of heterogeneous data sources and data consumers
- Context-aware management based on the ETSI CIM standard
  - Modeling of data sources, data consumers and data pipelines
- Development of monitoring framework for collecting and aggregating data
  - Separation between monitoring context and data planes

Next Steps

- Combination of context information from different levels:
  - Operations level → network functions, network services
  - Business level → network policies, intents, SLAs, owners
- Alignment with the SAIN architecture
- Auto discovery of context information
- Northbound API for interacting with the semantic data aggregator
- Closing the loop → Collection, processing, and application of configuration data



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