



Energy Consumption Monitoring with Graph Databases and SOA

Anargyros Kiourkos

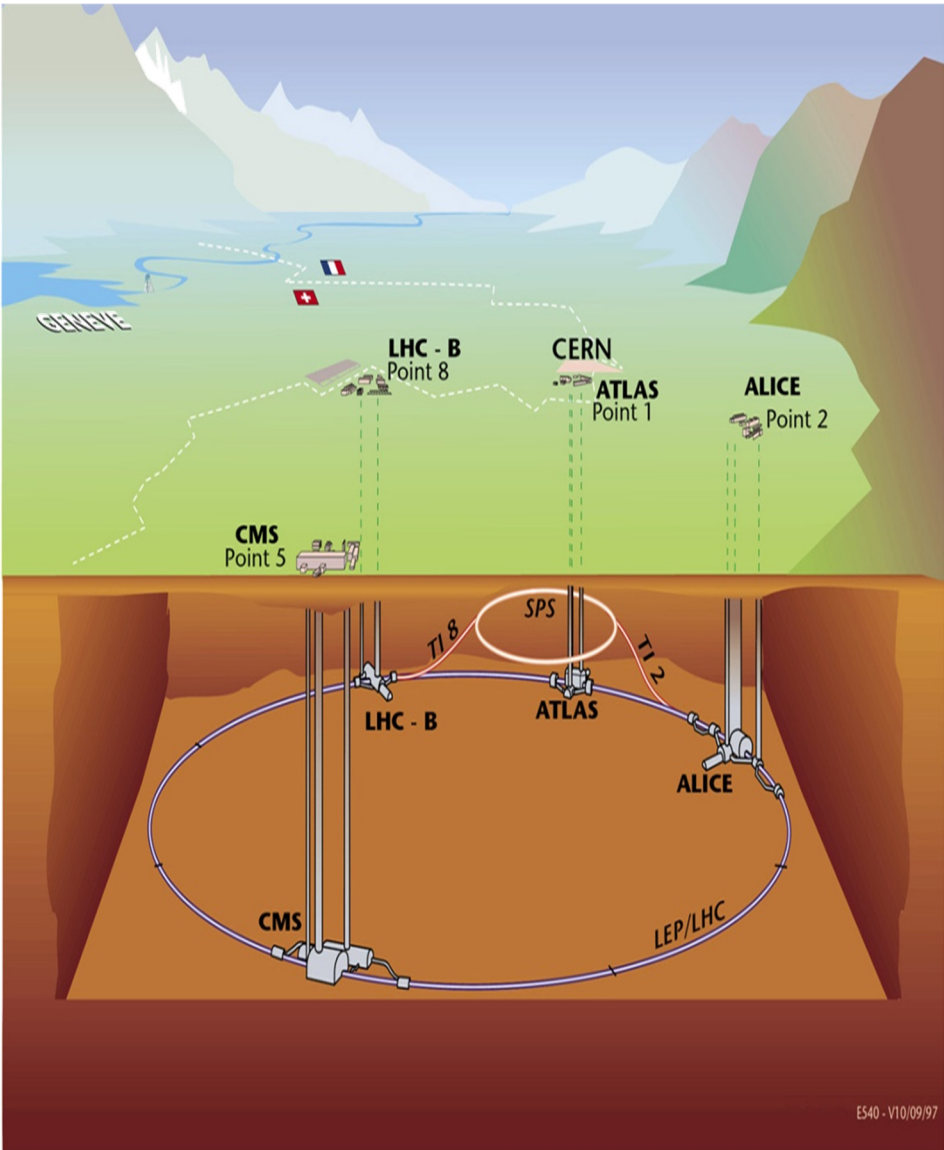
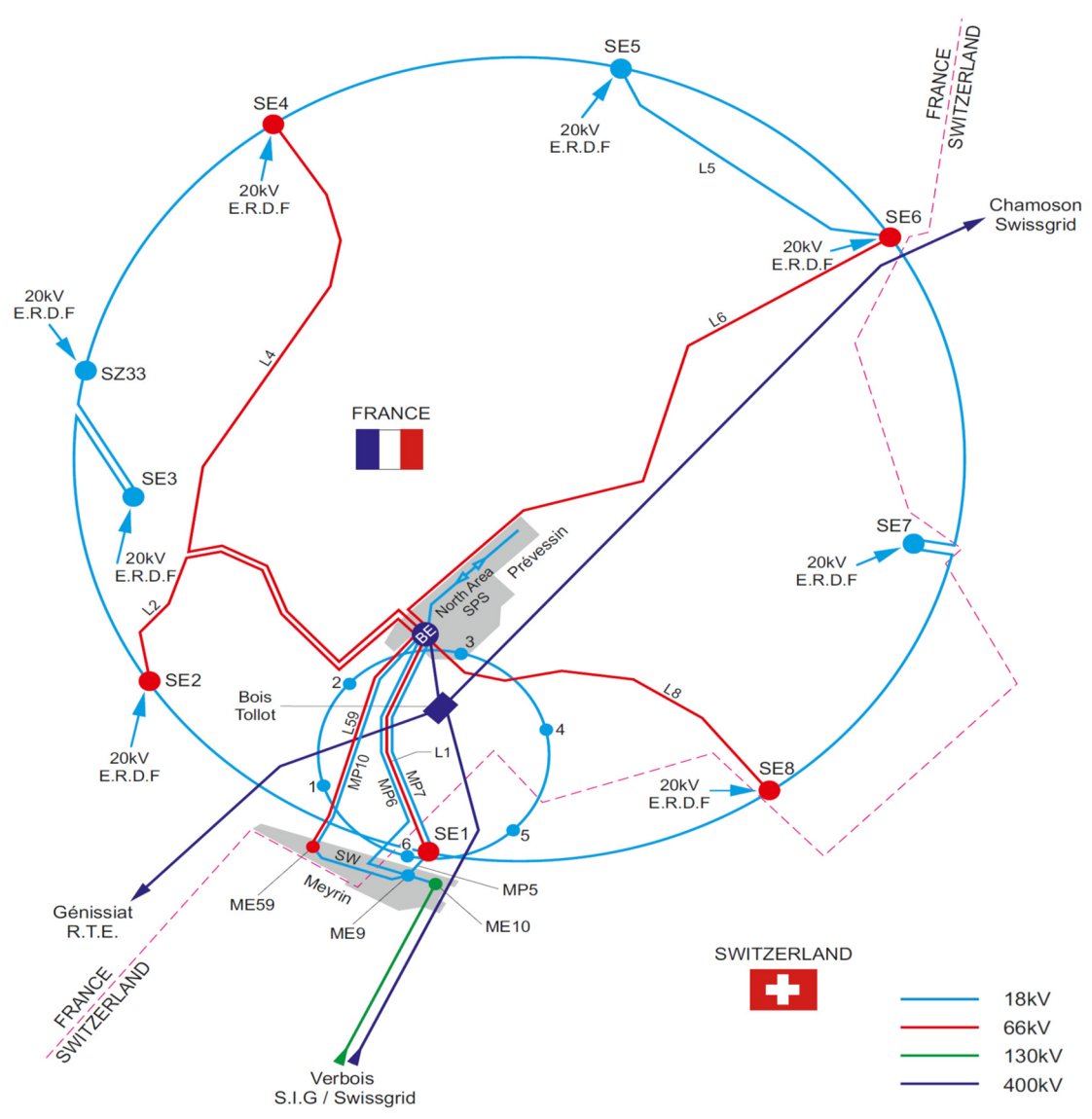


Agenda

- CERN's Electrical Network
- Energy Consumption Monitoring
- Graph Databases – A primer
- SOA & Microservices
- WebEnergy 2.0



CERN's electrical network

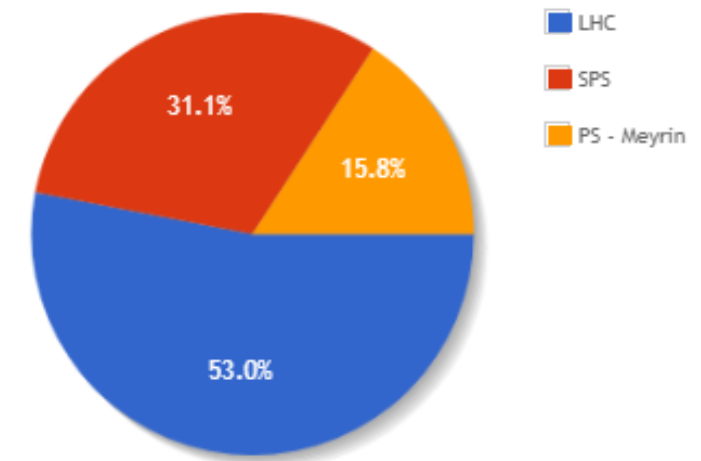


Energy consumption

Daily Average Power of CERN in 2018

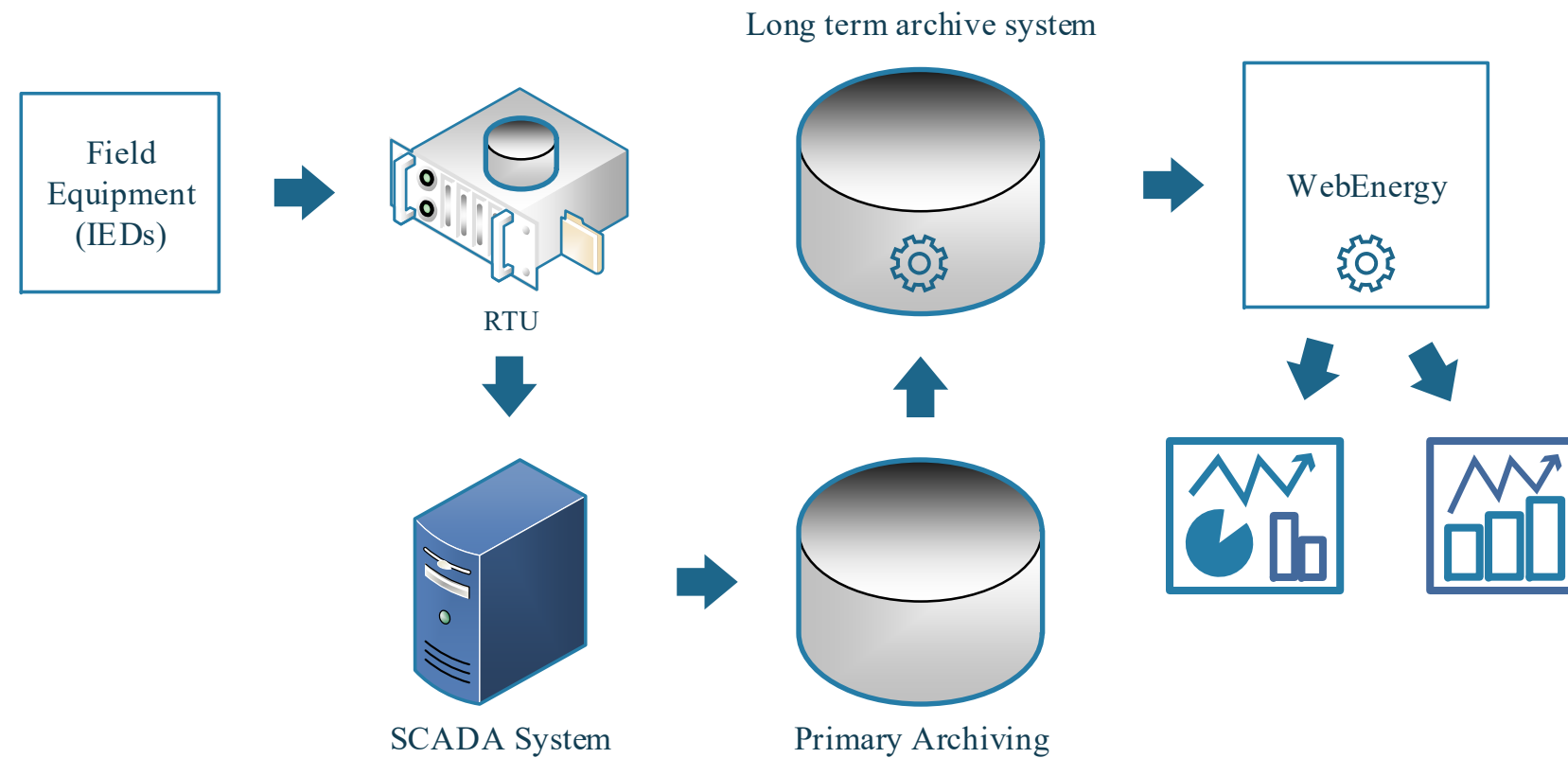


Yearly Energy Consumption of CERN per Site in 2018



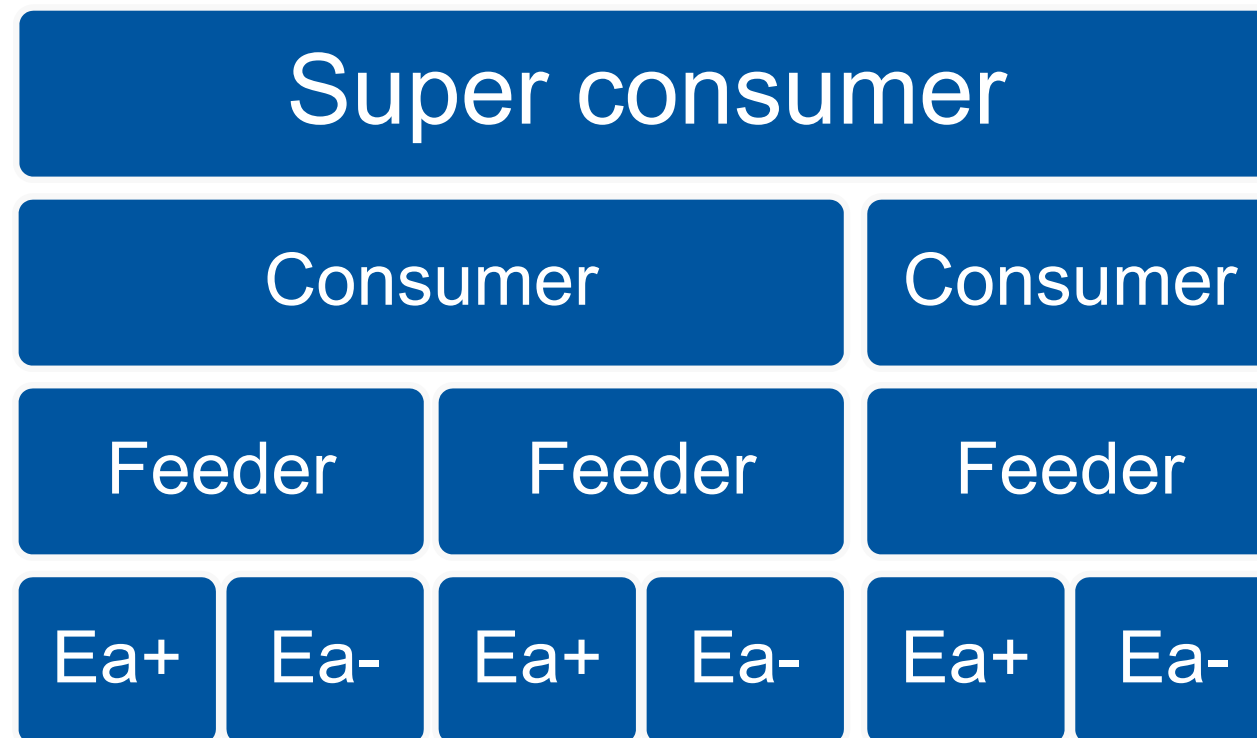
- ~1.2 TWh - 2018
- ~1/3 the Canton of Geneva
- LHC by far the biggest consumer
- One of the few consumers in France with 400kV substations (2x)

Energy consumption monitoring



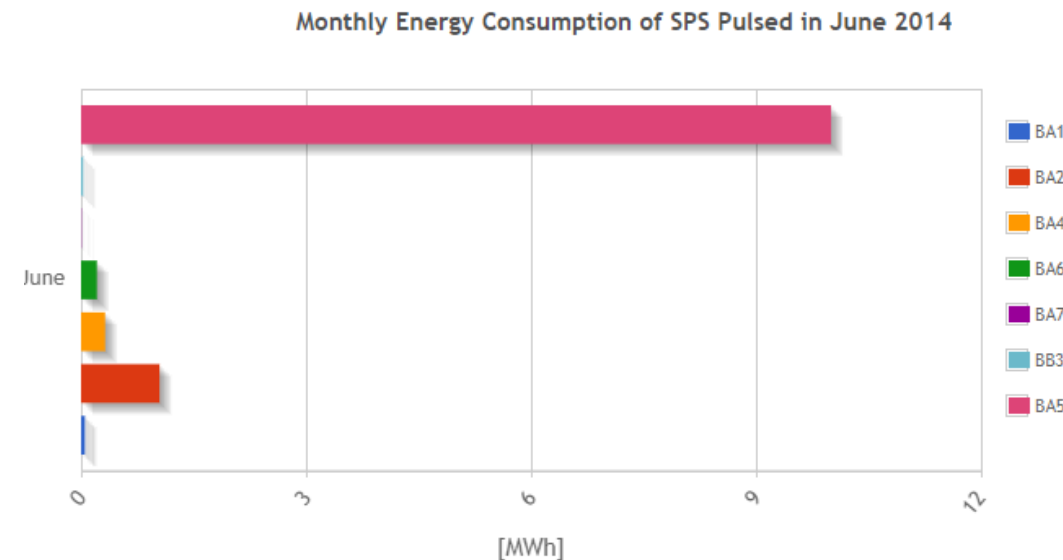
Data model (current)

- Hierarchical structure
- Traditional relational model
- Single parent-child relationship



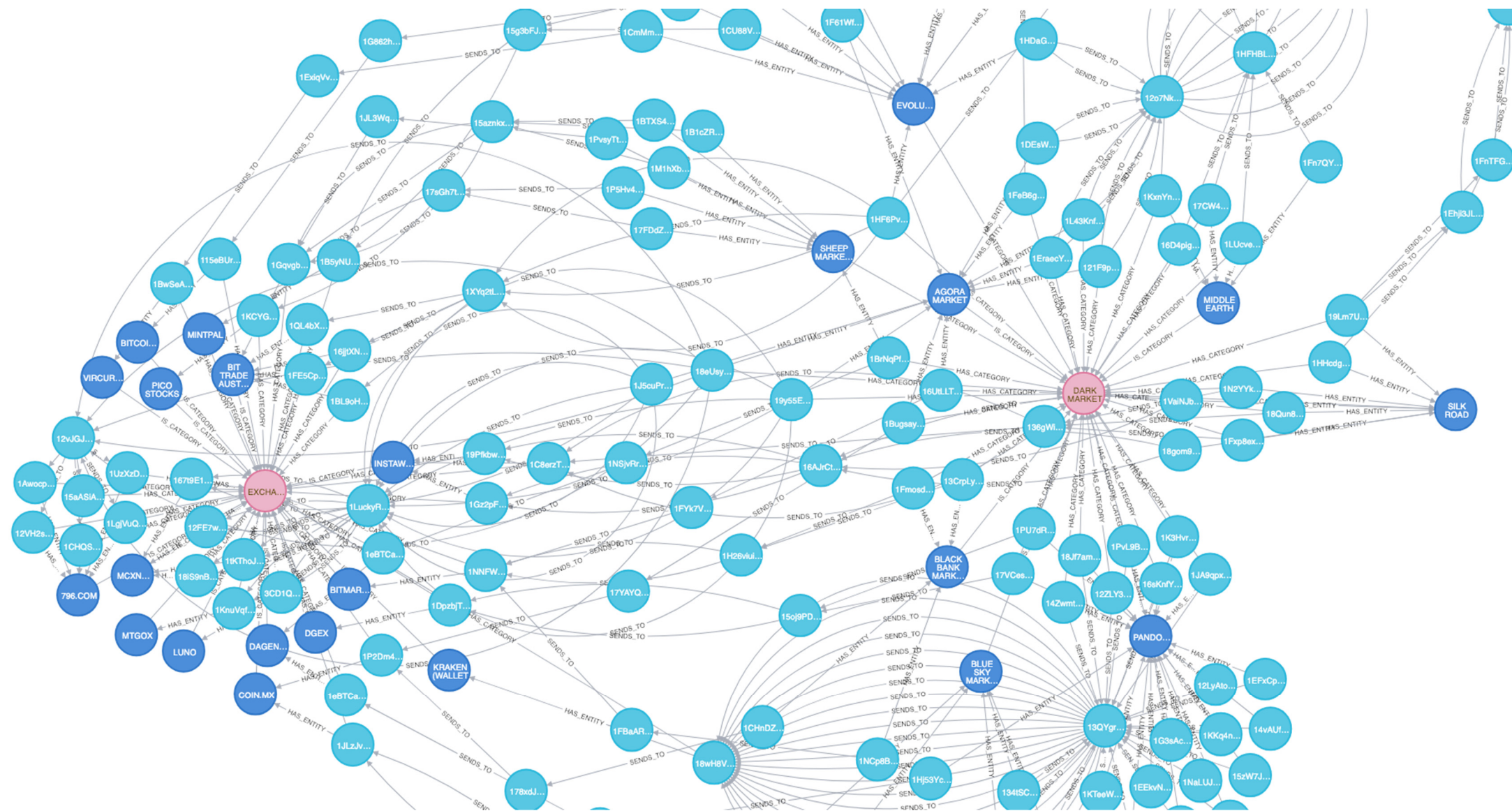
Auditing

- History of the electrical model not available
- E.g. Consumption of a specific site in June 2014



- Great... but how was the electrical network back then?

Graph databases – A primer



Building blocks

Nodes

- Represent entities (e.g. counter, feeder etc.)

Relationships

- Connect entities and structure domain

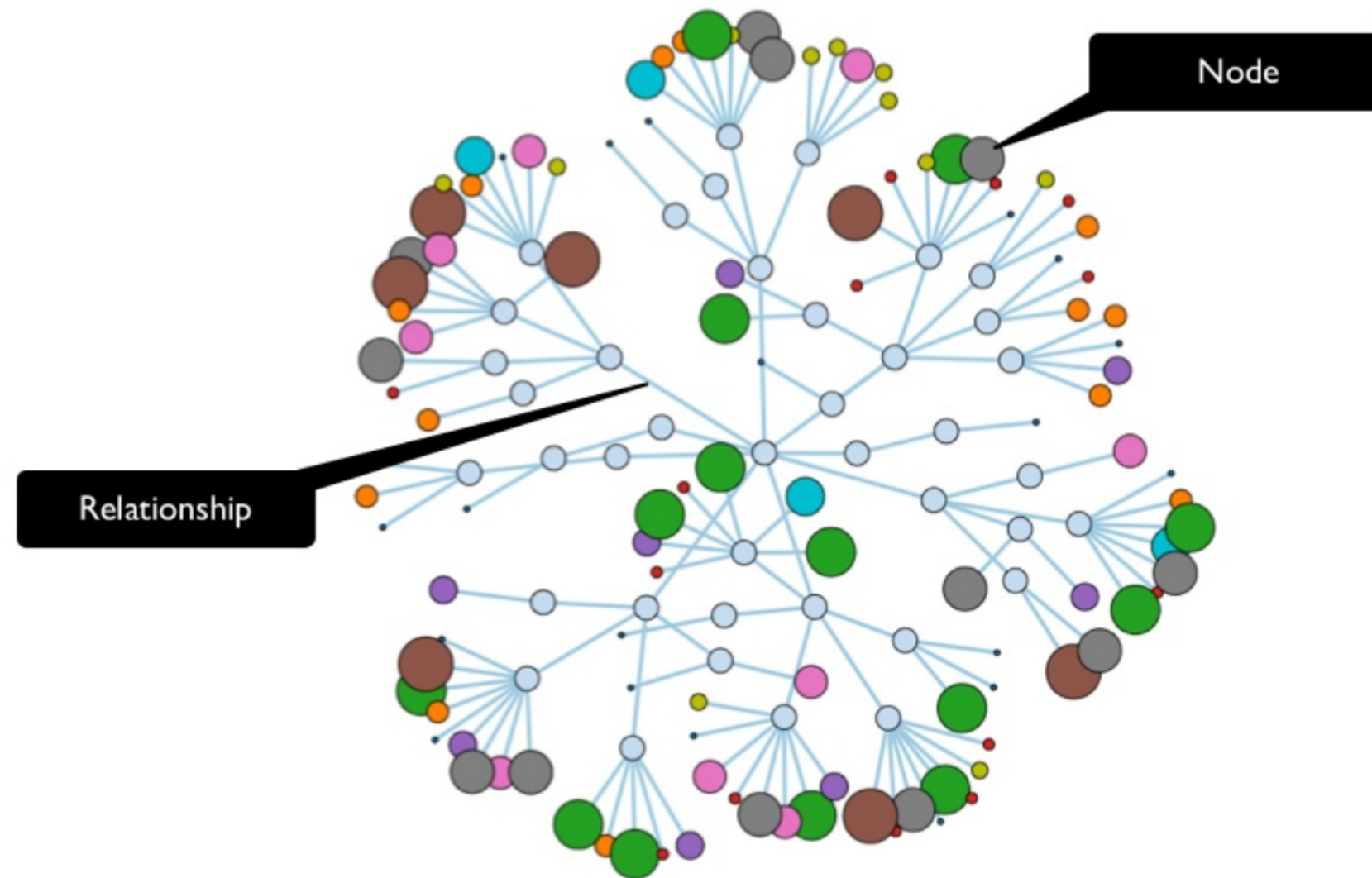
Properties

- Attributes and metadata

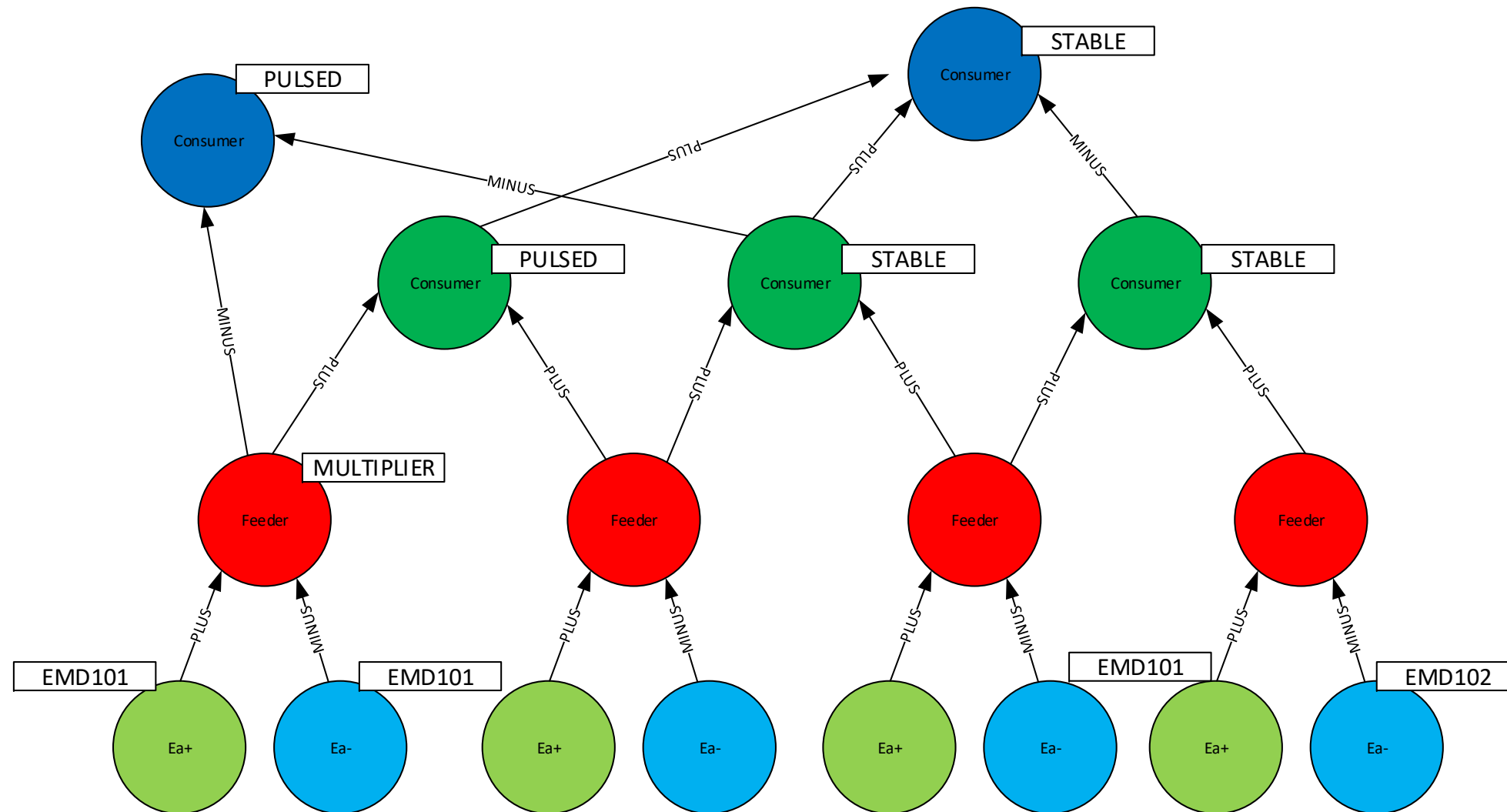
Labels

- Group nodes by role

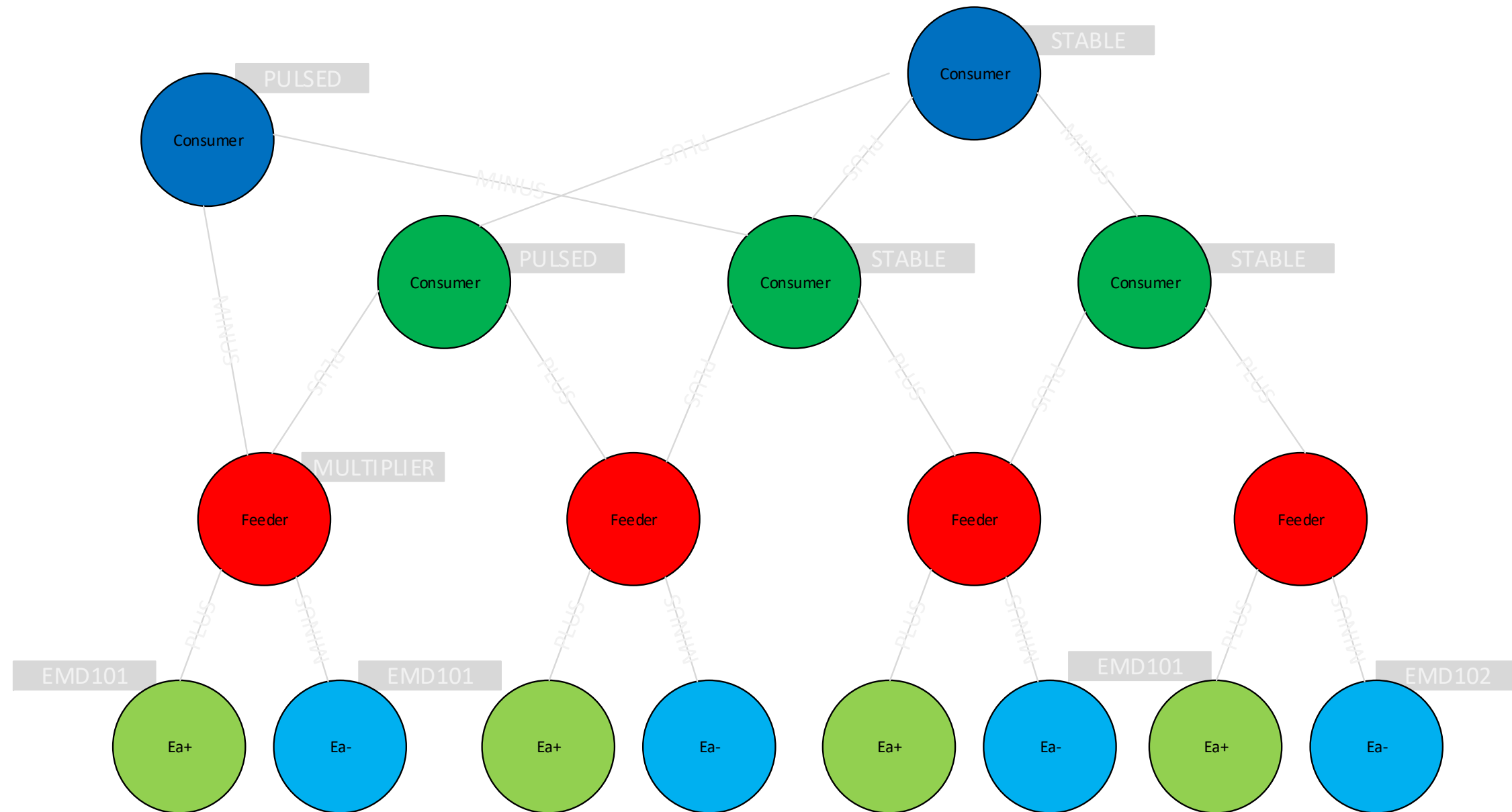
A graph



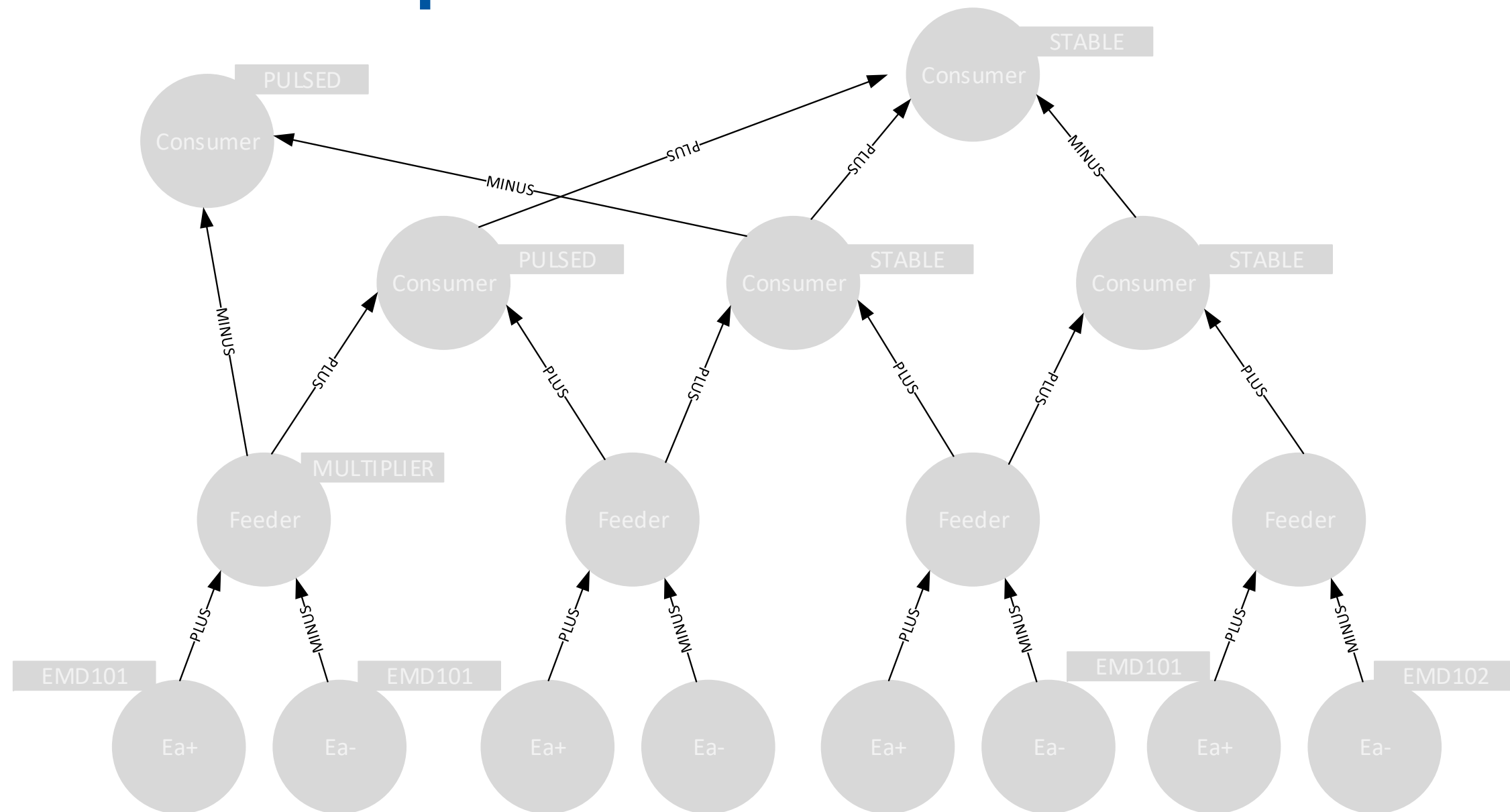
Property Graph Data Model



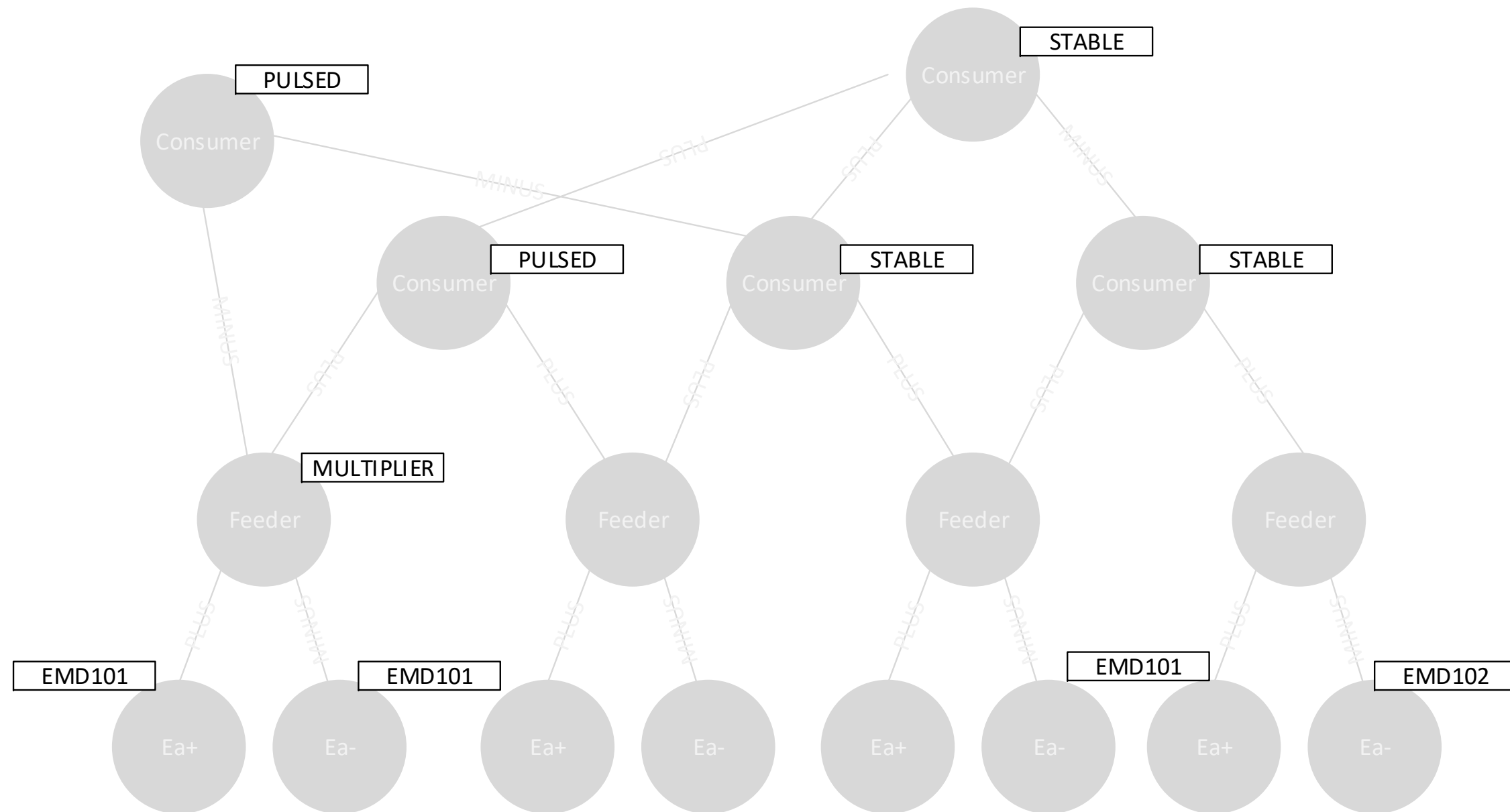
Nodes



Relationships



Labels

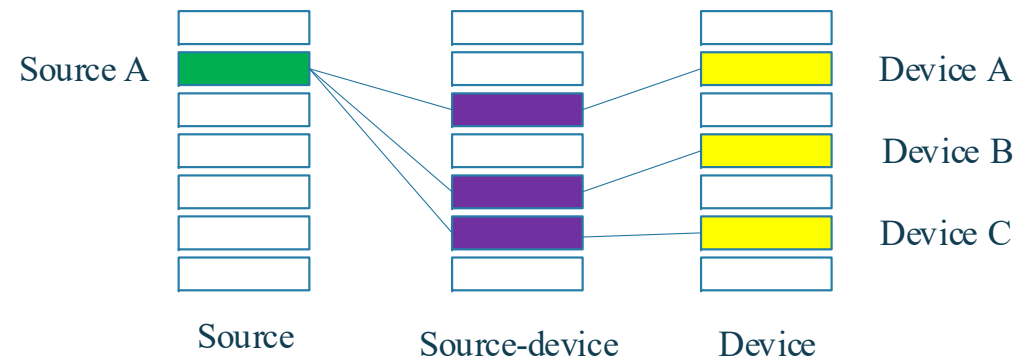


Graph vs RDBMS

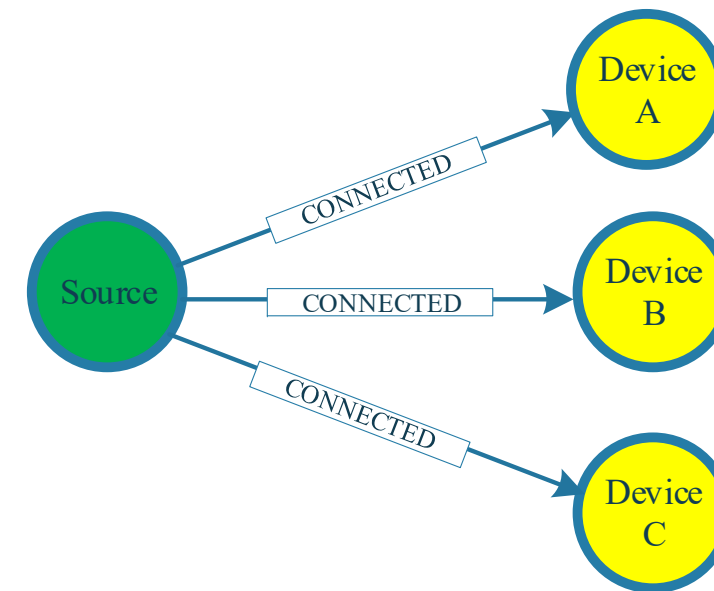
- Graph:
 - More performant with connected data. No joins, define entry point and walk the graph 👍
 - Model from whiteboard directly to database. Easy for business users to understand 👍
 - Relationships are first class citizens 👍
 - Bad for storing binary data 👎
 - Requires conceptual shift 👎
 - Sharding not available (horizontal partitioning). The graph needs to be in one place. 👎
- RDBMS:
 - More performant for writes 👍
 - Can be optimized for specific queries 👍
 - Abundance of tools and frameworks 👍
 - Model needs to be mapped to the RDBMS world. Not friendly to users, complex 👎
 - Relational only in name. Foreign keys <> relationships 👎
 - Connected data requires multiple joins. Bad for performance & complex 👎



FK's != “real” relationships

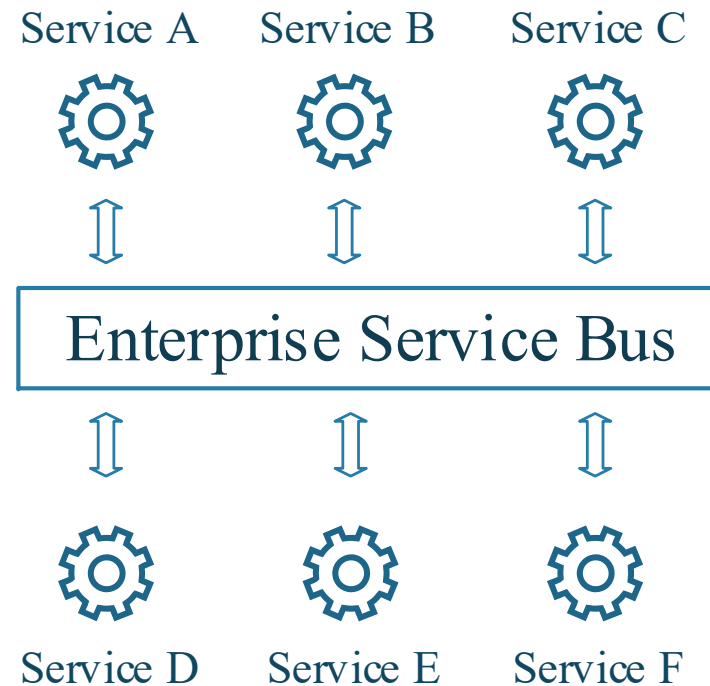


Relational model

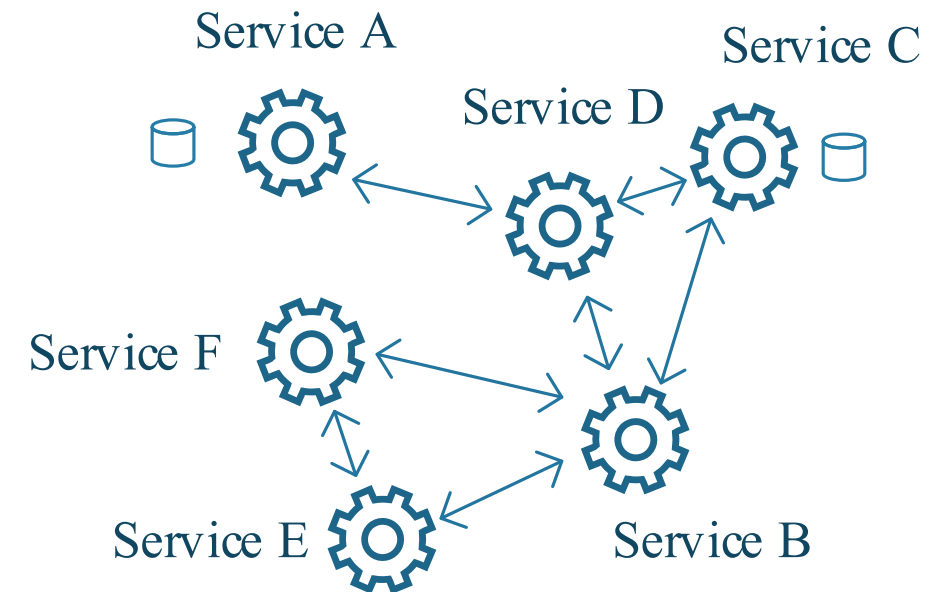


Graph model

SOA & Microservices

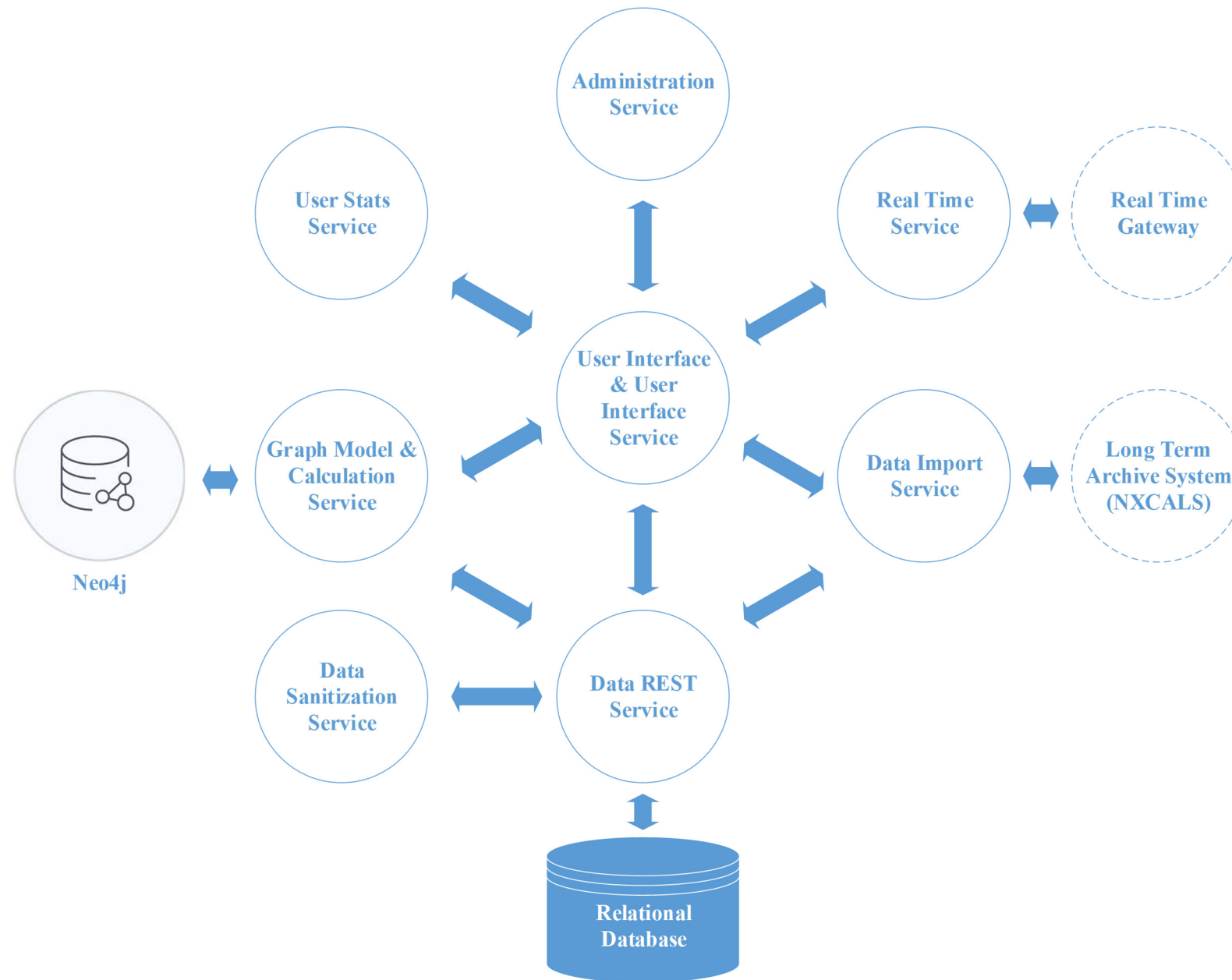


Service Oriented Architecture



Microservices

WebEnergy 2.0



WebEnergy 2.0 – Data Model

