Enabling the Vision of Bench-to-Bedside with Semantic Web Technologies

Bench-to-Bedside Needs

- Flexible Integration of many types of Data

- Enabling Translational Research

- Comprehensive and Efficient handling of Adverse Event Signals

- Application of Policies and Rules

What Can Be Gained through the Semantic Web

- Building Bridges between *all* data silos

- Incorporation of semantics to data

- Distributed and Discoverable Annotations

- Audit trail of all information

- Granular Security

- Linking Re-Usable Knowledge with Data

What is the Semantic Web?

Vast amount of confusion/disinformation:

- What is RDF?
- Waiting for Ontologies?
- Re-Building the Entire Web?
- What if we don't agree on semantics?

Myths and Facts

- RDF is based on XML?

- No, RDF *is* not based on XML!
  - RDF is a data modeling framework consisting <u>always</u> of *triples*
  - RDF can be translated into XML…
    - Also into N3, TRIPLES, TURTLES…

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Myths and Facts

- Are Ontologies required for RDF?

- No, Ontologies are *not* required for RDF
    - Constraints can be defined using RDFS
    - Data can be converted into RDF *now*!

Myths and Facts

- OWL is based on RDF

  – Triples

- RDF can refer to multiple OWL and RDFS documents

Myths and Facts

- Does the existing Web have to be rebuilt?

- No, Semantic Web Technologies can be incrementally added to the existing Web
    - Islands of RDF and OWL documents are examples of this

Myths and Facts

- Semantic Web does not require SOA
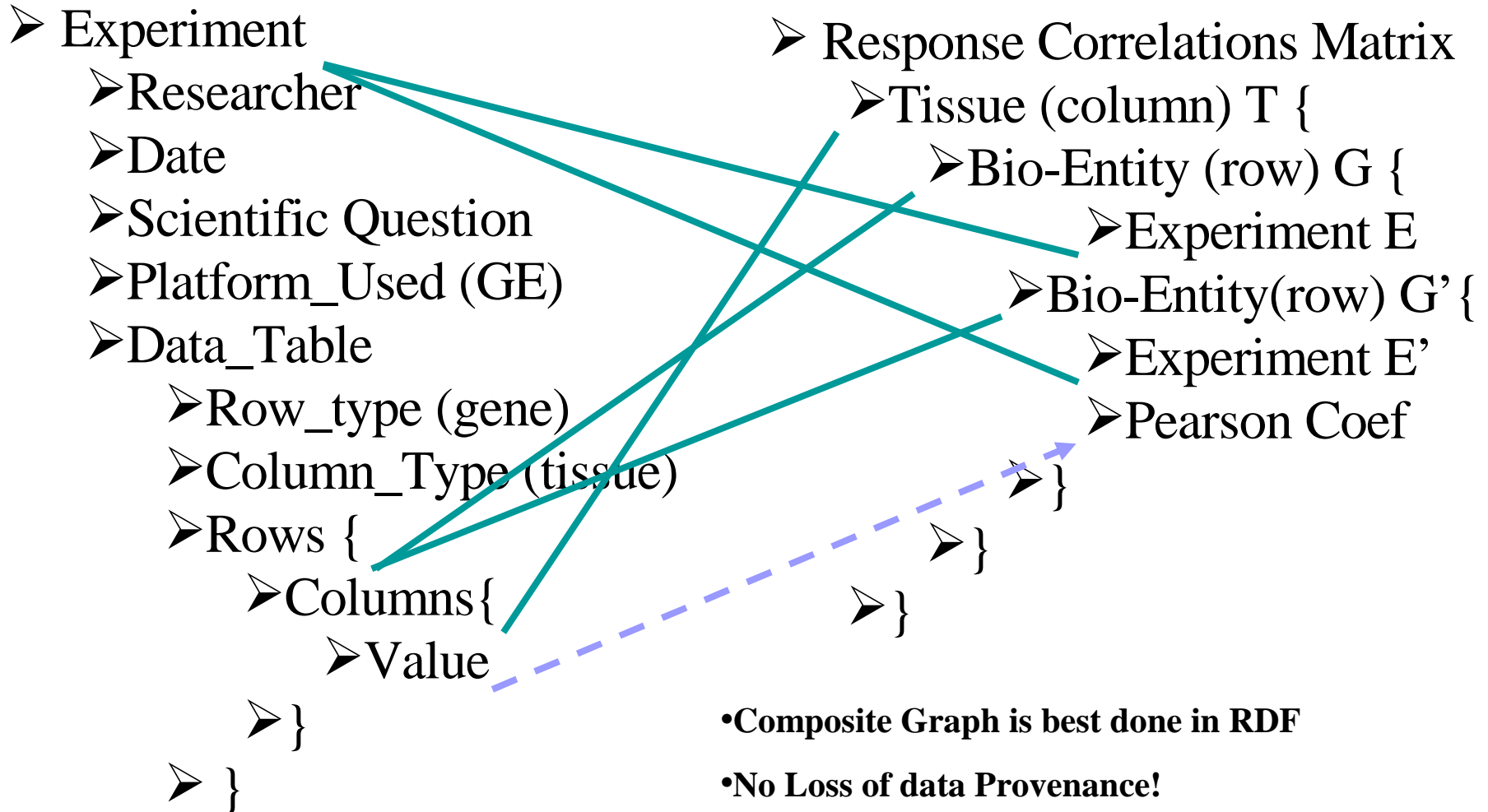 - SOAs can utilize WSDL defined in OWL
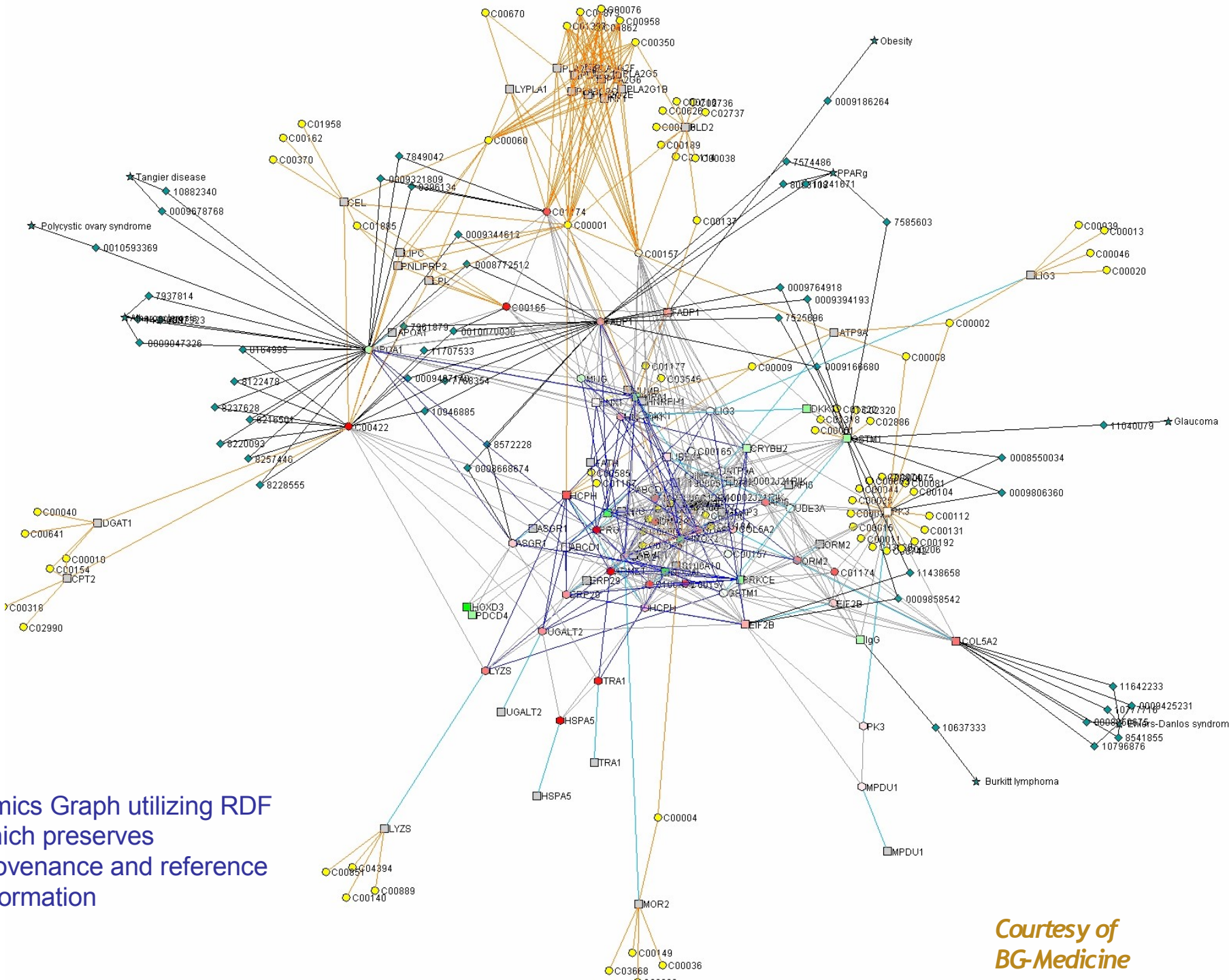
Myths and Facts

- Do we need agreement on one set of semantics?

- No, RDF supports multiple semantics that can be layered from any number of different namespaces

  - Mutiple semantics can be connected

Data Packing vs Semantics Encoding

- XML is designed for data packing
  - Not the complete story for data interoperability
- Data trees do not equal taxonomy trees!
  - Major confusion regarding semantics
- Omics solutions cannot rely only on trees
  - Data re-use requires graph connections, at least inter-trees

Trees vs Graphs
(example using XML)

- Experiment
  - Researcher
  - Date
  - Scientific Question
  - Platform_Used (GE)
  - Data_Table
    - Row_type (gene)
    - Column_Type (tissue)
    - Rows {
      - Columns{
        - Value
    - }
  - }

- Response Correlations Matrix
  - Tissue (column) T {
    - Bio-Entity (row) G {
      - Experiment E
    - Bio-Entity(row) G' {
      - Experiment E'
    - Pearson Coef
    - }
    - }
  - }

- **Composite Graph is best done in RDF**
- **No Loss of data Provenance!**

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Omics Graph utilizing RDF
which preserves
provenance and reference
information

Courtesy of
BG-Medicine

Approaches to developing semantics for the web

- Bottom-up
  - Social Web; Tagging; Grass-roots efforts
- Top-Down
  - Organized Ontological Projects; Engineering
- Mixture of both?

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…as applied to Drug Discovery