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Towards a Smart Secure Grid: Graph Analytics for Cyber Physical Security

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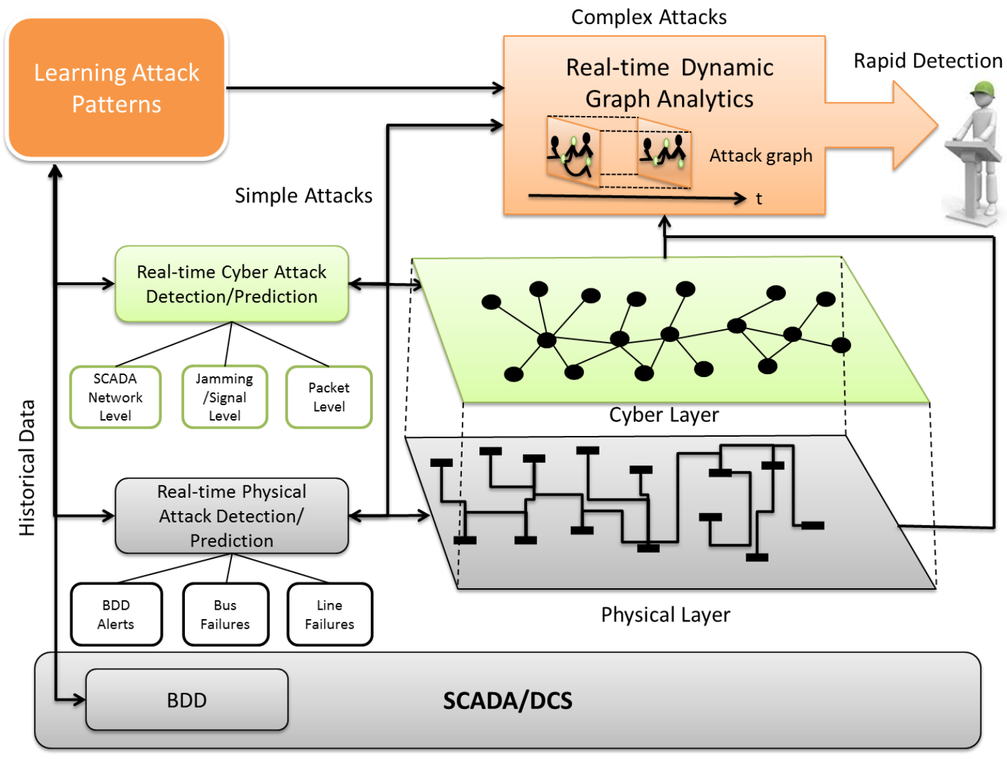
Smart Yet Secure Power Grid

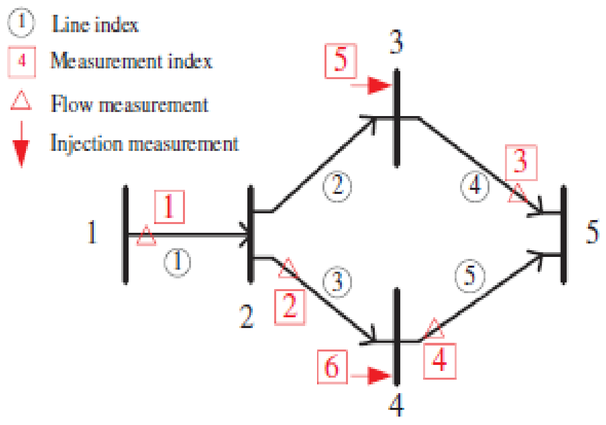
Smart Power Grid

- Massive volumes of real-time information
- Complexity
  - Diversity of data sources
  - Thousands of devices
- Security
  - Confidentiality and privacy
  - Cybersecurity monitoring
  - Increased points of entry

Real-Time Analytics



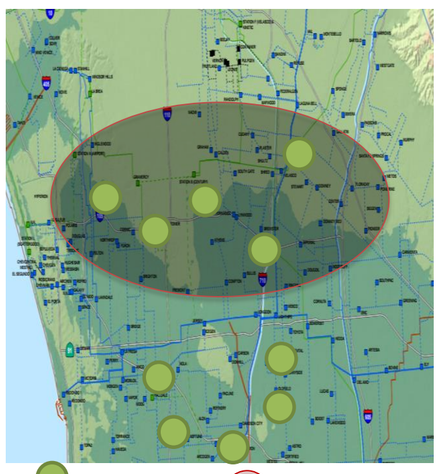
Meter Protection



Vertices – Buses
Edges – Transmission lines

- **Optimal Protection Problem**
  - Find the minimum set of meters to secure to avoid data integrity attacks

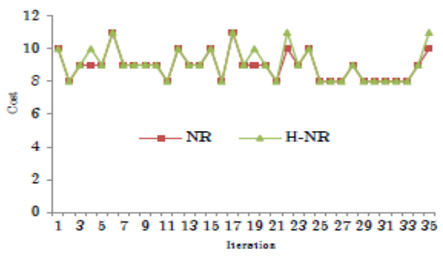
Theorem: The minimum measurements that need to be protected in order to secure the set of critical buses against hidden data injection attacks are given by the set of unprotected edges in the minimum Steiner tree that connects reference vertex in G_H with all the vertices that represent the critical buses.



Buses Current area to protect

Protection against data spoofing attacks.

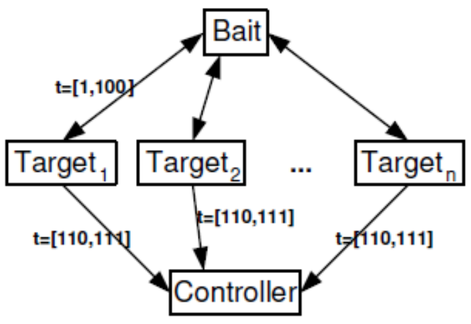
- Scalable graph heuristics for adaptive protection against smart-grid data spoofing attacks.

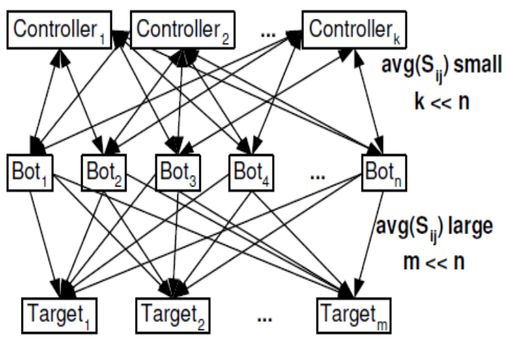


(a) NR vs H-NR

Cyber Attack Detection

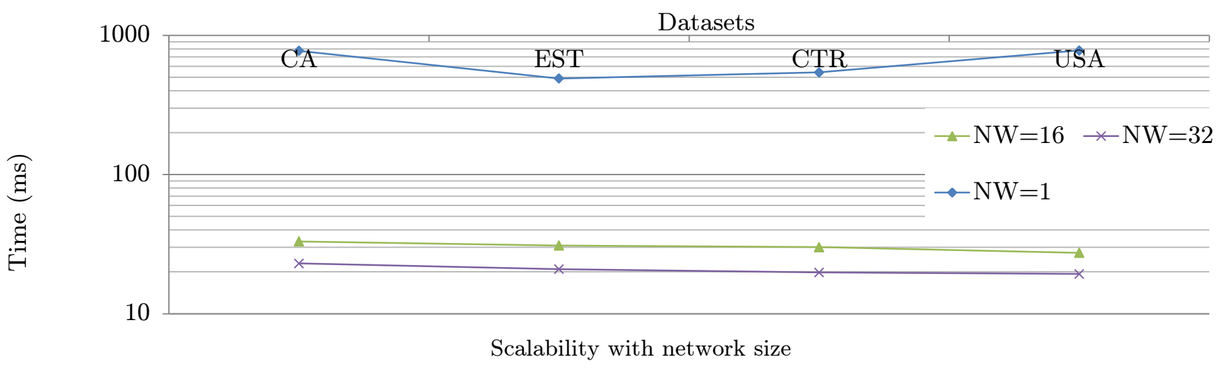
- Cyber attacks as graph patterns
  - Real-time subgraph pattern matching



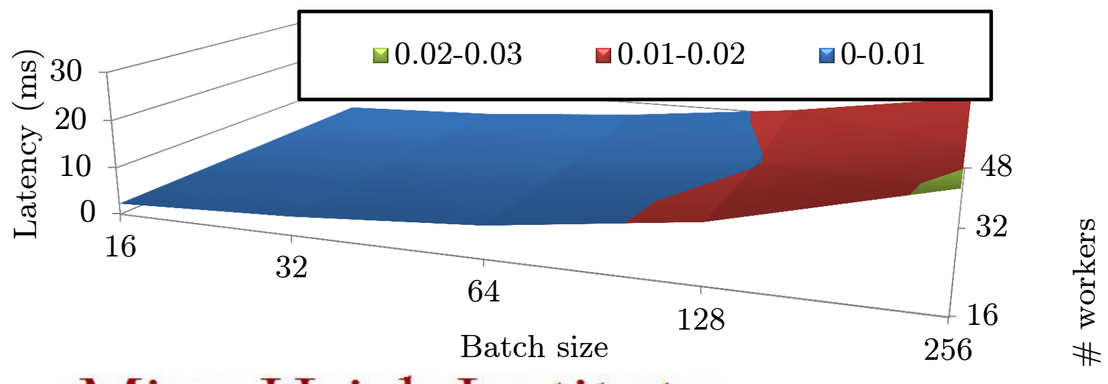


Attack Patterns

Low latency subgraph pattern matching



Scalability with network size



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