This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 608090.

HyRiM

A Multi-Level Approach to Resilience of Critical Infrastructures and Services

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2nd HyRiM End User Workshop
Barcelona, 15.11.2016

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 608090

Contents

- Motivation
- Resilience
- Proposed architecture
- Evaluation results
- Concluding remarks

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Motivation

- Protection of Critical Infrastructures
- Threats on the rise – Serious cyber attack believed likely
- Investigate threats
- Provide foundations
  - Novel protection mechanisms

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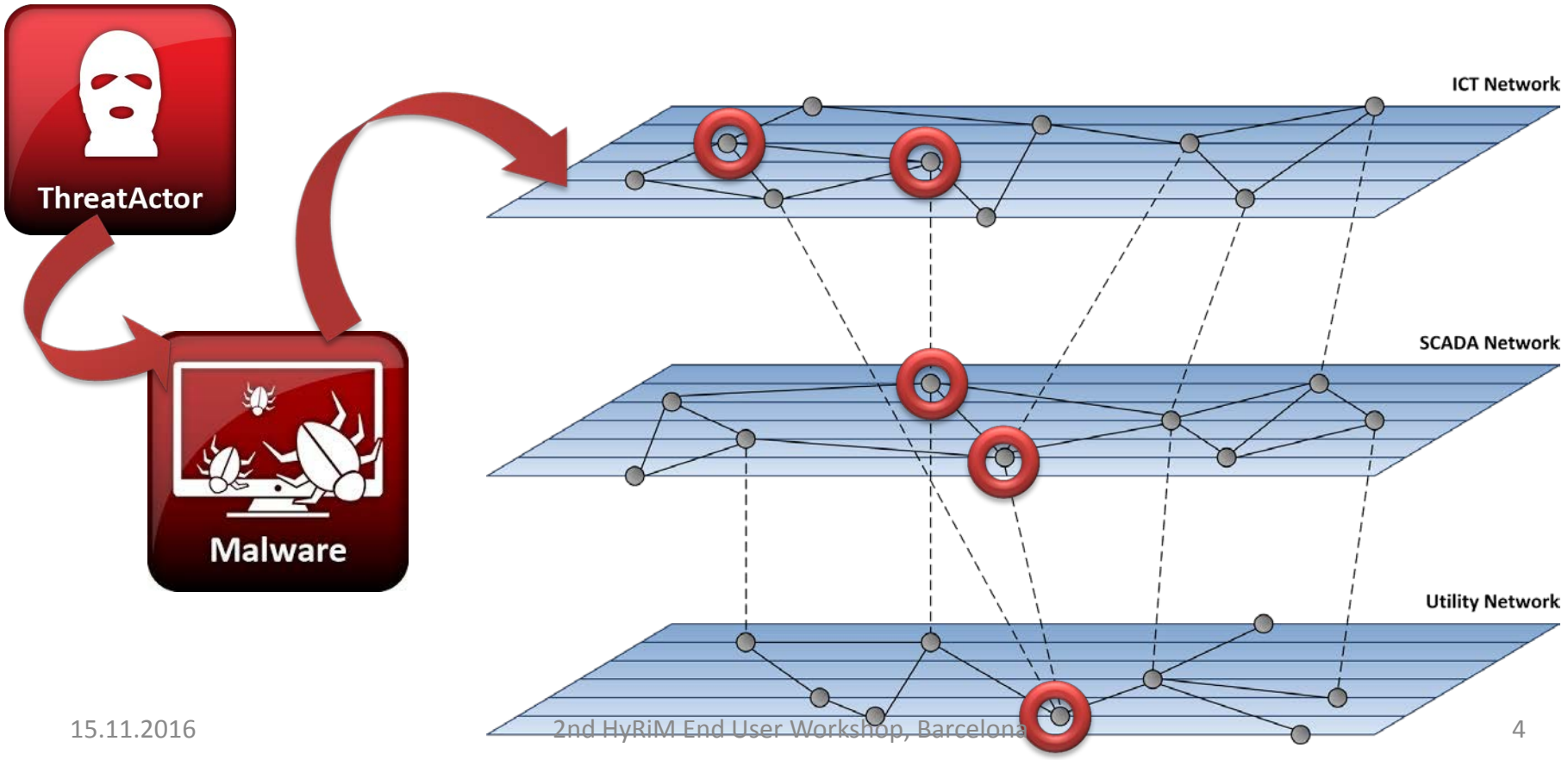
… a typical attack …



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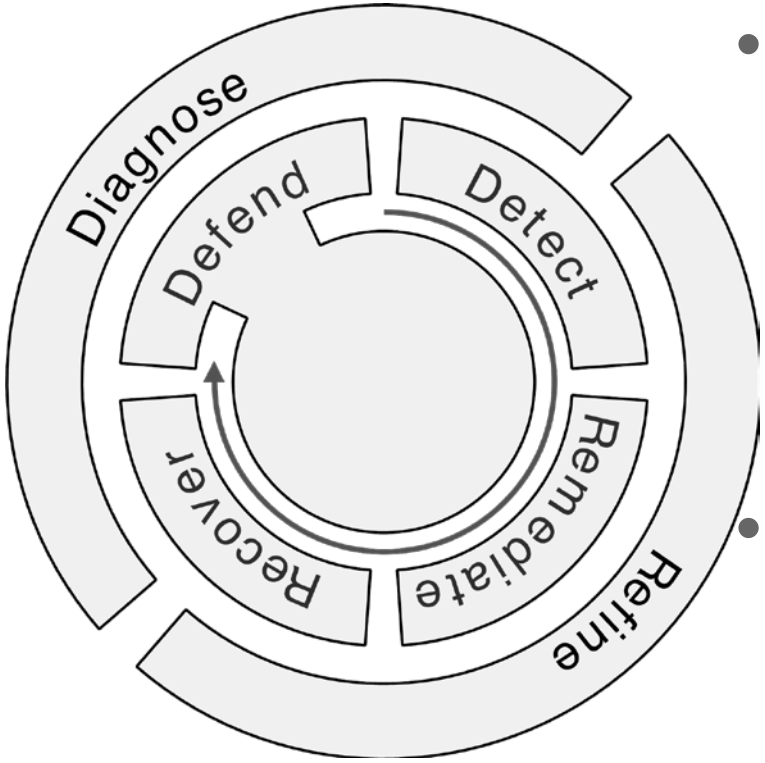
Resilience and ways of achieving it…



Resilience strategy

- *'… the ability of a network/system to defend against and maintain an acceptable level of service in the presence of challenges.' **
- D^2R^2+DR
  - Real-time control (internal) loop
  - Background (external) loop

* Sterbenz, James PG, et al. "Resilience and survivability in communication networks: Strategies, principles, and survey of disciplines." Computer Networks 54.8 (2010): 1245-1265.

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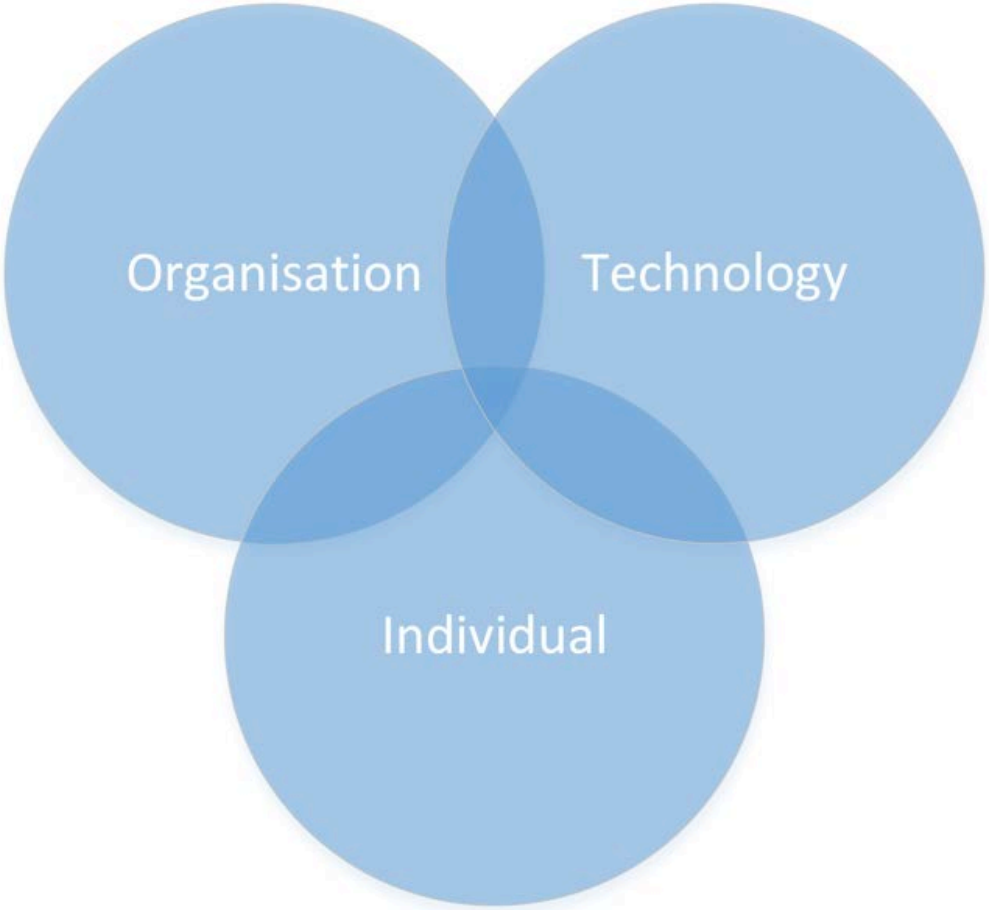
Viewpoints for utility networks



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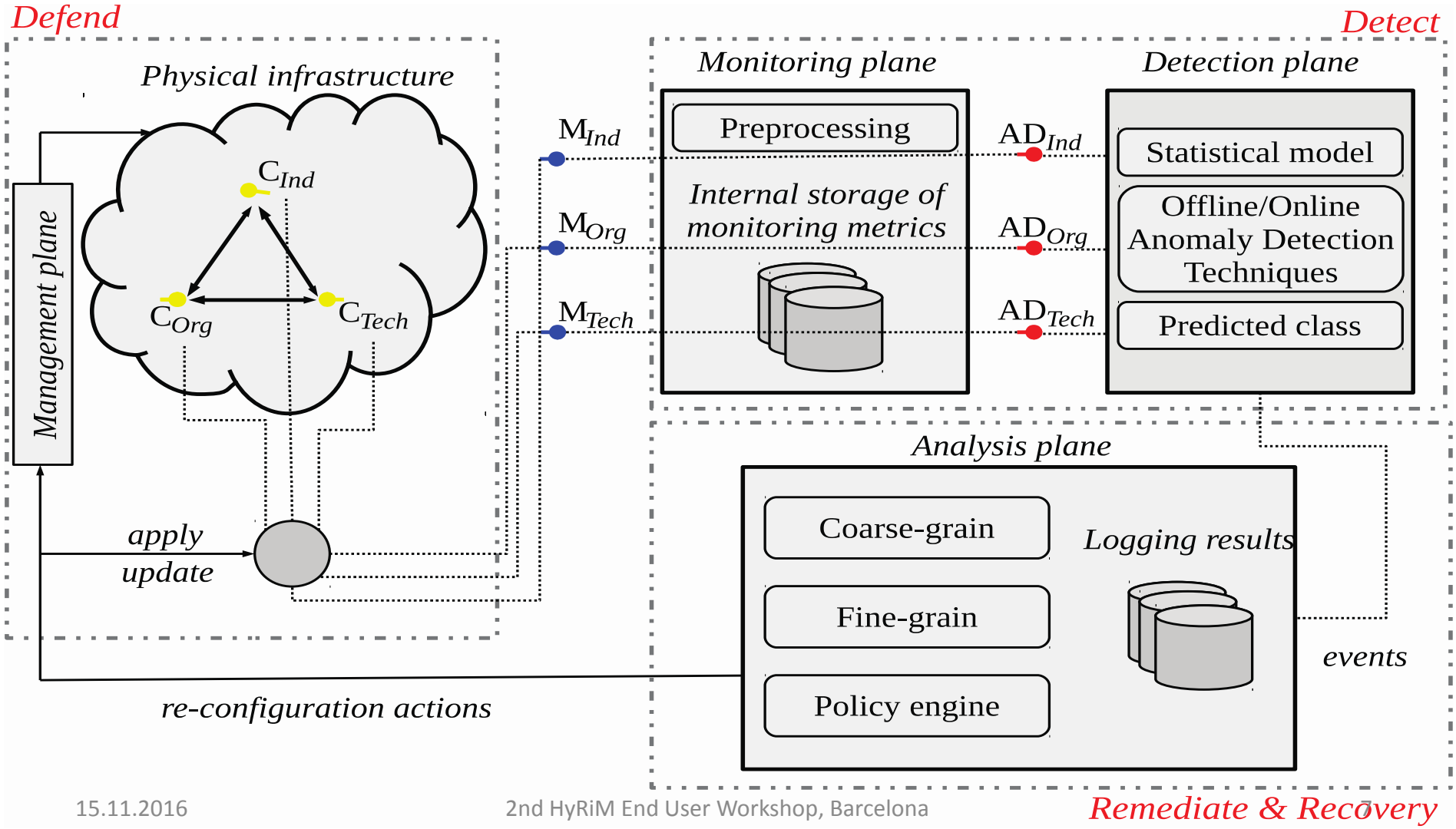
Resilience architecture



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What metrics to measure?

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- Periodic: Measure security control maturity and performance
  - E.g., Percentage of applications and systems subject to security testing
  - Challenge: High-level with long-term validation requirements
- Real-Time: Provide indicators of real-time threats
  - E.g., number of un-authorised access attempts, network throughput
  - Challenge: Conversion of measurements to representative metrics

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Examples of Threats and Metrics

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Threat	Metrics	OTI Level	Collector
BYOD	No. of connected personal devices No. of invalid running applications	Organisation Individual	C_{Org} C_{Ind}
Remote Access	No. of active remote connections	Organisation	C_{Org}
Spear Phishing	No. of spam e-mail	Individual	C_{Ind}
Network Scanning	No. of packets No. of bytes No. of active flows	Technical Technical Technical	C_{Tech} C_{Tech} C_{Tech}
Malware	Process utilisation Memory utilisation	Technical Technical	C_{Tech} C_{Tech}

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Evaluation Testbed

- Two hosts with Kernel Virtual Supervisor
- Apache HTTP daemon
- Volatility introspection library
- 10-minutes runs
- Anomaly Detection Techniques
  - K-Means
  - Principal Component Analysis

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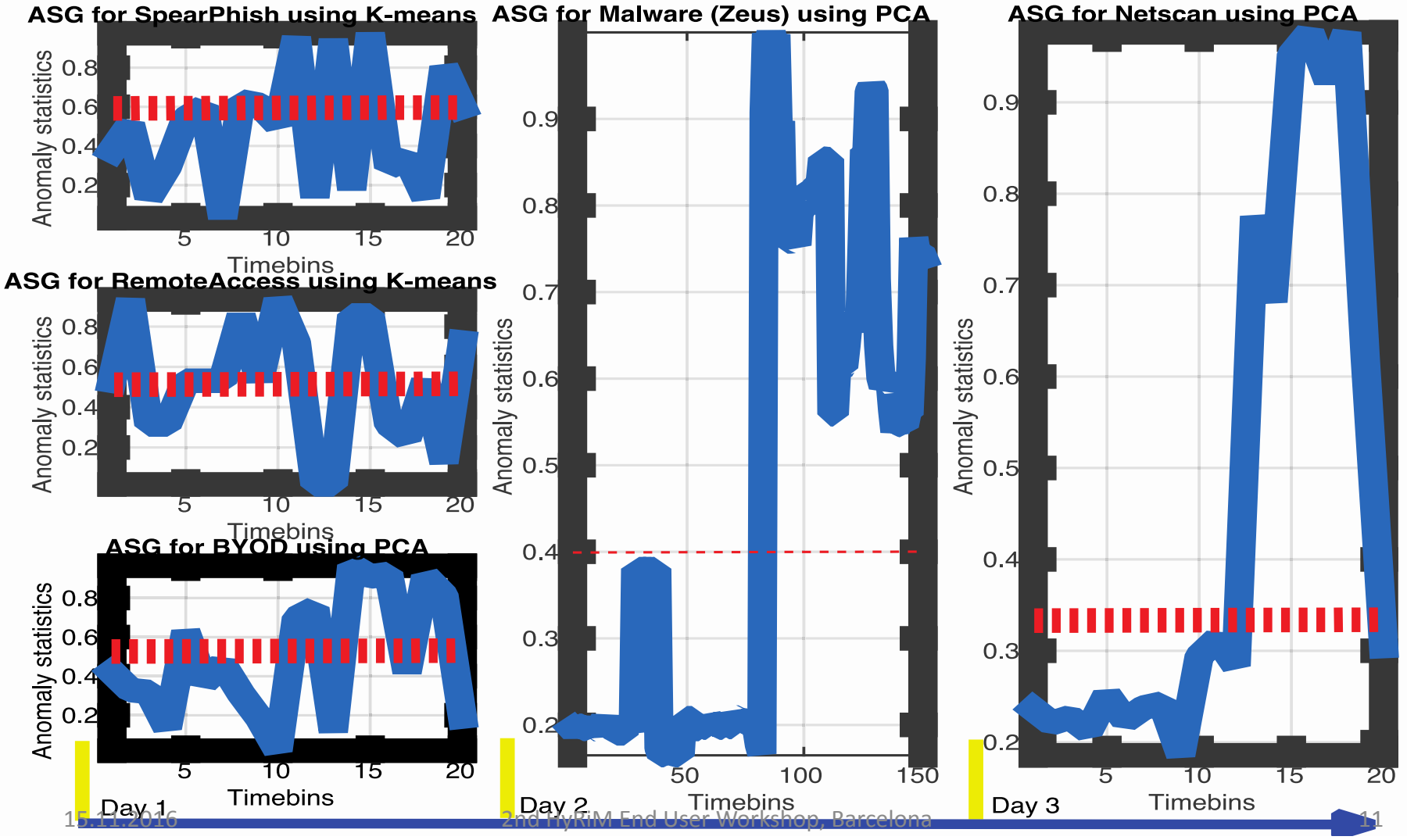
Evaluation



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Evaluation of SCADA attacks

- Dataset: *'Morris, T., Thornton, Z., Turnipseed, I., Industrial Control System Simulation and Data Logging for Intrusion Detection System Research. 7th Annual Southeastern Cyber Security Summit. Huntsvile, AL. June 3 - 4, 2015.'*
- Gas pipeline log, captured in a laboratory environment, including:
  - Normal operation
  - Cyber-attacks
    - Response injection
    - Reconnaissance
    - Denial-of-Service
    - Command injection

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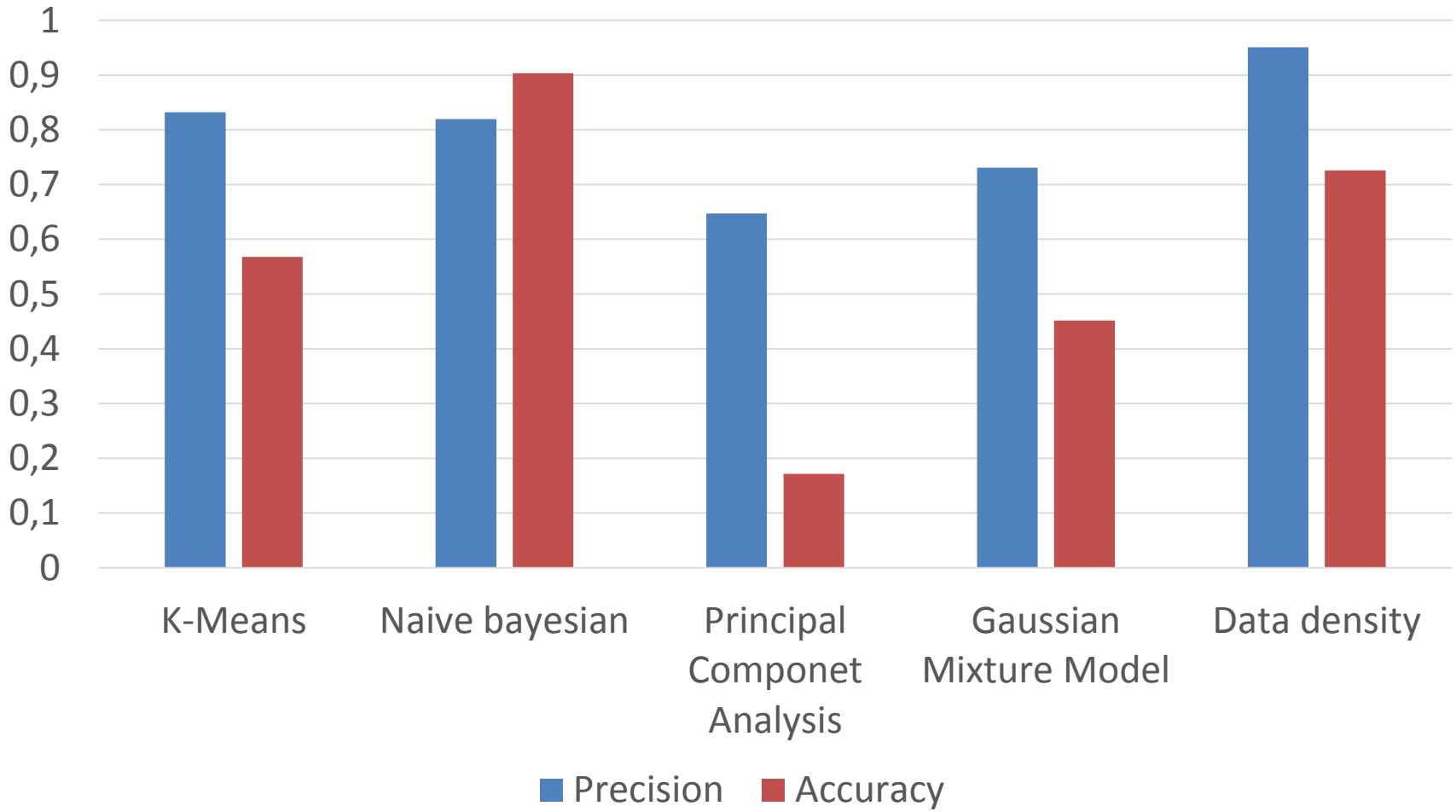
Comparison of AD techniques



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Conclusion and Future Steps

- Currently offering monitoring and detection services
  - Data Density algorithm
    - Unsupervised and memory less
- Identify threats using the OTI viewpoints
- Integrate our testbed/platforms
- Investigate the analysis and management planes

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Questions?