ESSENCE → GRIDSTATE

CEDS Program Review

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PROJECT SUMMARY - ESSENCE

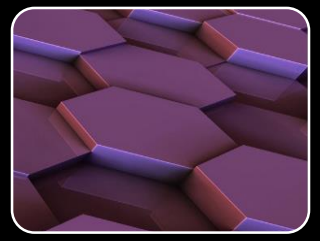
- Cost: $2,813,548 Federal Share + $1,125,239 cost share
- Partners: PNNL, CMU, Cigital, five (5) utility cooperatives
- Project Purpose: Anomaly detection and remediation for utility networks
- Five layer approach and objectives:
  - Real-time capture of utility network traffic without increasing attack surface (Layer 1)
  - High speed data processing – dynamically reconfigurable (Layer 2)
  - Boolean composer to explicitly specify rules; network mapper to identify unfamiliar addresses; machine learning classifier (Layer 3)
  - Support for decision makers in analyzing anomalies for remediative action (Layer 4)
  - Making changes in the network in response to anomalous behavior (Layer 5)
- Results: all objectives met in layers 1-4; layer 5 needs additional work

FIVE APPROACHES TO CYBER SECURITY

Eliminate the Bad Guys

Protect the Perimeter

Reduce Vulnerabilities



Segment the Architecture

React to Breach

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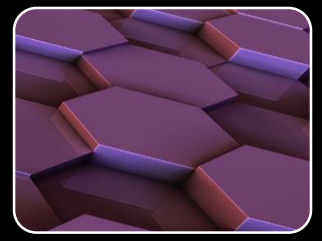
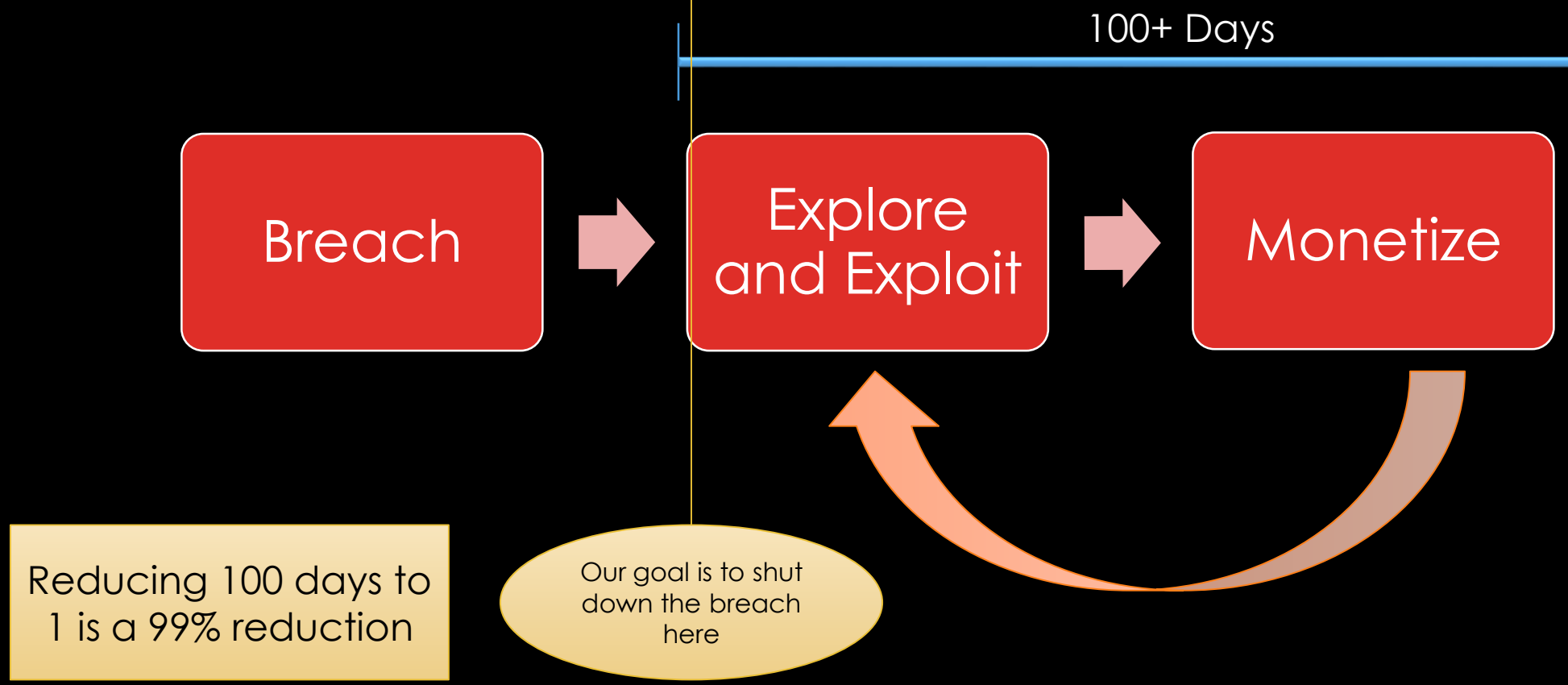


Segment the Architecture

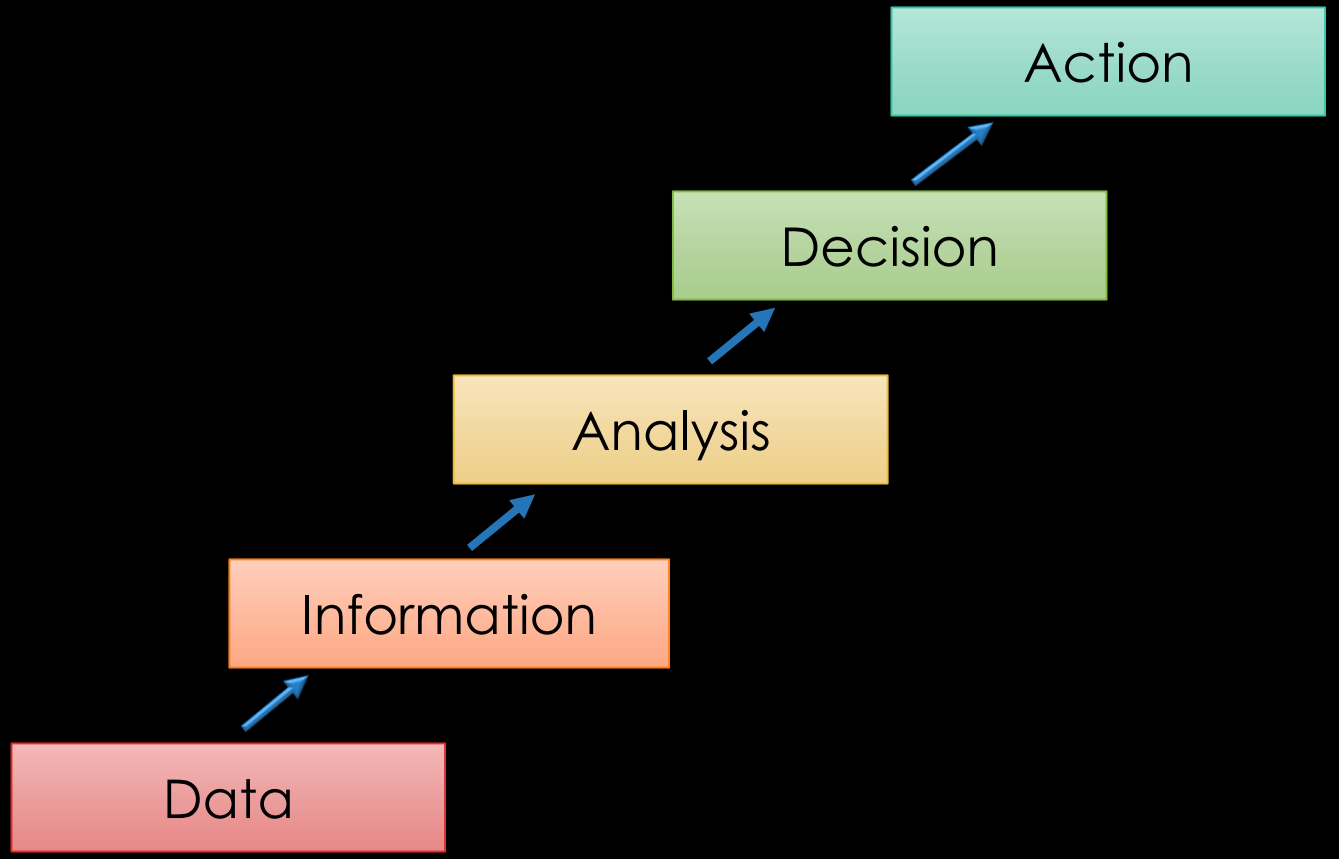
React to Breach

100+ Days – Breach to Detection, Start of Remediation

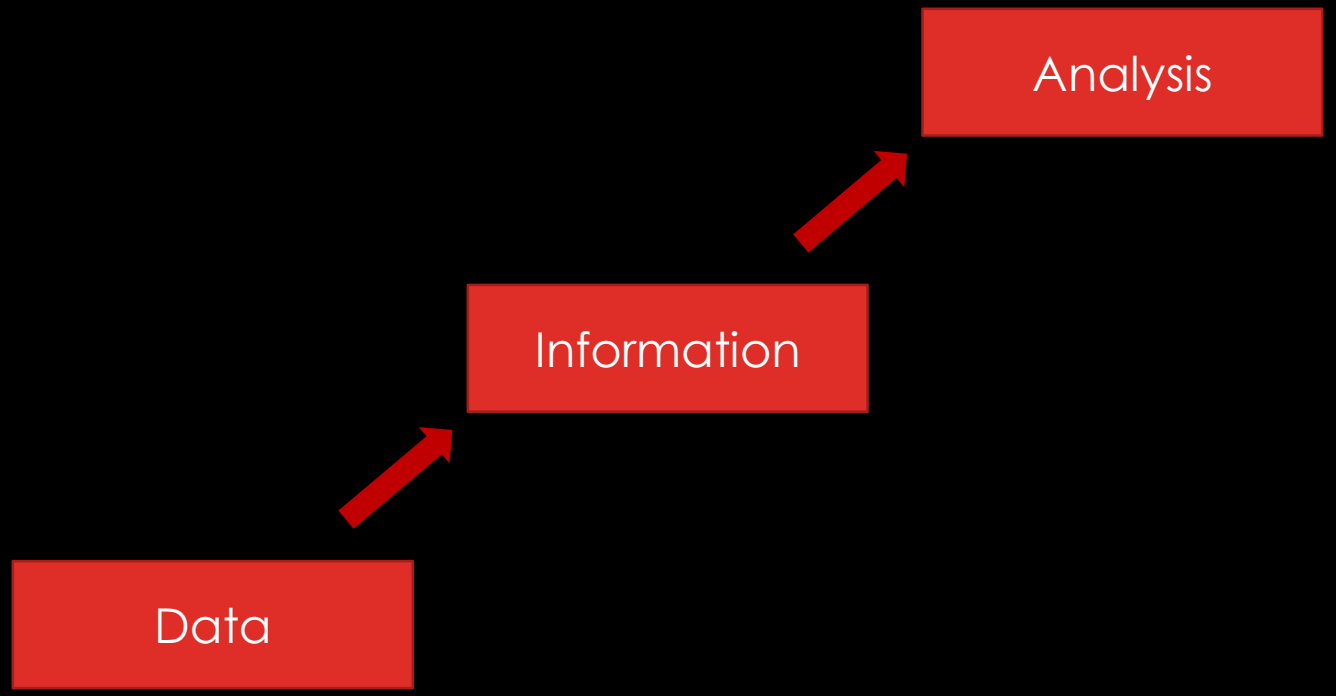
OPPORTUNITY FOR IMPROVEMENT



HOW APPLICATIONS ARE BUILT



ESSENCE TECHNICAL DEVELOPMENT



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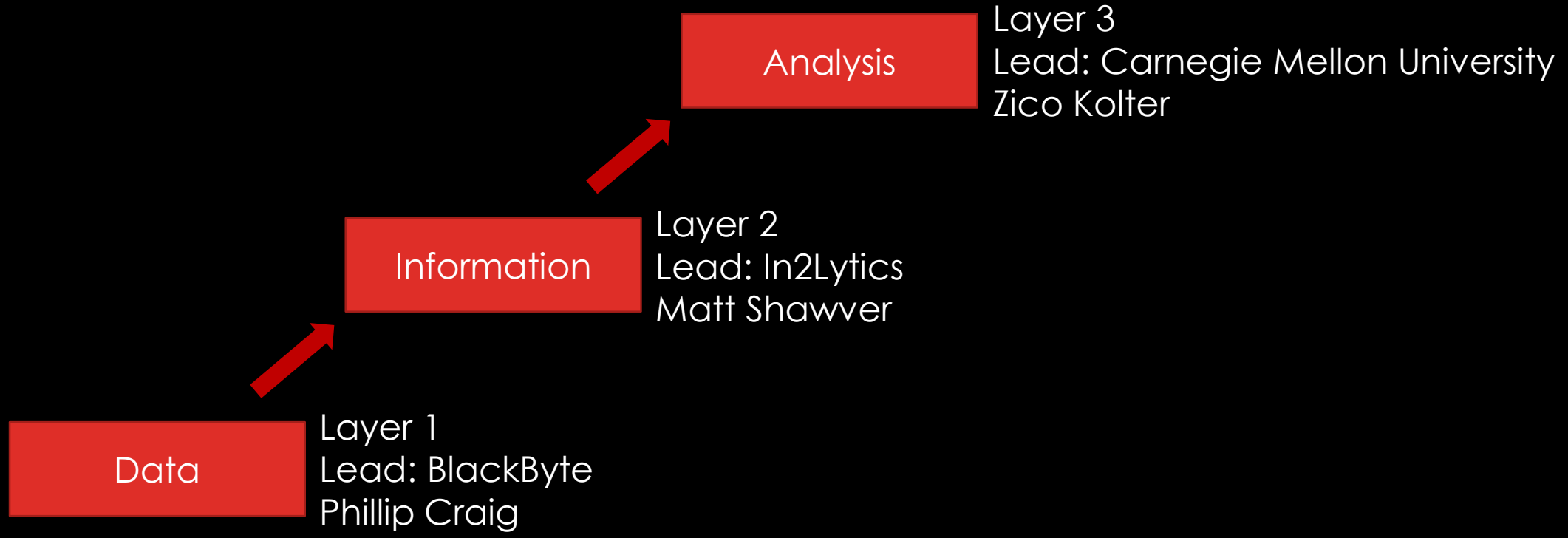


Data

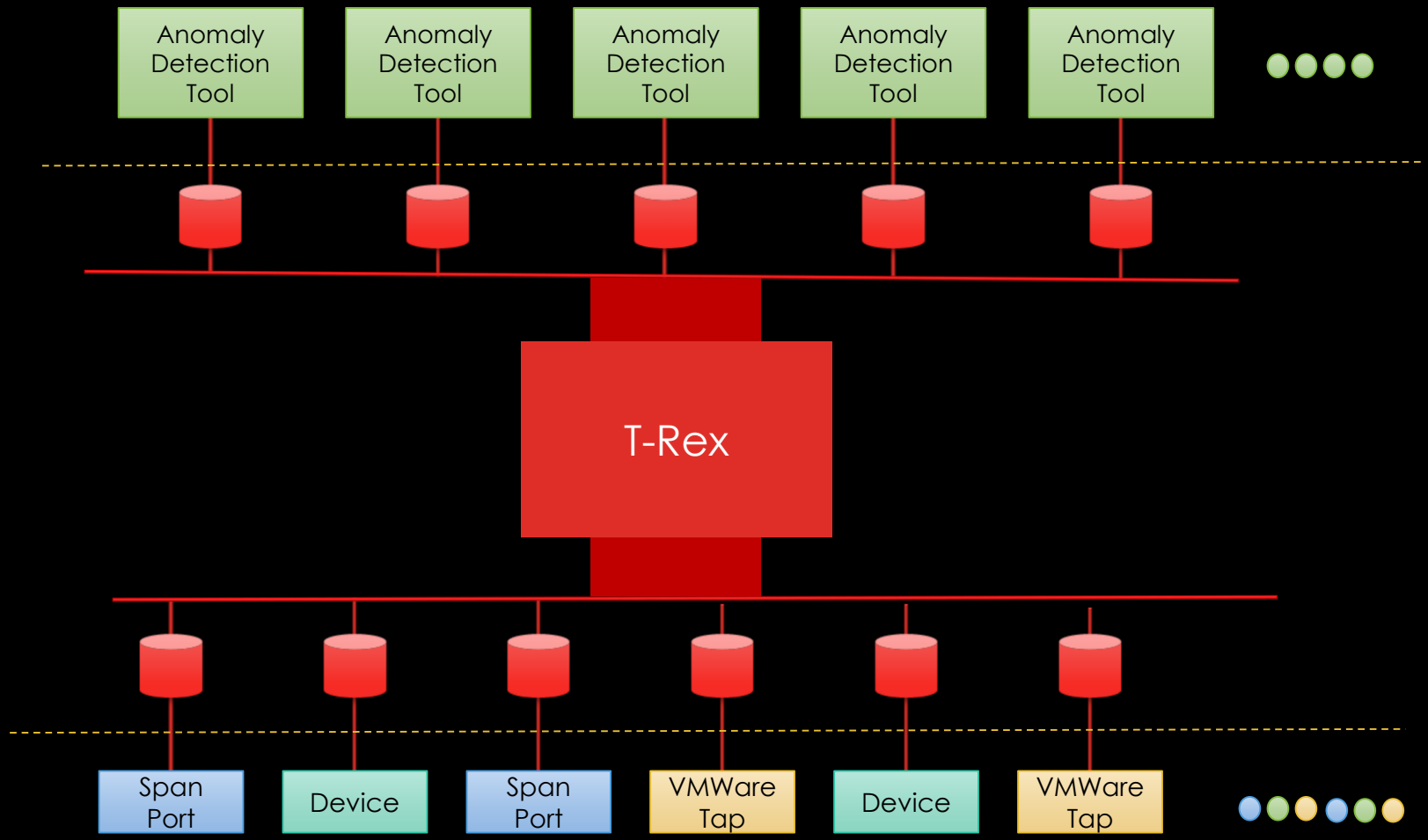
LAYER 1
LEAD: BLACKBYTE
PHILLIP CRAIG

Work to Date

- New Device
- Deployments: See Next Slide
- Protocols
  - Sensus Meters
  - MultiSpeak
  - CMEP
  - *DNP3 ← in process*
  - *ModBus ← in process*

INFORMATION

LAYER 2
LEAD: IN2LYTICS
MATT SHAWVER



INFORMATION

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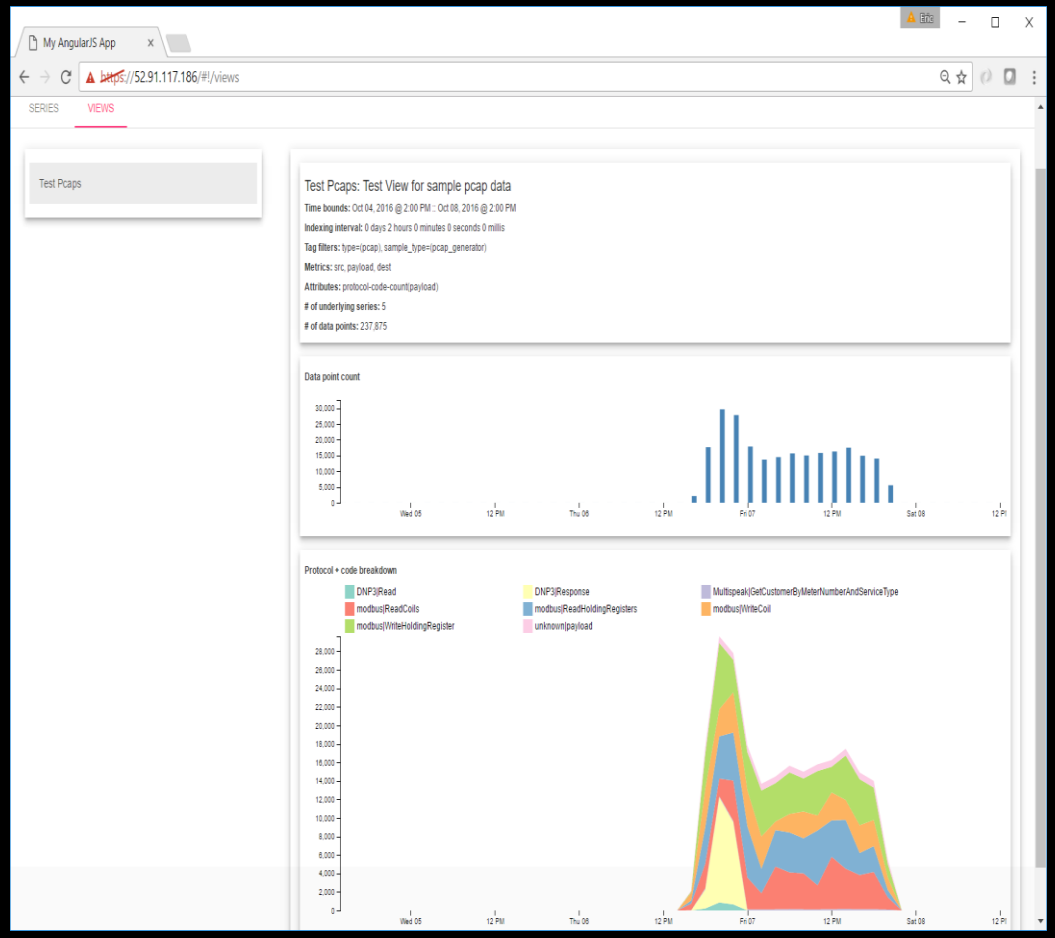
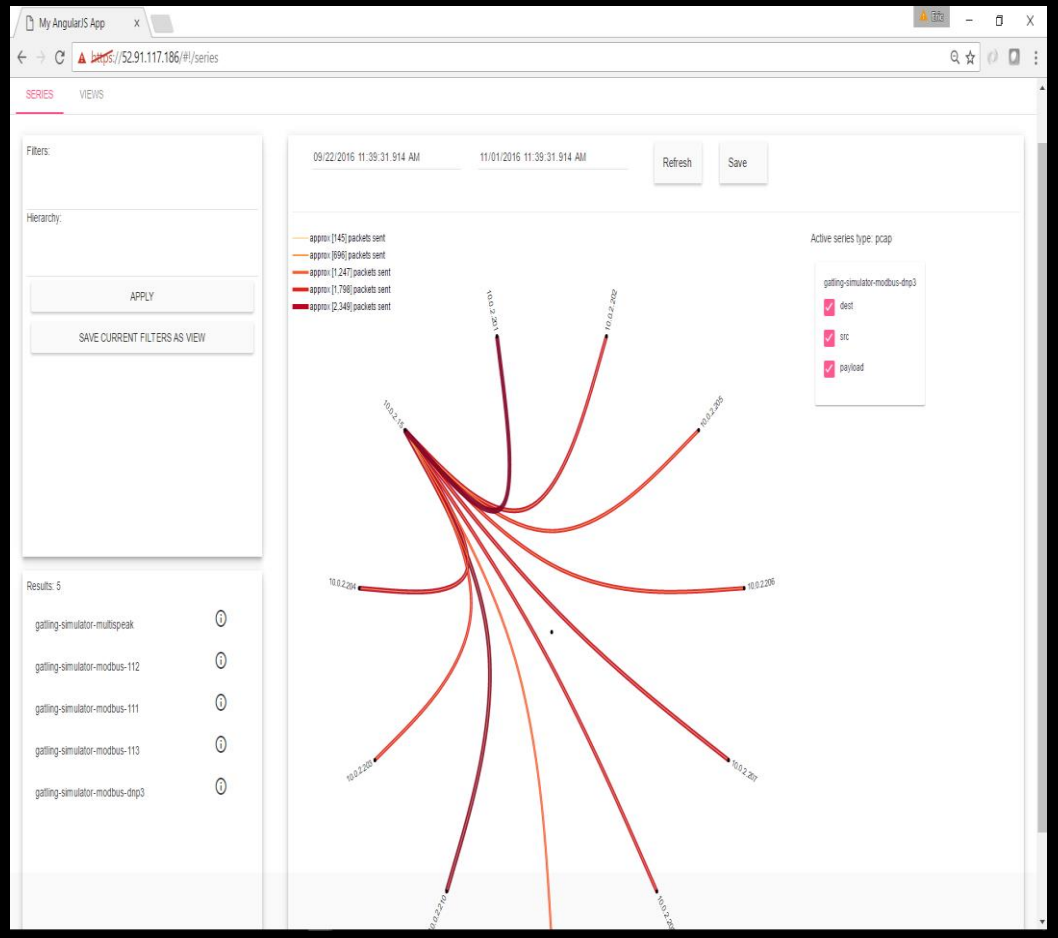




LAYER 2 PERFORMANCE / GOALS

- SCADA
  - 5000 sensors, 2 second rate
- AMI
  - 500,000 sensors, 15 minute rate
- PMU
  - 500 sensors, 60x per second rate

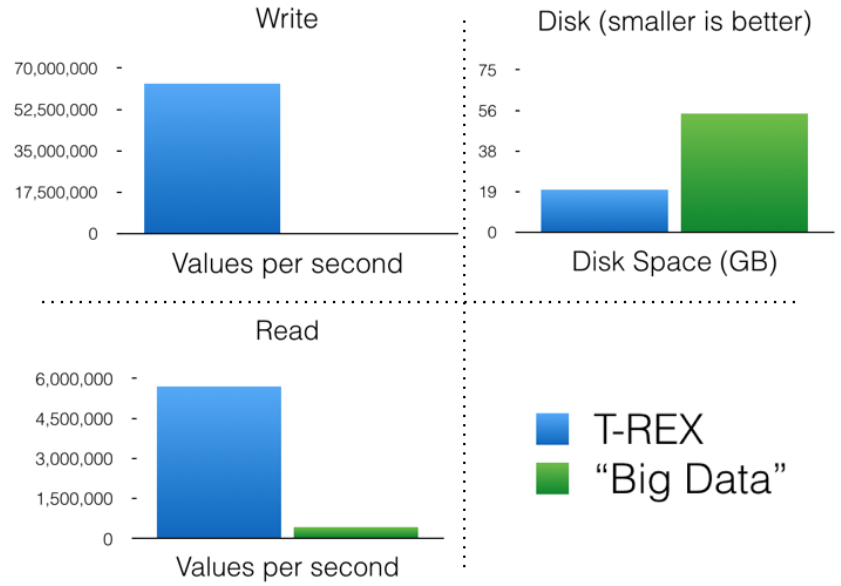
- Goals
  - Support real-time and bulk load
  - Support immediate read
  - All data into the same DB
  - Don't lose any information
  - Fast <sensor, time range> queries
  - Be as disk space efficient as possible
  - Provide reasonable persistence guarantees
  - Idempotent writes
  - Rollback partially failed writes

T-REX VS CASSANDRA

- Most grid analytics problems are I/O performance bound…
- Benchmark
  - 1000 sensors
  - Recorded synchronously in groups of 5
  - 4 million values recorded per sensor
  - 4 billion total measured values
  - Values are random (not compressible)
  - Write all data, then read all data for one measurement

	T-REX	"Big Data"	Improvement
Write (s)	63 (1 min)	70555 (19.5 hrs)	1120x
Write (values/s)	63,500,000	56,700	
Read (s)	0.7	9.7	14x
Read (values/s)	5,700,000	412,000	
Disk (GB)	19.61	54.83	3x
Disk (bytes/value)	4.9	14.7	

30x with real data (estimated)

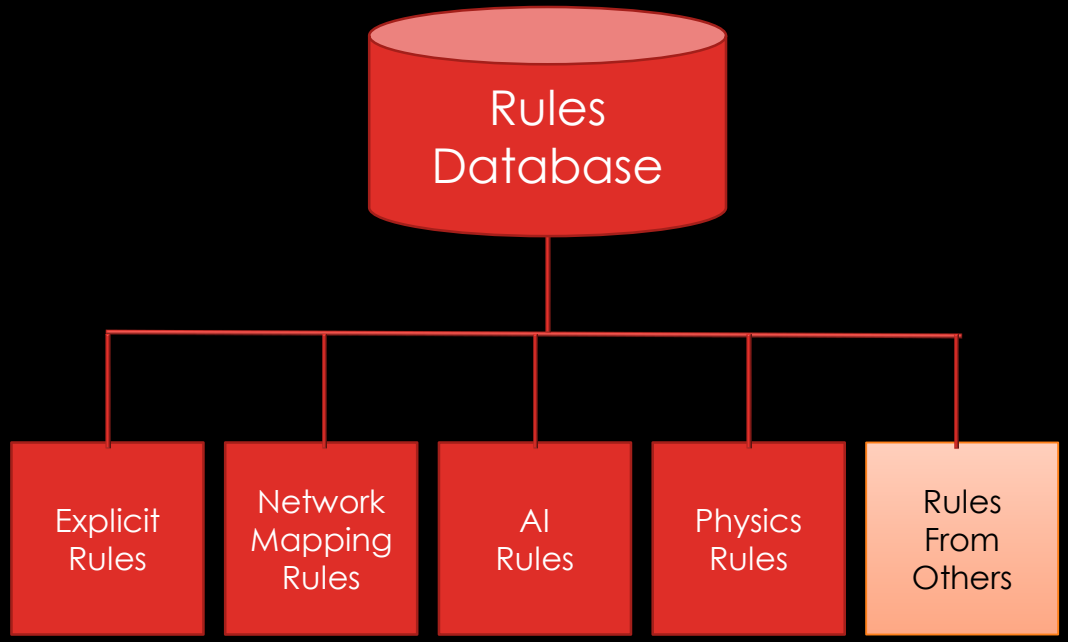


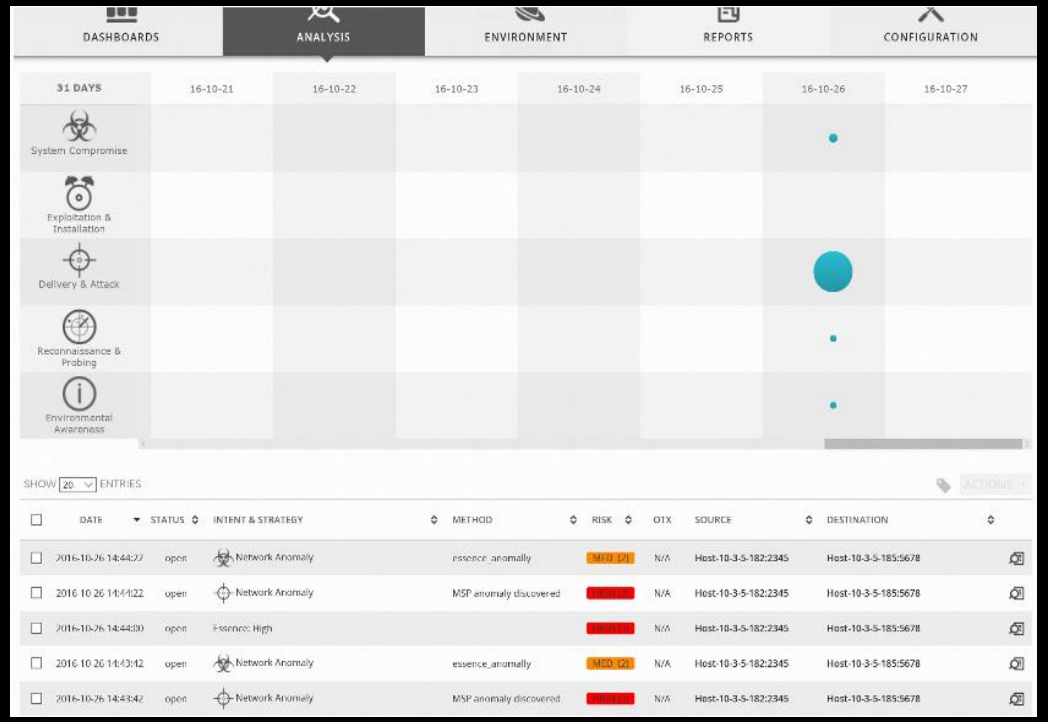
- T-REX can provide single server performance that requires 100's of "big data" servers
- Full access to data from engineering tools and third party apps
  - Avoid collecting data from 100's of machines in the cloud
  - Enables forensics, real-time, and multi-vendor applications that are difficult/impossible in the cloud
- Small footprint on-premise deployment
  - Reduces cloud and system admin costs
  - Lower initial and recurring costs
  - Reliability: Less reliance on service providers (ISP, cloud)
  - Reliability: Smaller hardware footprint

ANALYSIS

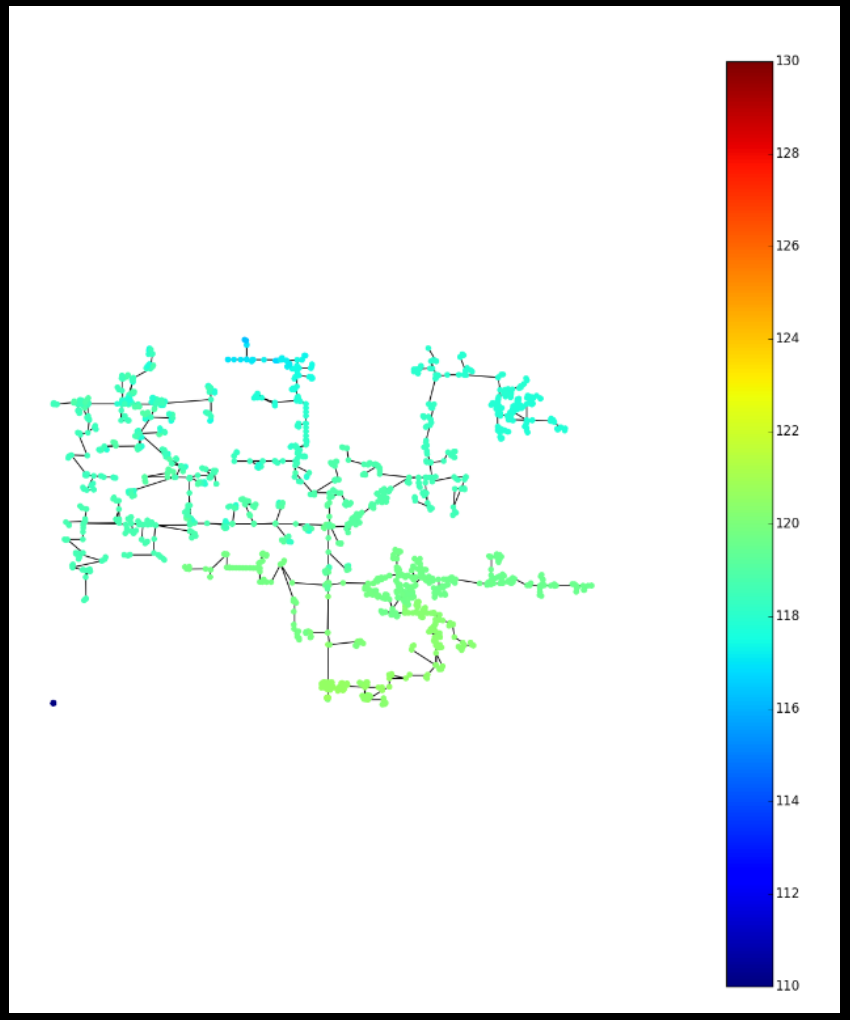
LAYER 3
LEAD: CARNEGIE MELLON
ZICO KOLTER

Goal: Unified Rules Syntax





TESTING: ABEC FEEDER



TEST FILE

Quads: time, node number, voltage, current, frequency, angle
Control signal: time, node, control signal

June 2016
30 days x 24 hours x 12 mesurements per hour x 200 nodes = 1,728,000 records
+ 1000 control records

1. IMPORT FEEDER MODEL
2. MODIFY GRIDLAB-D TO EXPORT QUAD AT EACH TIME CLICK
3. MODIFY GRIDLAB-D TO EXPORT CONTROL SIGNALS

GOING TO MARKET

SEDC

+

MILSOFT
Utility Solutions

NRTC

GOING TO MARKET

n-dimension solutions

260 SEDC

ALIEN VAULT™ + 1000 MDFT Utility Solutions

500 NRTC