AMIS: Software Defined Privacy-Preserving Measurement Instrument and Services

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Overview of IRNC AMIS Project

Major objectives:

- *Measurement capability*: A whitebox instrument with scalable processing capabilities on network flows at up to 100Gbps line rate;
- *Programmable*: Software defined measurement framework that allows creating measurement tasks and making queries;
- *Privacy preserving*: privacy oriented algorithms to report measurement results while protecting user flow privacy;
- *Analytics*: Analysis and visualization of measurement data to provide insights to network operations.

Overview of AMIS Framework

Measurement Control plane

- Equery language to compose measurement functions
- Web interface for user interaction and data visualization
- Restful APIs

Measurement Substrate

- Distributed instruments
- Programmable measurement instrument box
- Optimized hw/sw system for up to 100Gbps
- Flexible to implement and deploy new functions
- Support differential privacy on flow analysis

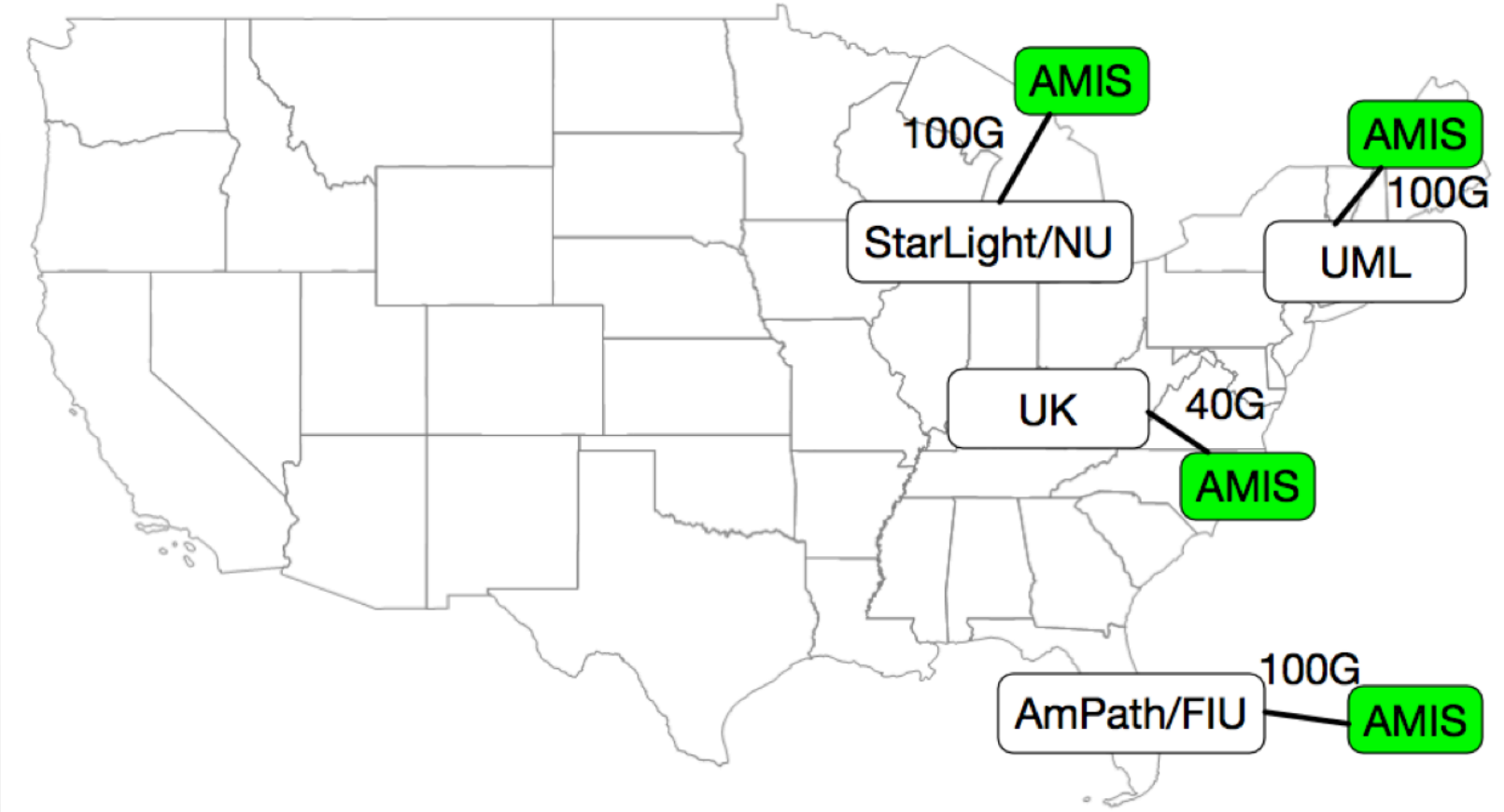
Why Another Measurement Box?

A Comparison with PerfSONAR

Differences	AMIS	PerfSONAR
Measurement method	Passive (do not generate traffic)	Active (generate traffic)
Real-time	Measure flows in real-time	Has no visibility of real-time flows
Flow granularity	Yes	No
100Gbps	Yes	Yes
Privacy preserving	Yes	No
Support event driven measurement	Yes	?

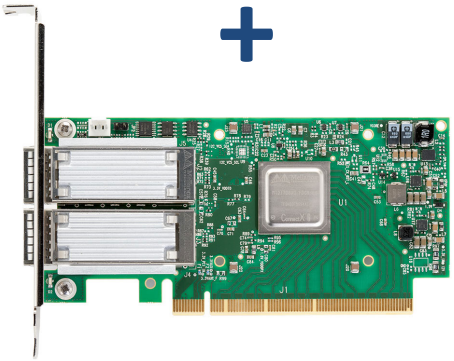
Current Deployment of IRNC AMIS

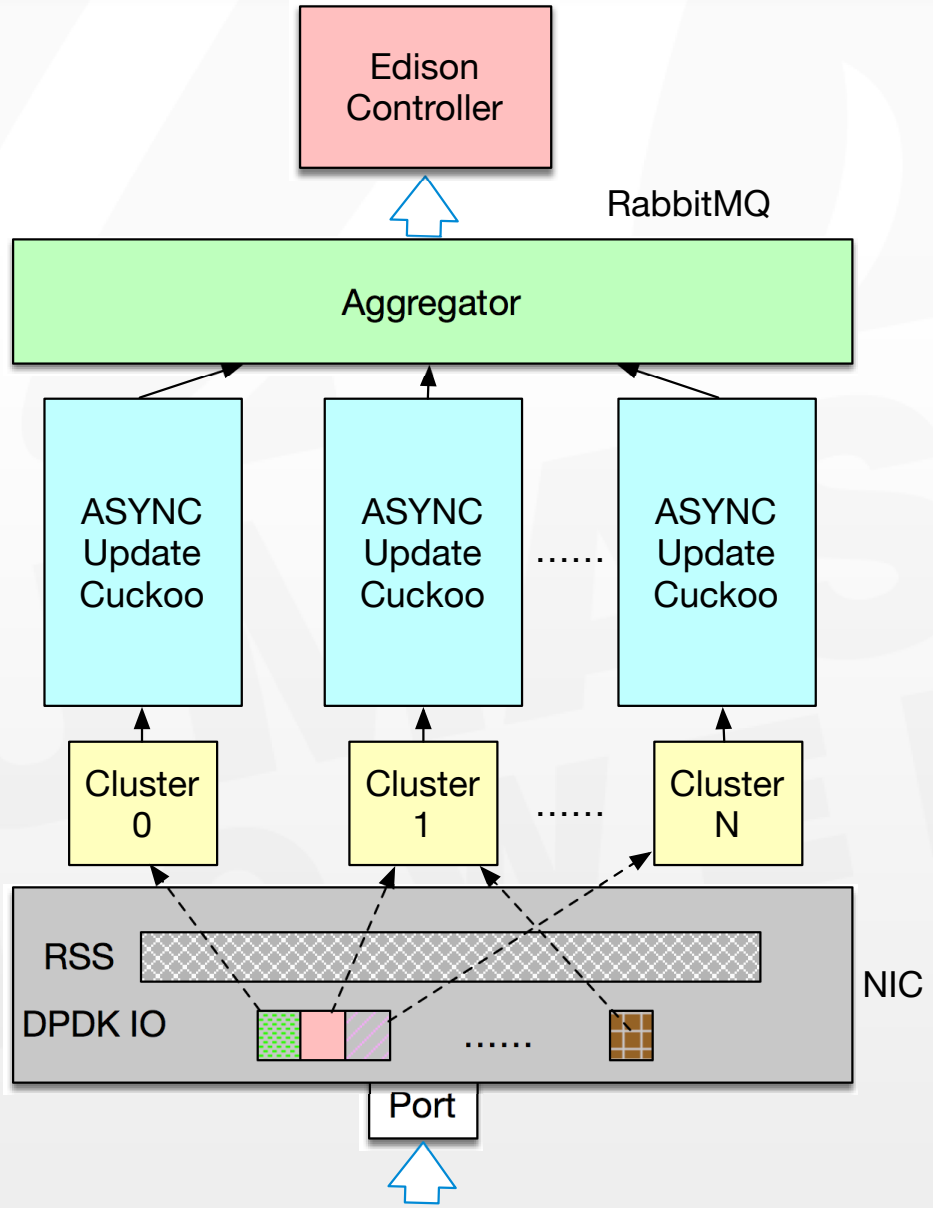
As of June 2018



AMIS Demos @ SC16, SC17, TNC18, SC18

The Box

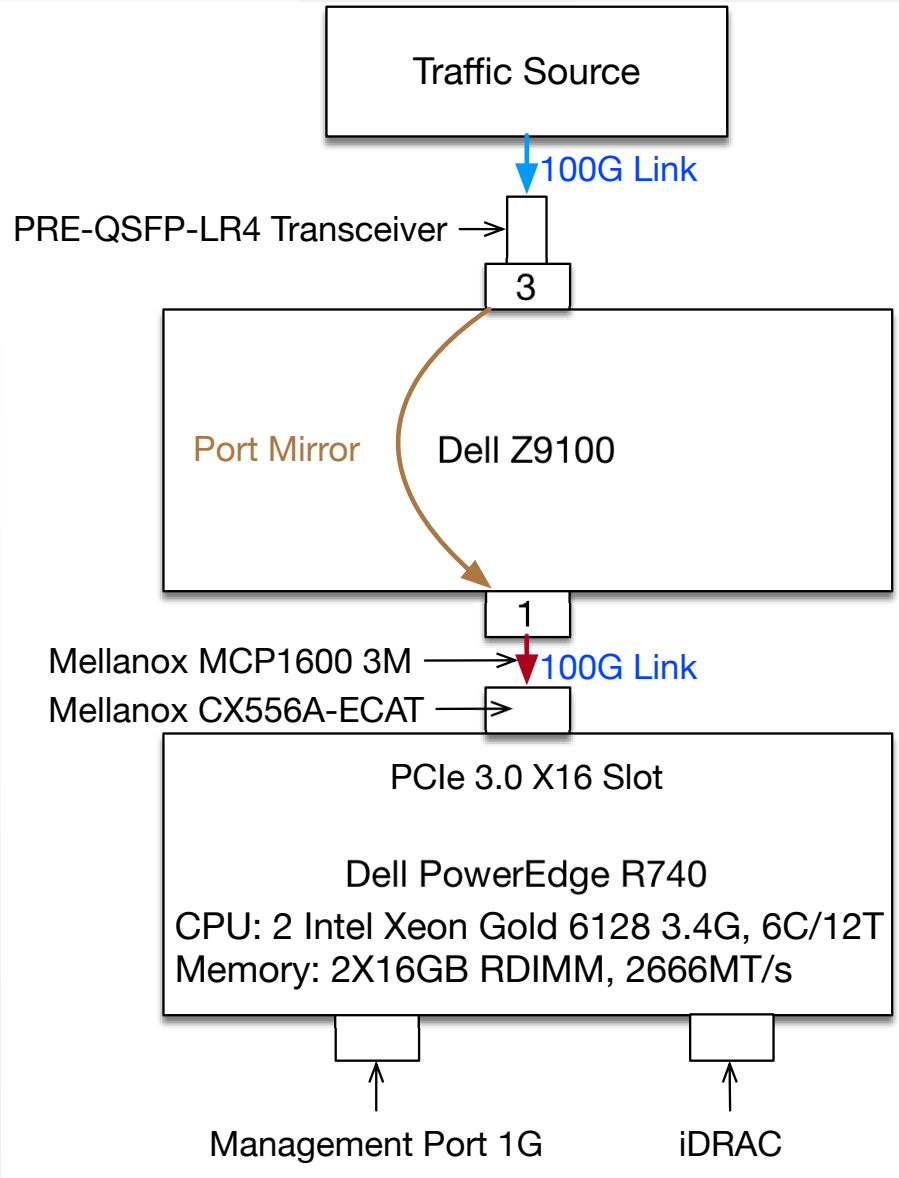



Edison Controller
RabbitMQ
Aggregator
ASYNC Update Cuckoo
ASYNC Update Cuckoo
.....
ASYNC Update Cuckoo
Cluster 0
Cluster 1
.....
Cluster N
RSS
DPDK IO
.....
NIC
Port

Measurement Instrument and Functions

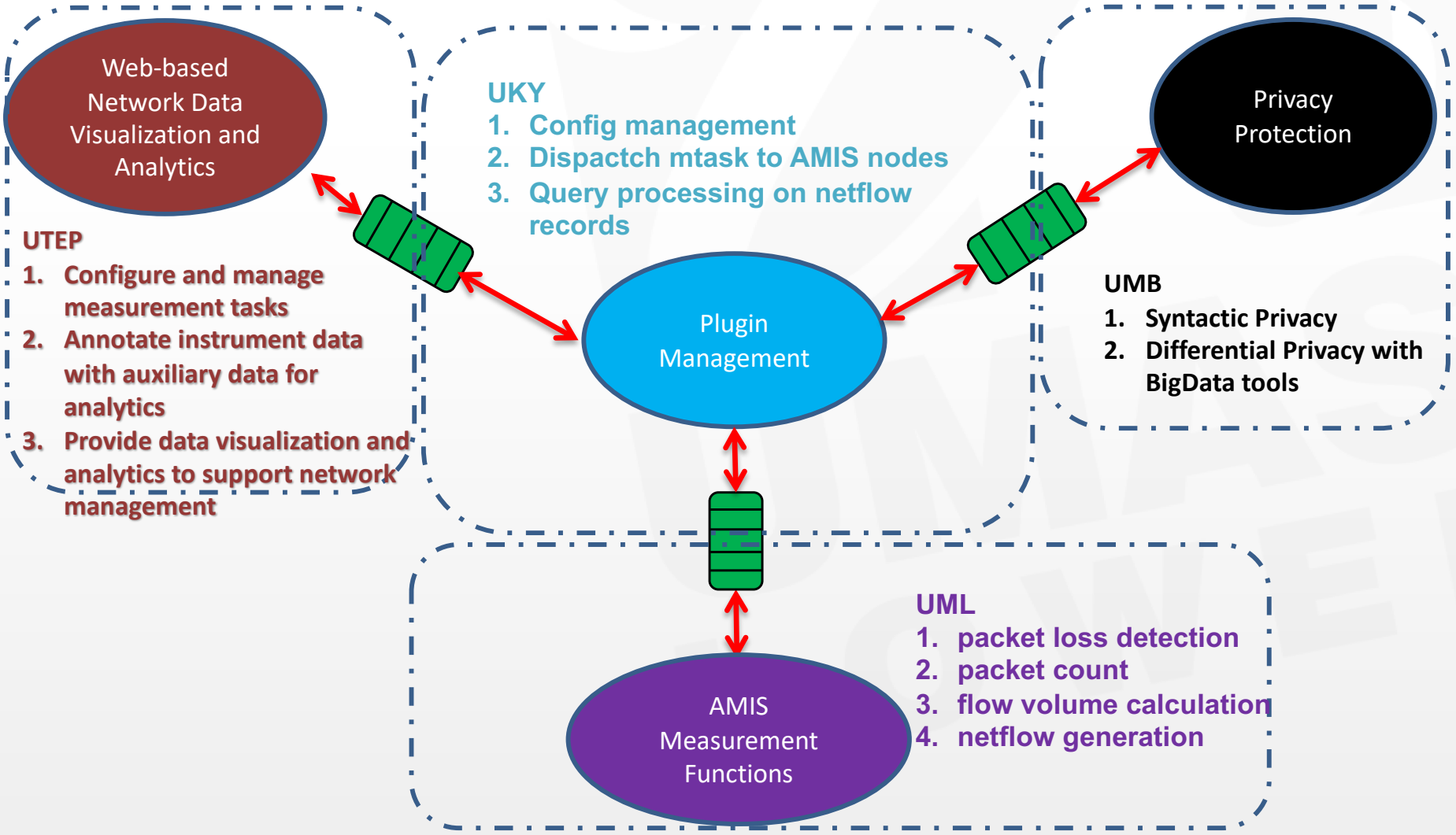
- A whitebox and open source software
  - Multicore x86 server with 100Gbps NICs (Mellanox)
  - DPDK + AMIS software modules
  - Measurement functions an run in a VM
- Measurement functions
  - Top 10 flows
  - Netflow generation
  - Header-only stats: e.g. pack loss, TCP window size
  - Packet tracing
  - *new ones can be created*

The Setup for Traffic Feeds



(Or TAP)

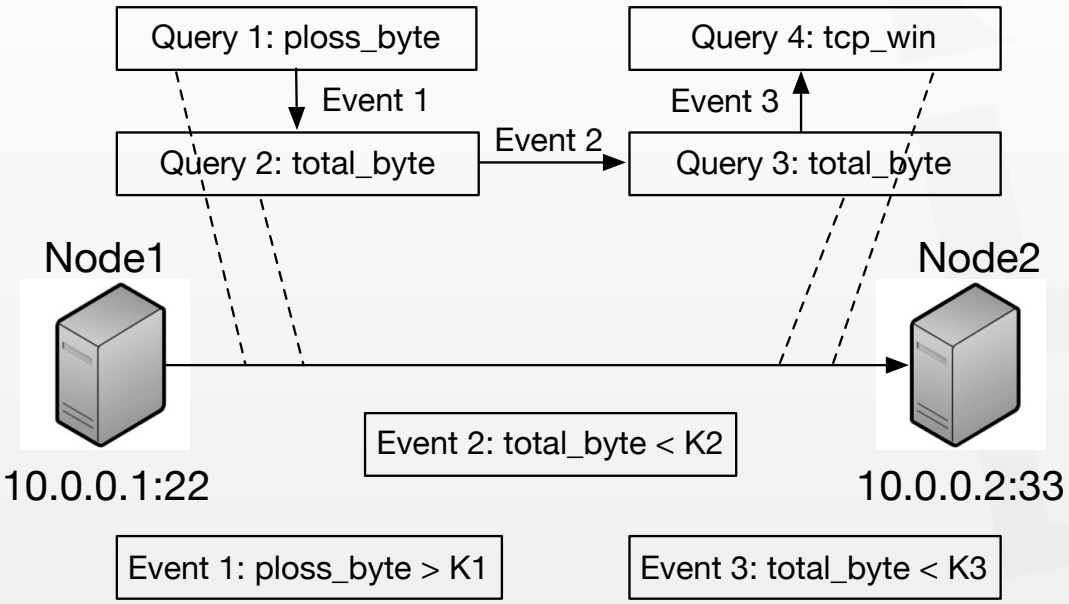
Overview of AMIS Software Framework



Equery Language for Network Measurement

- An event driven declarative language
- Language spec: SQL like with network oriented primitives

Example: troubleshooting DTN traffic

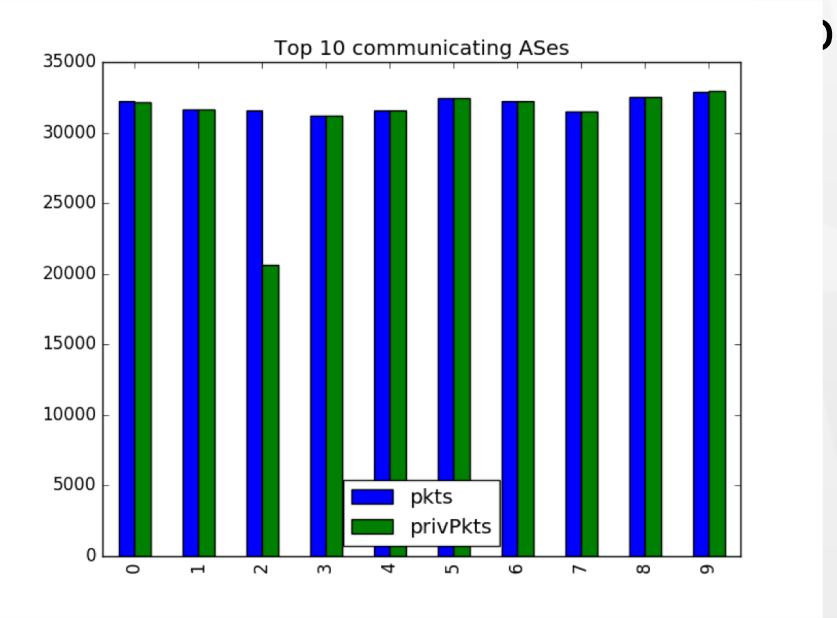


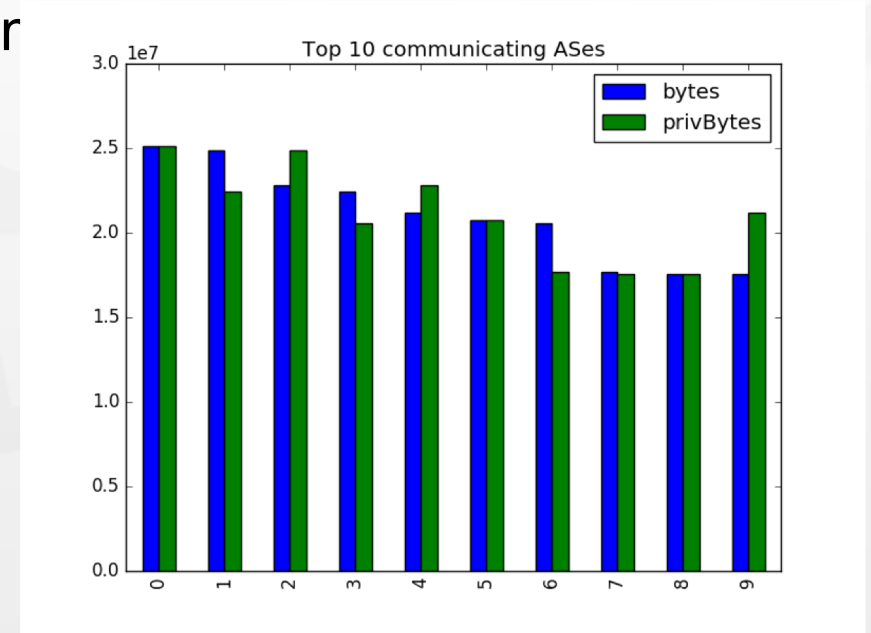
- q1: **select** ploss_byte **where** src_addr=10.0.0.1, dst_addr=10.0.0.2, src_port=22, dst_port=33, protocol=TCP, node_id=Node1;
- q2: **select** total_byte **where** src_addr=10.0.0.1, dst_addr=10.0.0.2, src_port=22, dst_port=33, protocol=TCP, node_id=Node1 **when** q1.ploss_byte > K1;
- q3: **select** total_byte **where** src_addr=10.0.0.1, dst_addr=10.0.0.2, src_port=22, dst_port=33, protocol=TCP, node_id=Node2 **when** q2.total_byte < K2;
- q4: **select** tcp_win **where** src_addr=10.0.0.1, dst_addr=10.0.0.2, src_port=22, dst_port=33, protocol=TCP, node_id=Node2 **when** q3.total_byte < K3;

EQuery: Enable event-driven declarative queries in programmable network measurement, Ran Y, et al. 2018 IEEE/IFIP Network Operations and Management Symposium, April 2018

Privacy Preserving Query

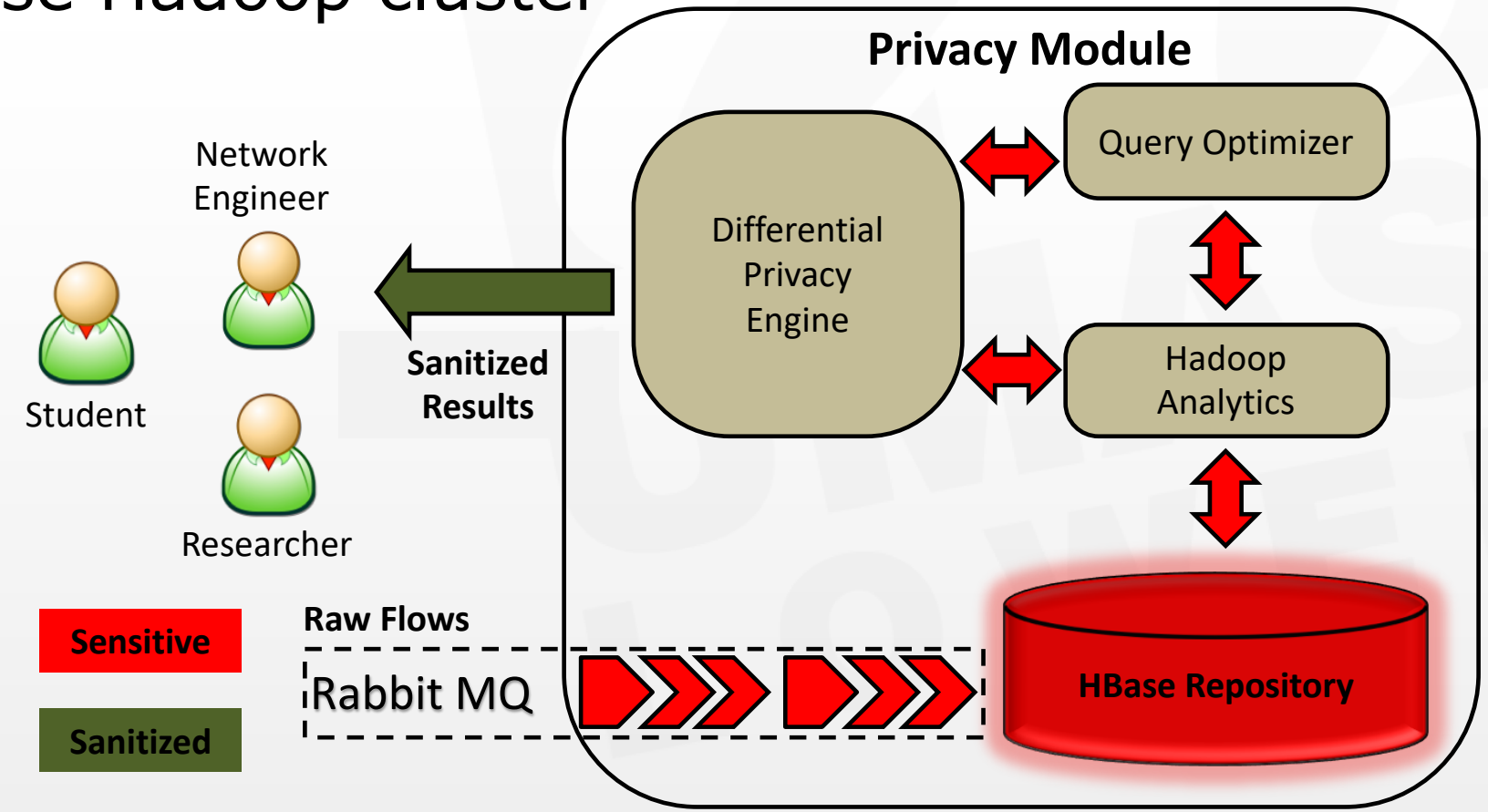
- To protect privacy, Differential Privacy adds Laplace noise to results
- We do show ASNs but protect individual flows
- Good accuracy obtained, even for strong privacy (ε=0.2):
  - 100% precision and recall for *Top10-communicating ASN*



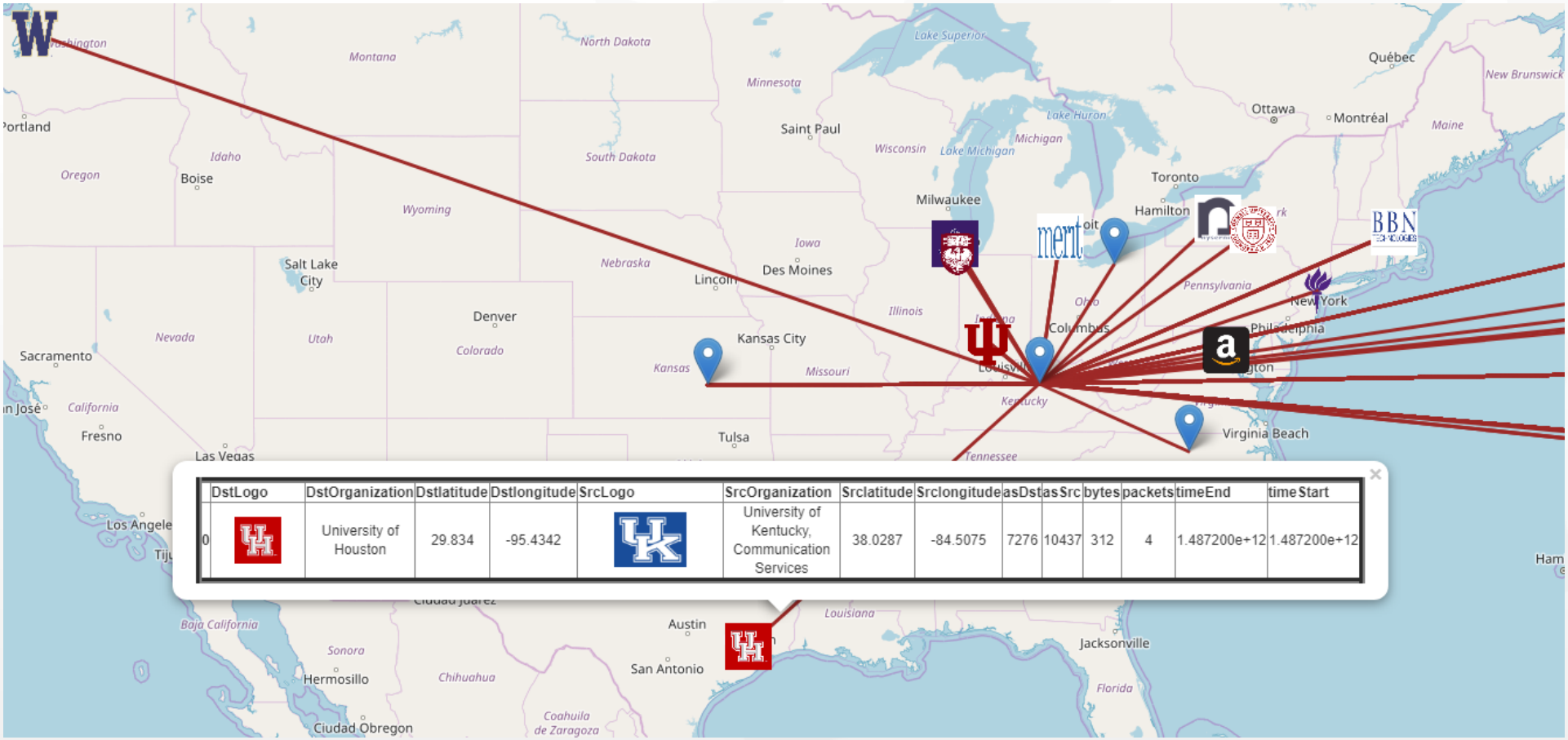


Privacy Preserving Modules

- Differential privacy algorithms
- Hbase Hadoop cluster

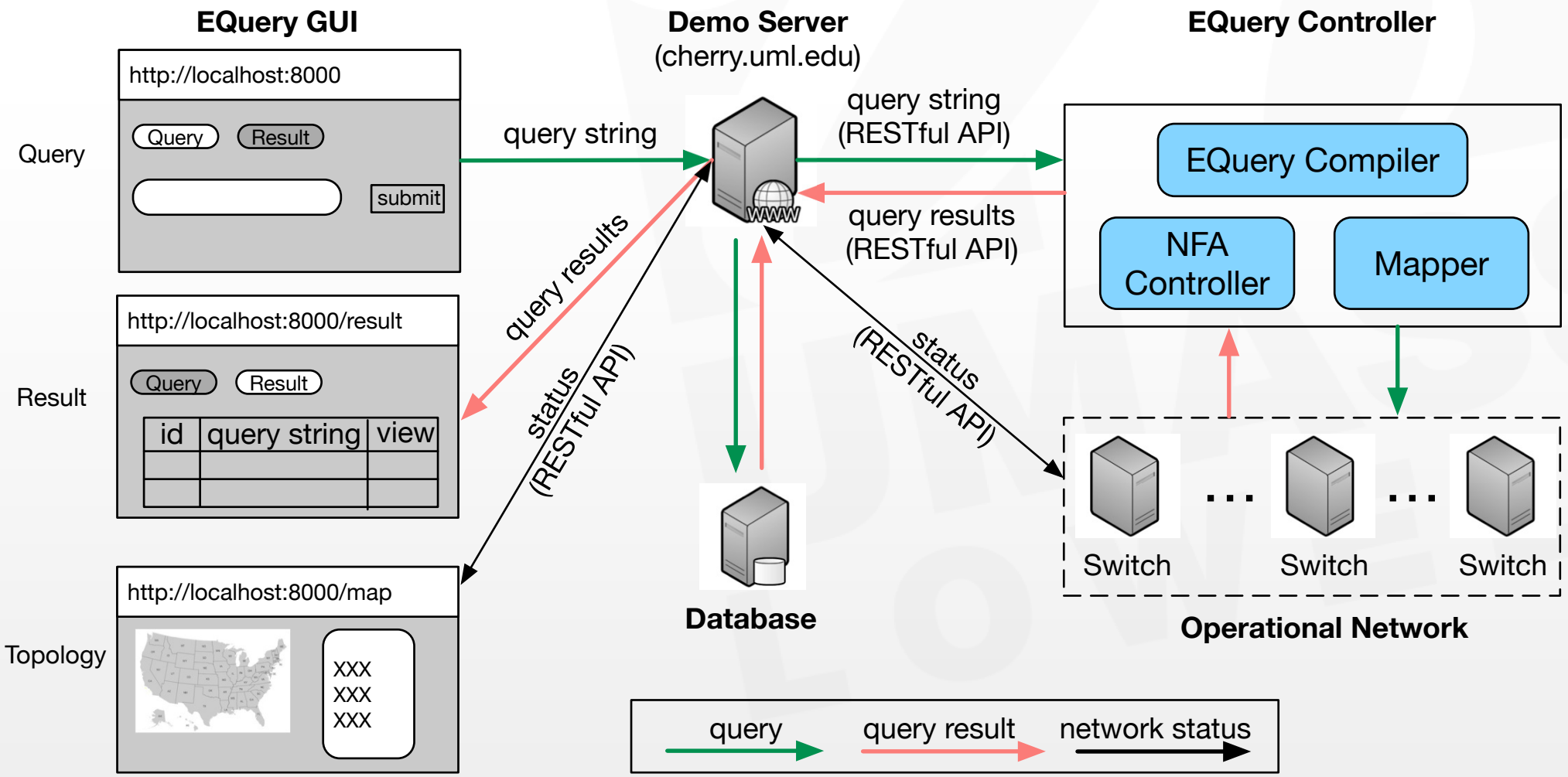


Traffic Matrix Visualization



	DstLogo	DstOrganization	Dstlatitude	Dstlongitude	SrcLogo	SrcOrganization	Srclatitude	Srclongitude	asDst	asSrc	bytes	packets	timeEnd	timeStart
0		University of Houston	29.834	-95.4342		University of Kentucky, Communication Services	38.0287	-84.5075	7276	10437	312	4	1.487200e+12	1.487200e+12

AMIS Demo


EQuery GUI
Demo Server
(cherry.uml.edu)
EQuery Controller
http://localhost:8000
Query
Result
submit
query string
query string
(RESTful API)
query results
(RESTful API)
EQuery Compiler
NFA
Controller
Mapper
http://localhost:8000/result
Query
Result
id
query string
view
query results
(RESTful API)
status
(RESTful API)
status
(RESTful API)
Switch
Switch
Switch
Database
Operational Network
http://localhost:8000/map
Topology
XXX
XXX
XXX
query
query result
network status

Thanks !

Q&A

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