Software Defined Privacy-Preserving Measurement Instrument and Services

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AMIS Project

▸ Objectives
- 40+Gbps flow-granularity network measurement
- Software defined measurement
- Preserving privacy of network flow data
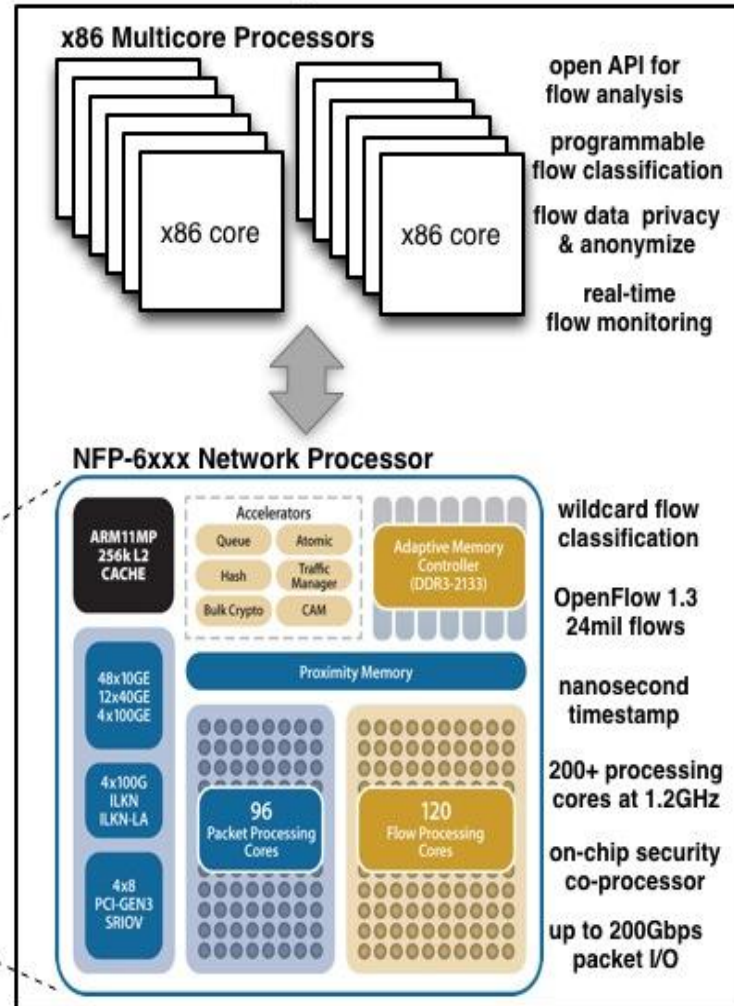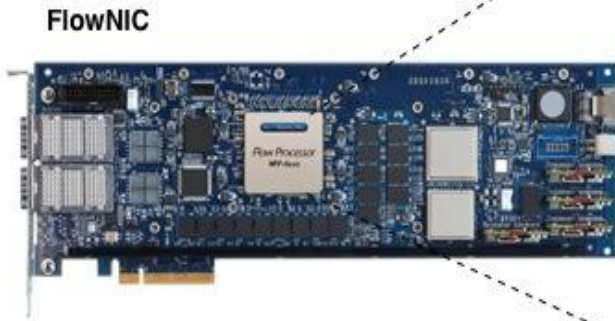- In-depth flow analytics

▸ Project Team:
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- Cody Bumgardner, Co-PI, University of Kentucky
- Michael McGarry, Co-PI, University of Texas El Paso

AMIS At a Glance
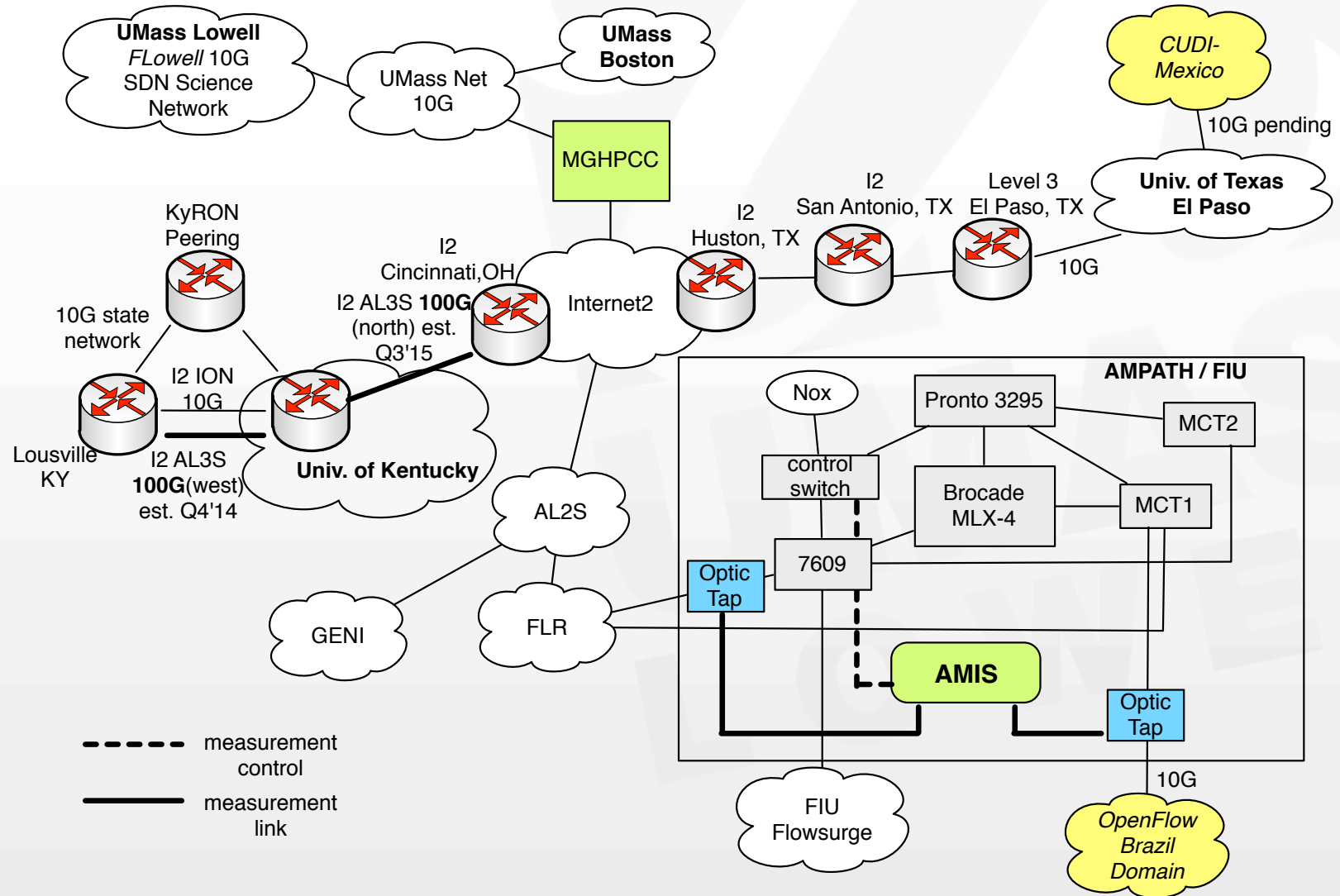
Advanced Measurement Appliance

Network Processor based Advanced Measurement Appliance

Software Defined Measurement

▶ Why?

- target changes (flows, subnets, AS)
- measurement metrics changes
- changes in measurement conditions or period
    - *e.g. measure packet inter-arrival time when flow duration is longer than 5 minutes*

▶ How?

- Measurement Data Plane
- Measurement Control Plane

SDM Data Plane

▶ Challenges
- Application and protocol diversity
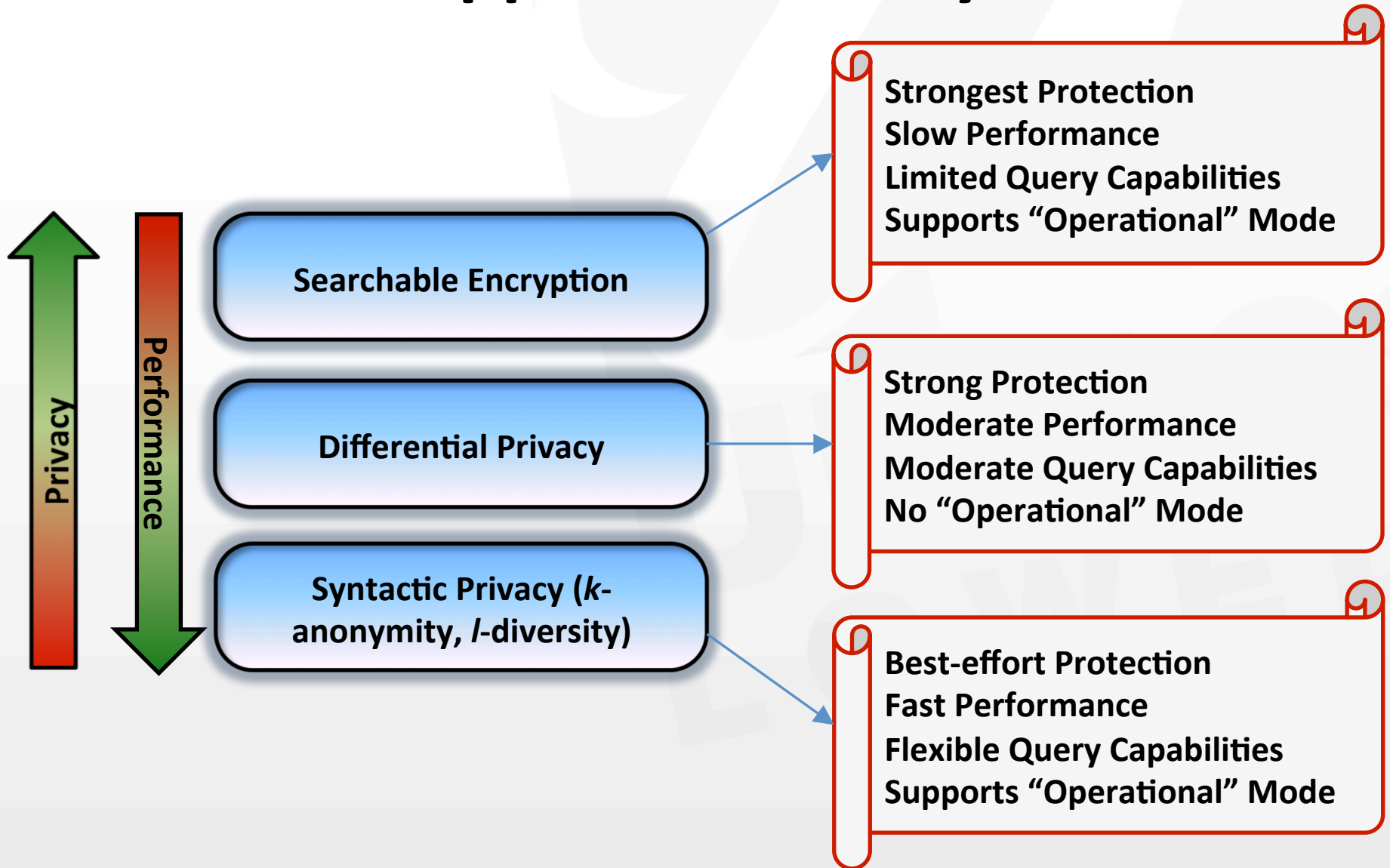- Streaming data
- High-speed line-rate
- Distributed environment

▶ Possible solutions
- Programmable parsing
- Data stream computation
- Hardware acceleration
- Collaborative measurement
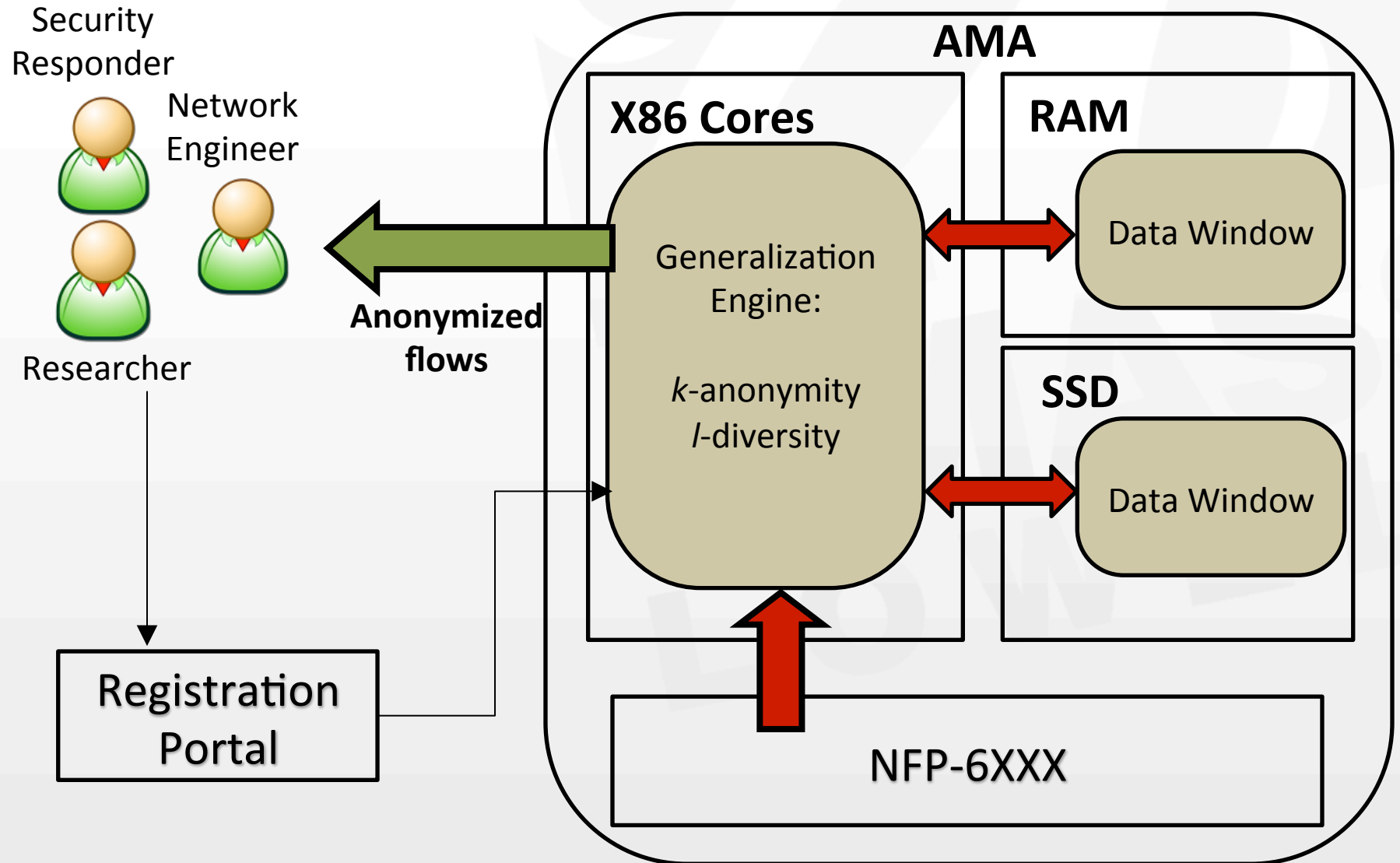
AMIS Privacy Framework

- Comprehensive framework that encapsulates most prominent privacy models
    - Syntactic models (generalization/suppression)
    - Semantic models (differential privacy)
    - Cryptographic models (searchable encryption)

- Supports diverse set of data uses
    - E.g., operations, statistics, data mining
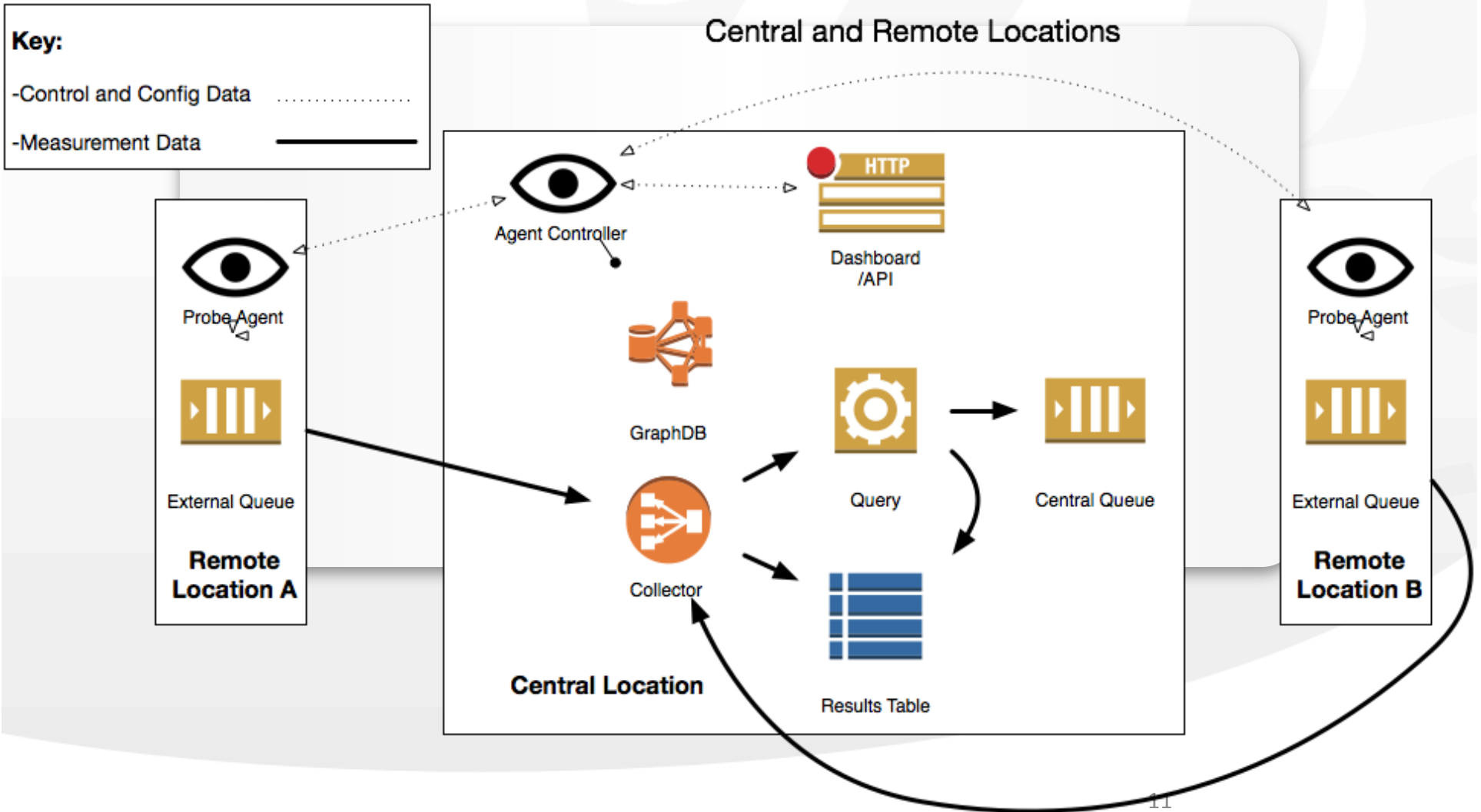
AMIS: Supported Privacy Models

Privacy ↑ **Performance** ↓

Searchable Encryption

Differential Privacy

Syntactic Privacy (*k*-anonymity, *l*-diversity)

Strongest Protection
Slow Performance
Limited Query Capabilities
Supports "Operational" Mode

Strong Protection
Moderate Performance
Moderate Query Capabilities
No "Operational" Mode

Best-effort Protection
Fast Performance
Flexible Query Capabilities
Supports "Operational" Mode

AMIS Privacy: Online Component

Processing and Data Management Framework

-Decentralized (hierarchical) framework for the management of distributed systems.

-Agent-based foundation used for configuration management and the collection of performance metrics.

-Advanced modules for stream and batch processing.

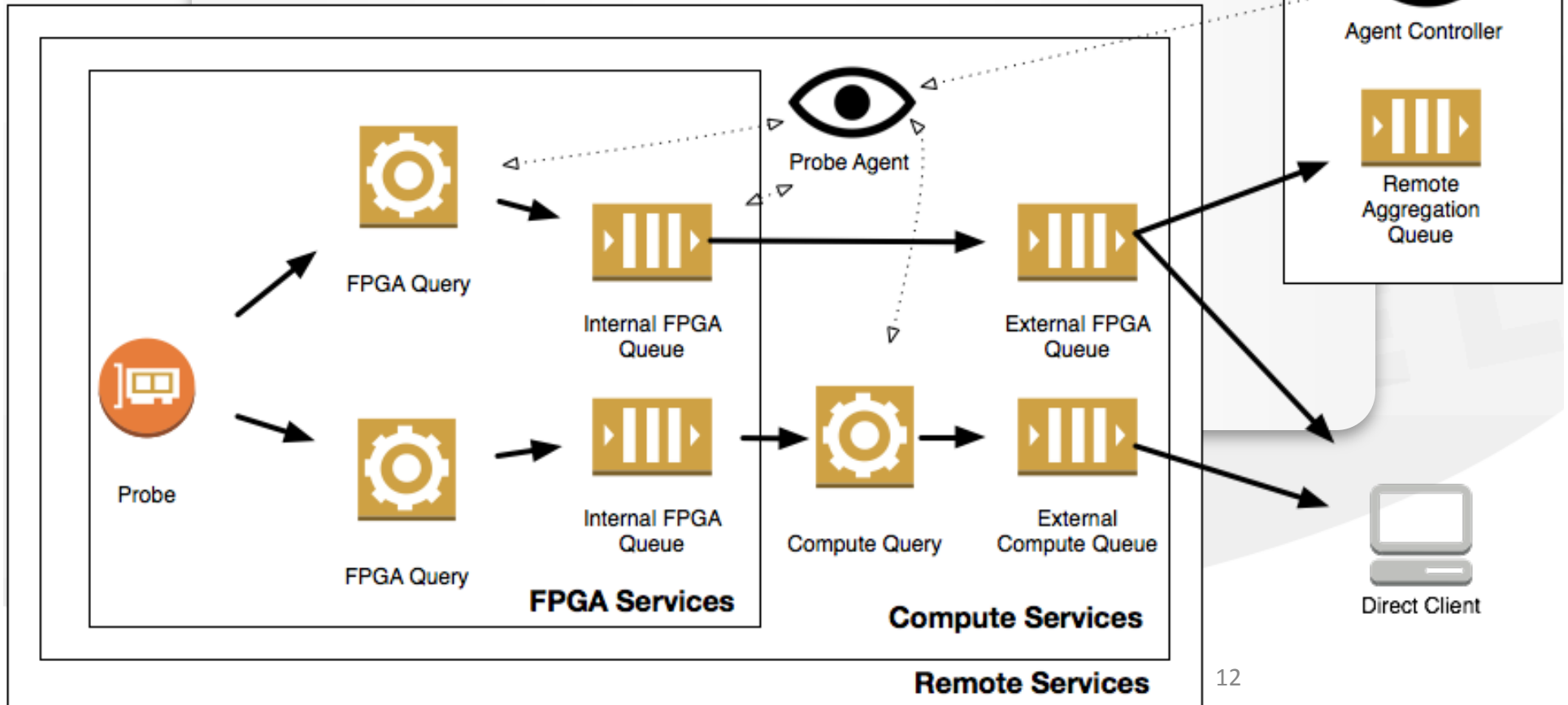-Web-GUI and API interface for pipeline management.

Global Processing View

Key:

-Control and Config Data ⋯⋯⋯⋯

-Measurement Data ▬▬▬▬

Central and Remote Locations

Agent Controller

HTTP
Dashboard /API

GraphDB

Query

Central Queue

Collector

Results Table

Central Location

Probe Agent

External Queue

Remote Location A

Probe Agent

External Queue
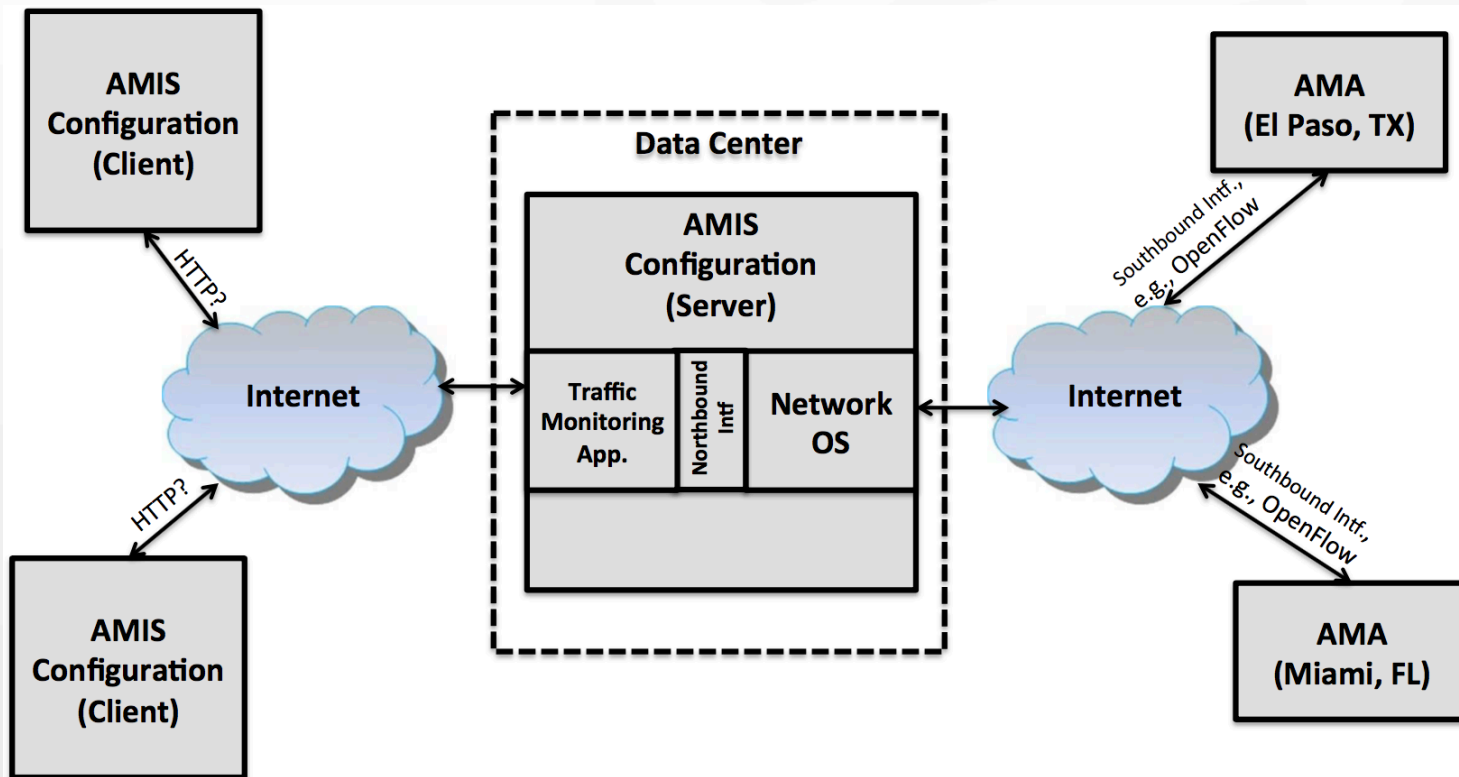
Remote Location B

Local Processing View
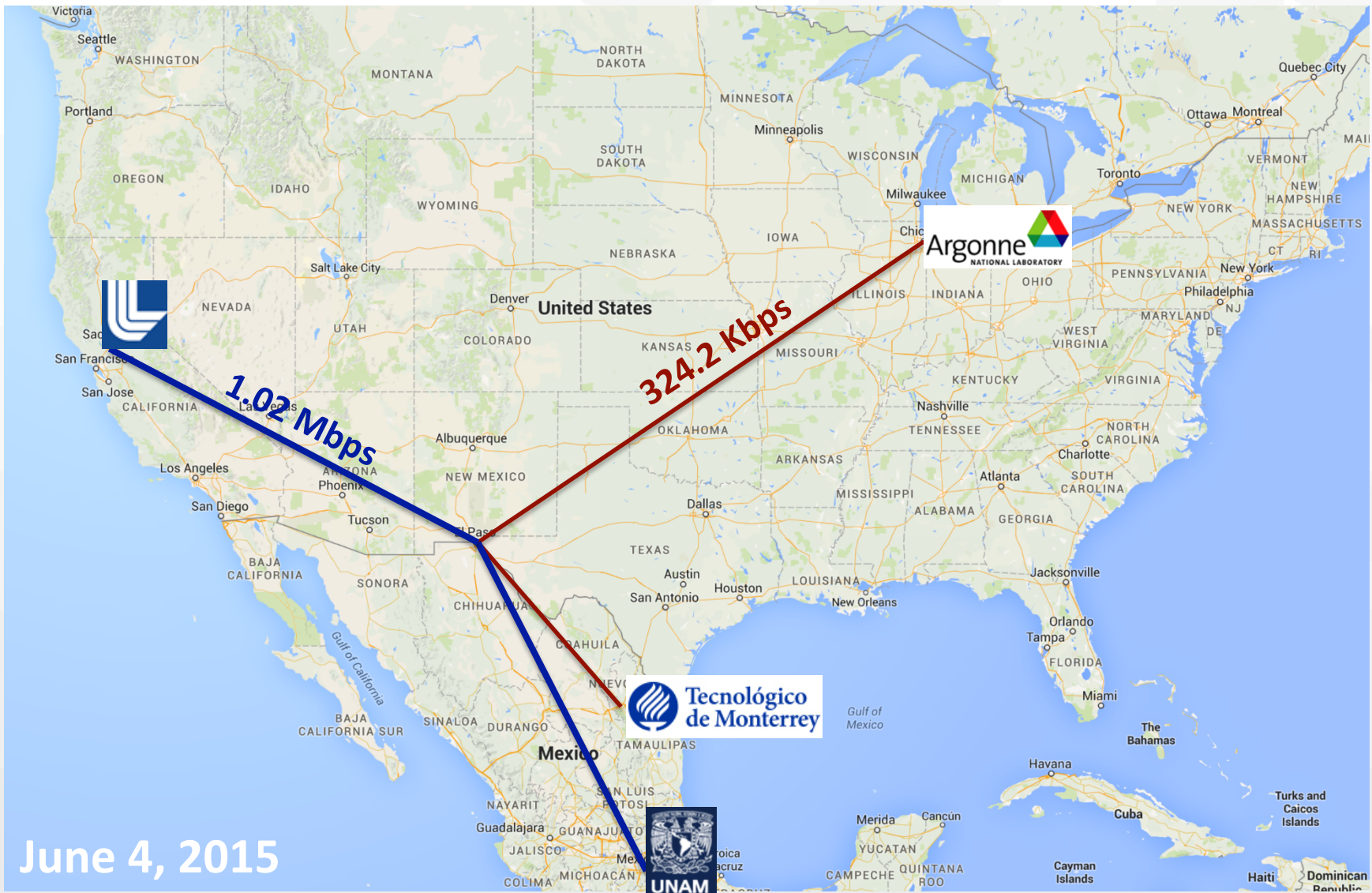
AMIS Traffic Data Analysis

- Traffic matrix

- Flow-level

- Burst-level

- Miscellaneous
  - e.g., network event detection

- Predictive
  - e.g., congestion event prediction

AMIS Configuration

- AMA devices will be configured for traffic monitoring through a client application that communicates with a server application running in the data center

Traffic Matrix

1.02 Mbps

324.2 Kbps

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Thank you!