SNAG: SDN-managed Network Architecture for GridFTP Transfers

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OUTLINE

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- Conclusions and Future Work

INTRODUCTION

Software Defined Networks (SDN) are transforming research and education (R&E) networks

We are interested in:

- Classifying data flows from scientific projects
- A policy-driven approach to network management & security

SCIENTIFIC PROJECTS @ UNL

Holland Computing Center (HCC) @ UNL

Supports well-known scientific projects such as:
- Compact Muon Solenoid (CMS)
- Laser Interferometer Gravitational-Wave Observatory (LIGO)
- Large datasets with projects consuming significant storage and networking resources

- Our Work:
  - Ability to *apply policies* to these projects at the experiment level
  - Ability to *differentiate* CMS traffic over LIGO

Globus GridFTP

- Protocol for cluster and grid environments
  - Enables large-volume data transfers
- GridFTP maximizes data transfer throughput
  - Creates multiple TCP streams per transfer
  - Overcomes TCP limitations for high-latency, high-bandwidth WANs
- CMS and LIGO both use GridFTP for data transfers

- **Cost**: Fairness

PROBLEM

Associate policies based on application layer properties with network layer flow-level information.

- GridFTP breaks TCP fairness
  - Need to differentiate high-priority transfers
- GridFTP control channel is encrypted
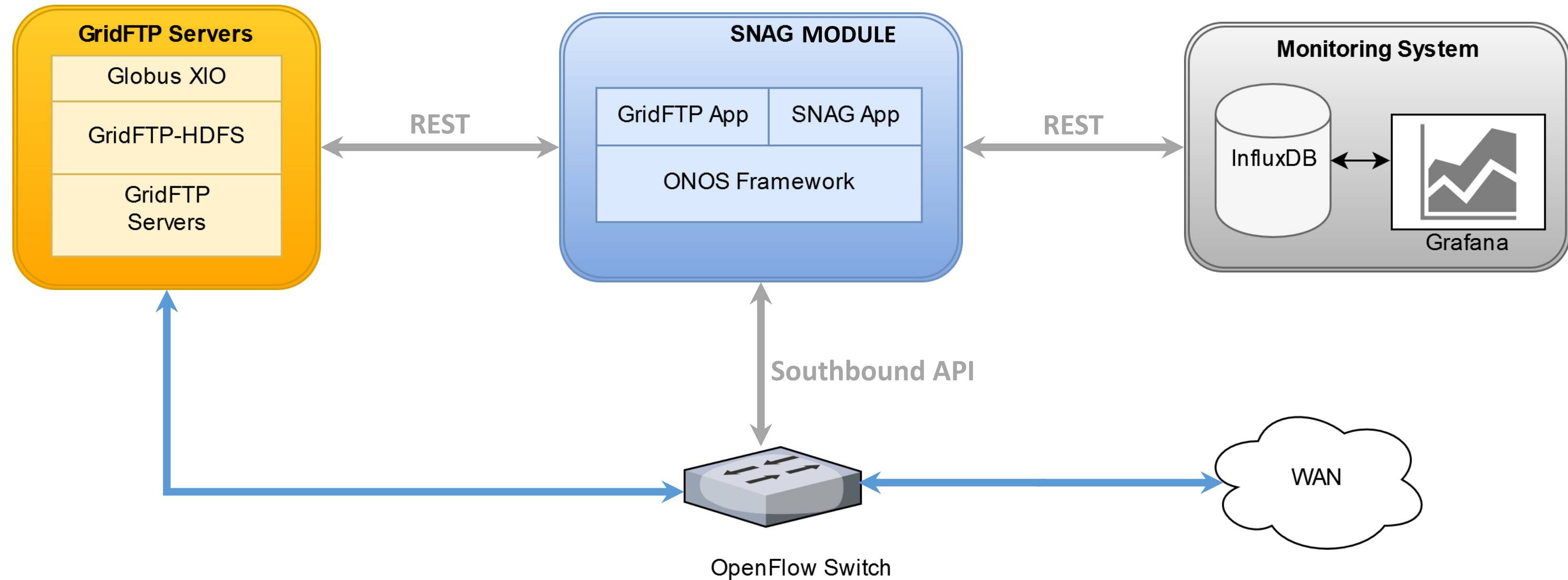 - Traffic cannot be classified by "sniffing" control channel

Solution: SNAG

Our SDN-managed Network Architecture for GridFTP Transfers
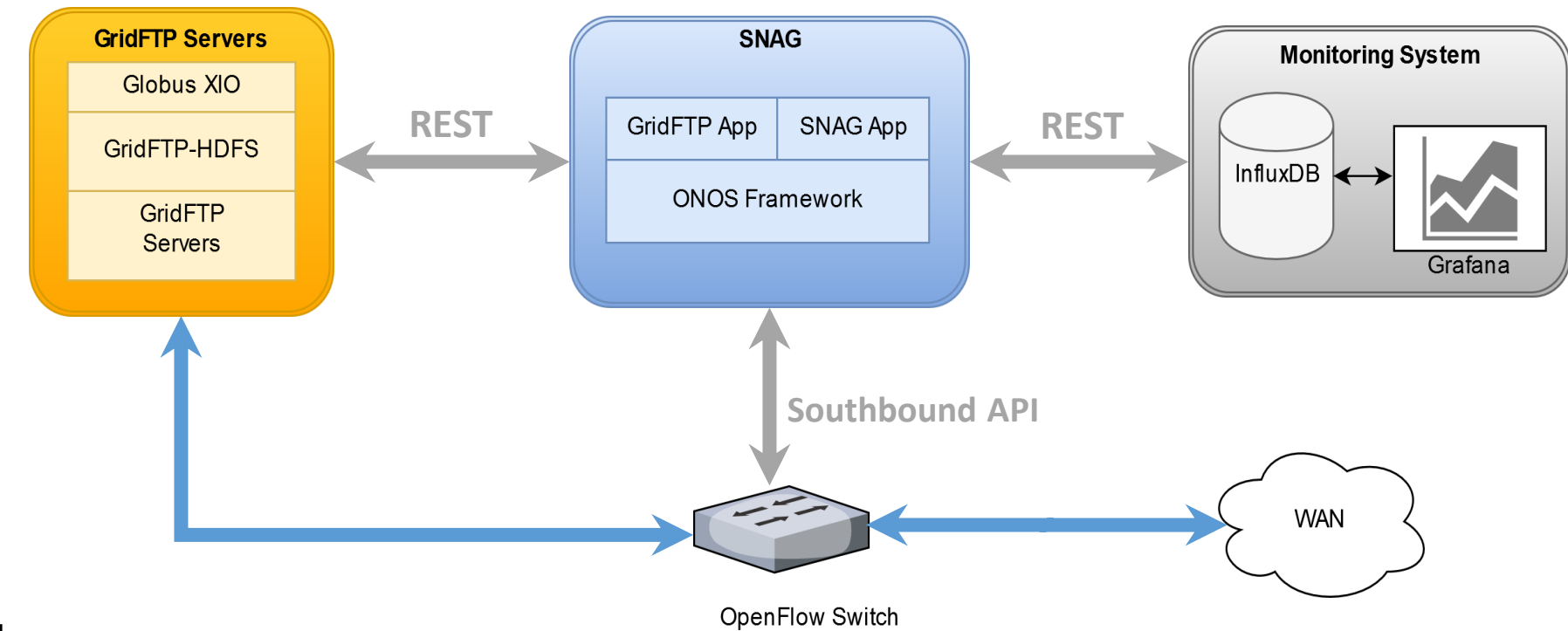
SNAG Architecture:
- Integrates SDN capabilities with GridFTP
- Provides network monitoring and management capabilities
- Differentiates GridFTP transfers:
  - To/from various sources, and
 - By owners

SNAG ARCHITECTURE

SNAG COMPONENTS

Three main components namely:

i. GridFTP Servers, Globus XIO Module and GridFTP-HDFS plugin

ii. SDN controller (ONOS), SNAG App and GridFTP App

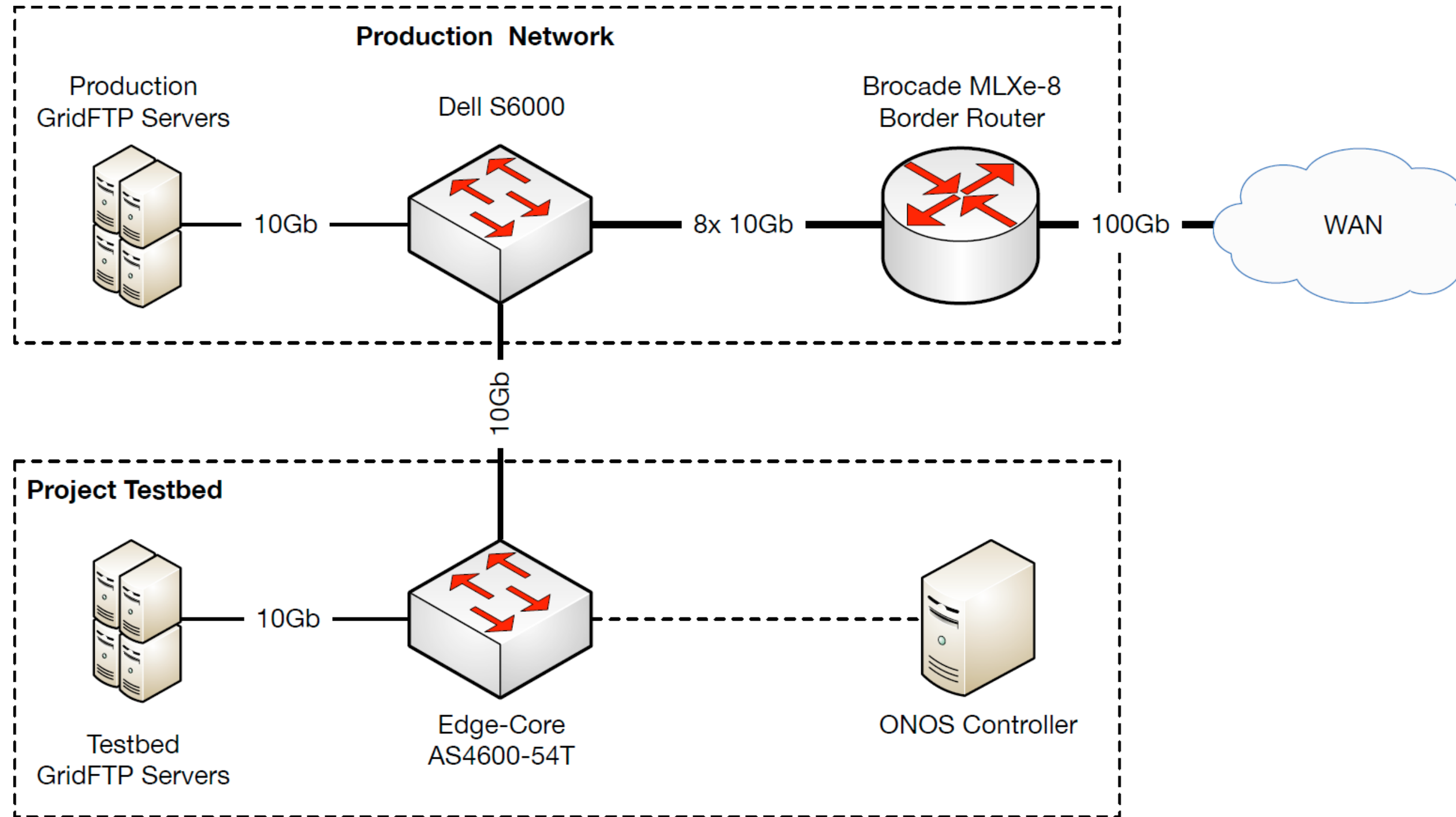iii. Monitoring System (InfluxDB + Grafana)

Communication between components using RESTful APIs

- L3, L4 info (src/dst IPs, port-pairs)
- Application layer info (file transfers, direction etc.)

# GridFTP XIO Callout + SNAG
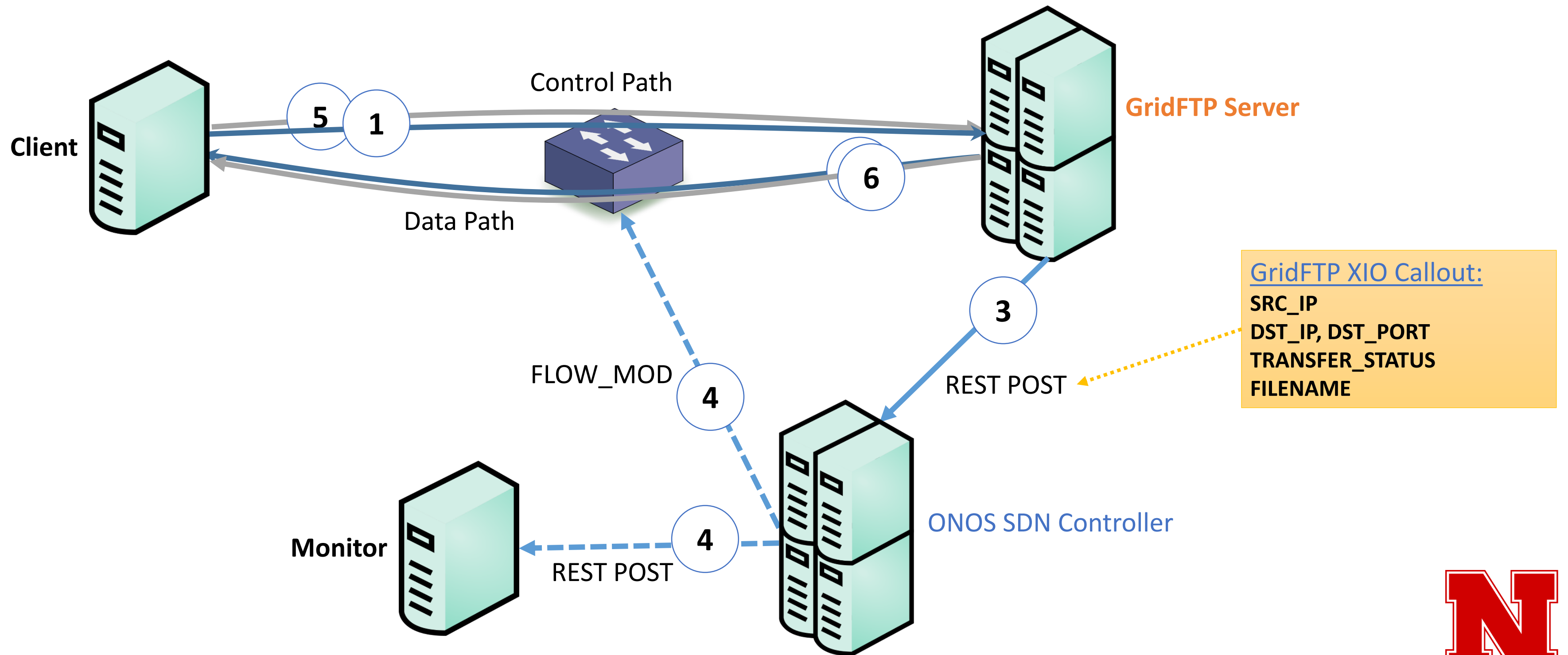
NETWORK TOPOLOGY

RESULTS (1)

Classified users based on four types of traffic:

a) **CMS PhEDEx** - CMS production data movement
- Maps user initiated transfers to the PhEDEx data placement system
- Consists of large physics datasets (.root files) to/from sites

b) **CMS Analysis** - Represents analysis transfers associated with users' jobs (typically mapped to an individual user)

c) **CMSProd** - transfers associated with CMS production workflows

d) **LCG Admin** - transfers associated with SAM (Site Availability Monitoring)

RESULTS (2)

Classification of CMS Data Transfers by Users

CMS Data Transfers by Users

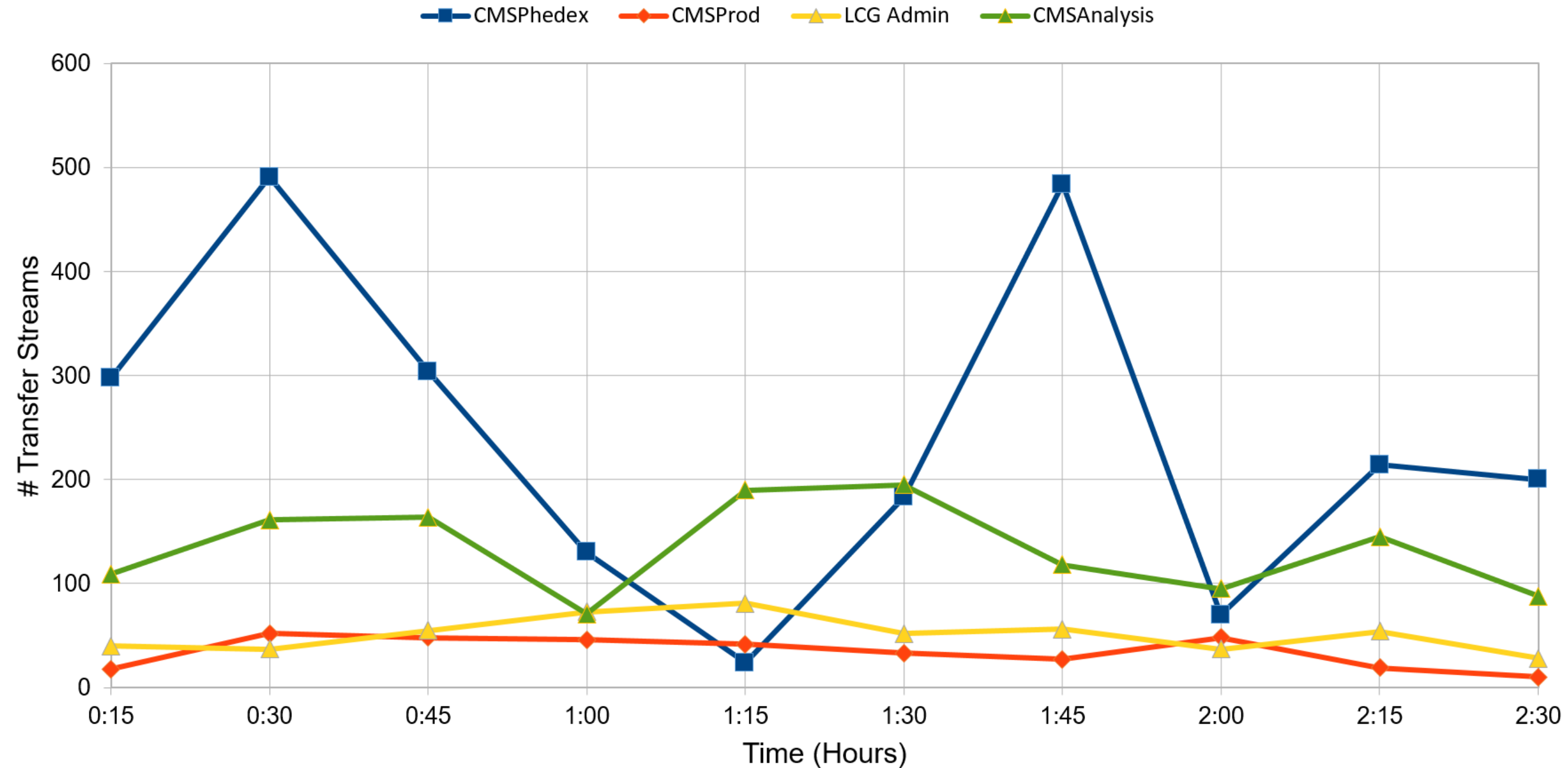■ CMSPhedex ■ CMSProd ■ LCG Admin ■ CMSAnalysis
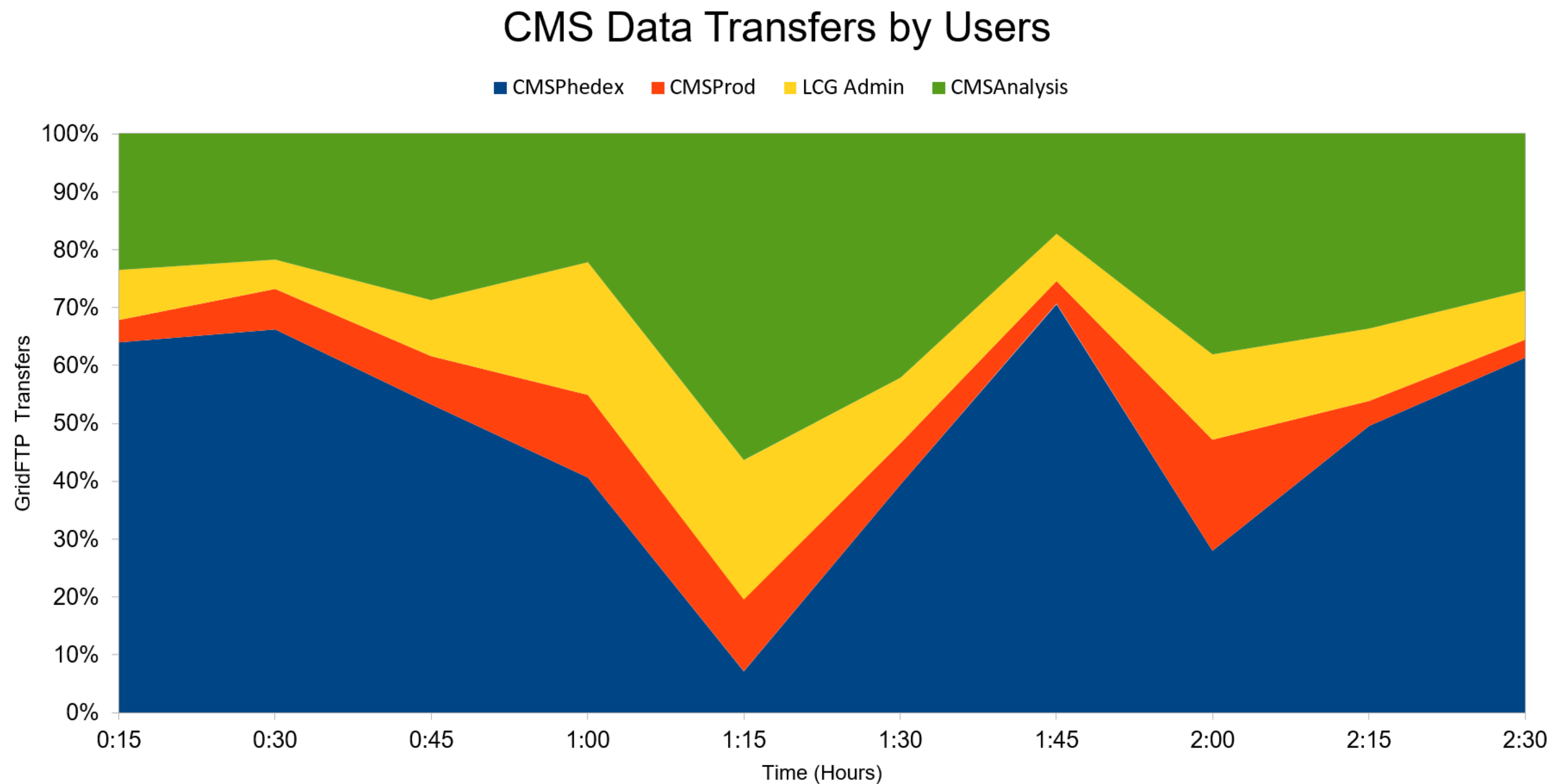
- Each measurement shows the #users at every 15 min intervals
- Data normalized over 65 users

RESULTS (3)

Classification of #Transfer Streams per User type

Total Number of GridFTP Transfer Streams

■ CMSPhedex ◆ CMSProd ▲ LCG Admin ▲ CMSAnalysis

- Represents the number of active TCP streams by user type

CONCLUSIONS

- SNAG builds network layer views based on application layer properties
  - Resulting monitoring views cannot be achieved through the traditional approaches
  - SNAG accounts for resource usage and provides insights into opportunistic sharing (such as LIGO)

FUTURE WORK

- Transition from passive monitoring to active network management
  - Proactively change network flows based on monitoring information
  - Traffic prioritization and QoS for CMS/LIGO Transfers
  - Optimize capacity and increase network utilization
- Integration with other data flows such as XROOTD
- Insights into access patterns (Site-level info)

Thank You

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