14th ANNUAL WORKSHOP 2018

COMPREHENSIVE, SYNCHRONOUS, HIGH FREQUENCY MEASUREMENT OF INFINIBAND NETWORKS IN PRODUCTION HPC SYSTEMS

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U.S. DEPARTMENT OF ENERGY NNSA

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OUTLINE

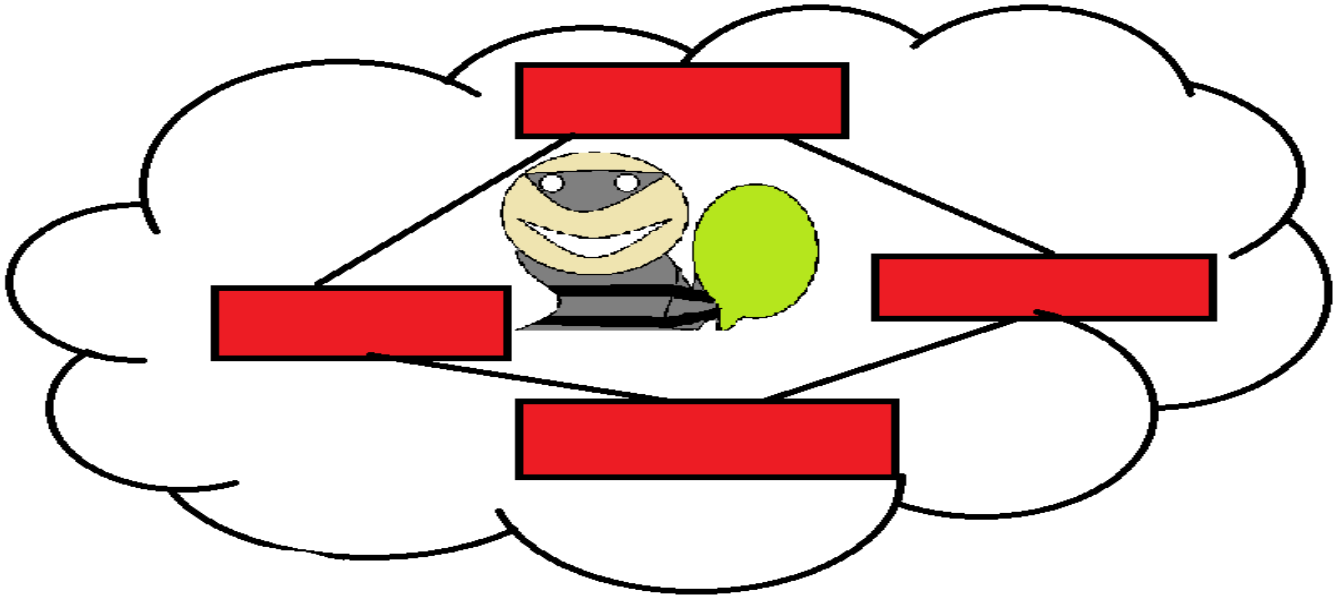
- **Why Synchronous Performance Data Gathering?**
- **Challenge of Pulling Performance Data from Big HPC Fabrics**
  - How Previous Experience Shaped Our Approach
- **Experiments**
- **Results**
- **Conclusions**
- **Questions?**

WHY DO WE CARE ABOUT STRICT SAMPLE INTERVALS?

STRICT SAMPLING INTERVALS

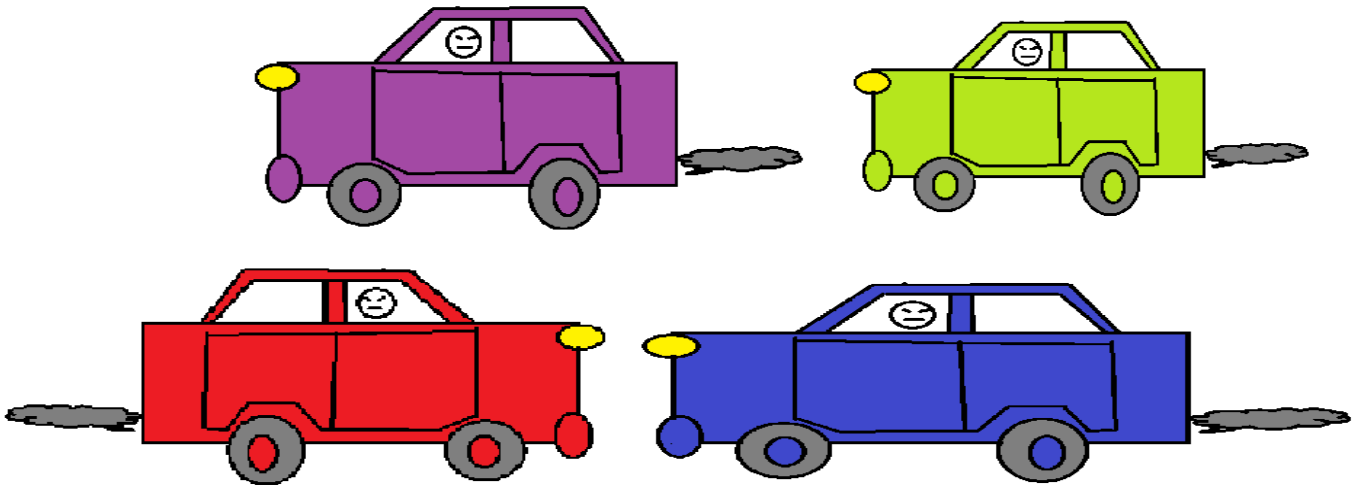
- **We are looking for network related issues that slow our computational performance.**

Performance Reducing Thieves



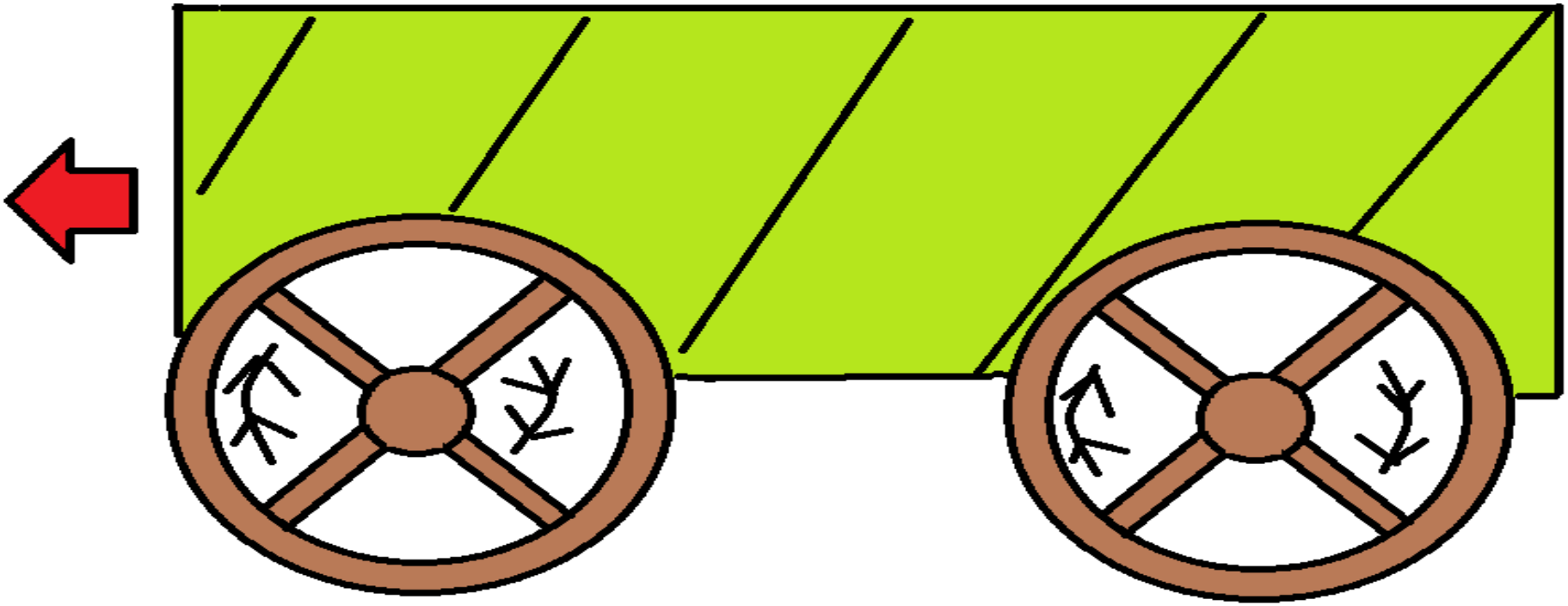
STRICT SAMPLING INTERVALS

- **Easier to correlate performance data with running jobs.**
- **Shorter sampling intervals allow us to more easily see dynamic changes in network traffic.**



STRICT SAMPLING INTERVALS

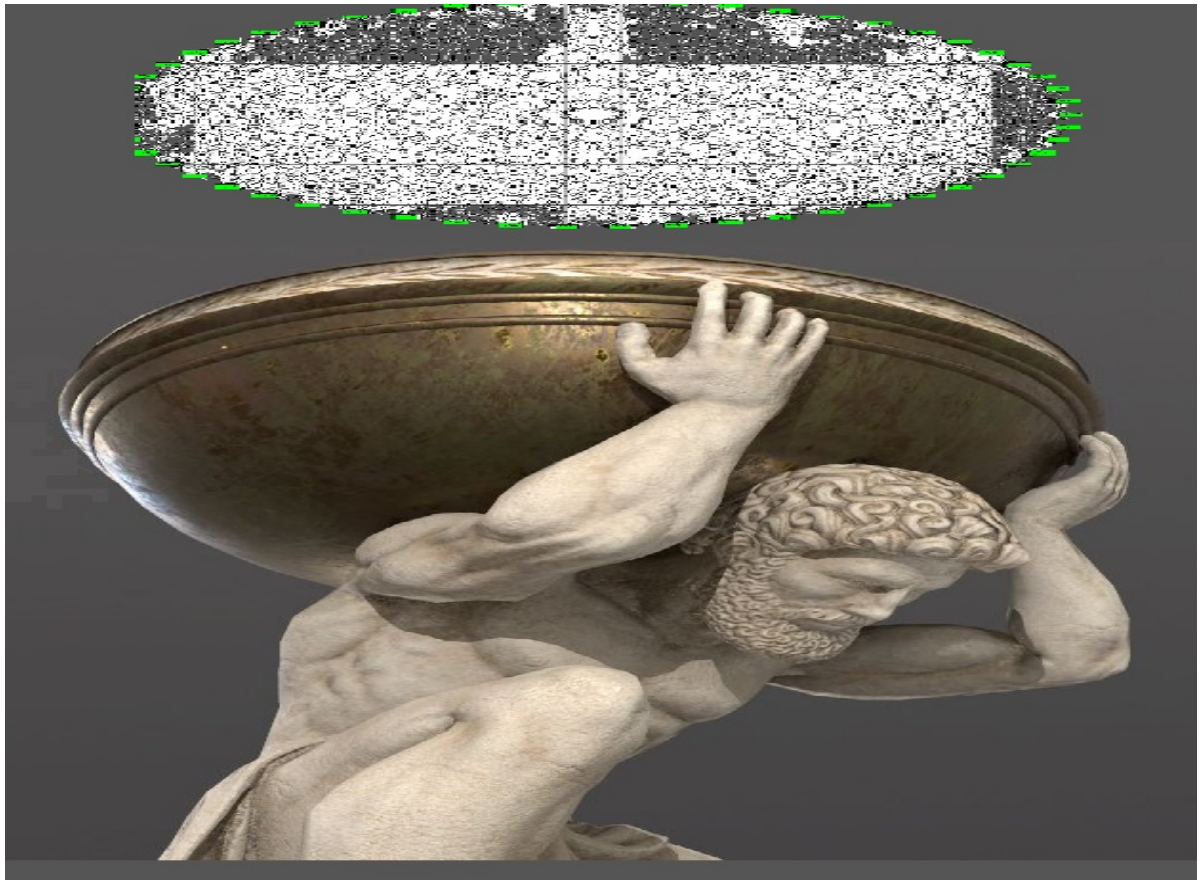
- **The more infrequently we gather performance statistics, the more we smooth away information. Peaks get hidden.**



CHALLENGE OF PULLING PERFORMANCE DATA FROM BIG HPC FABRICS

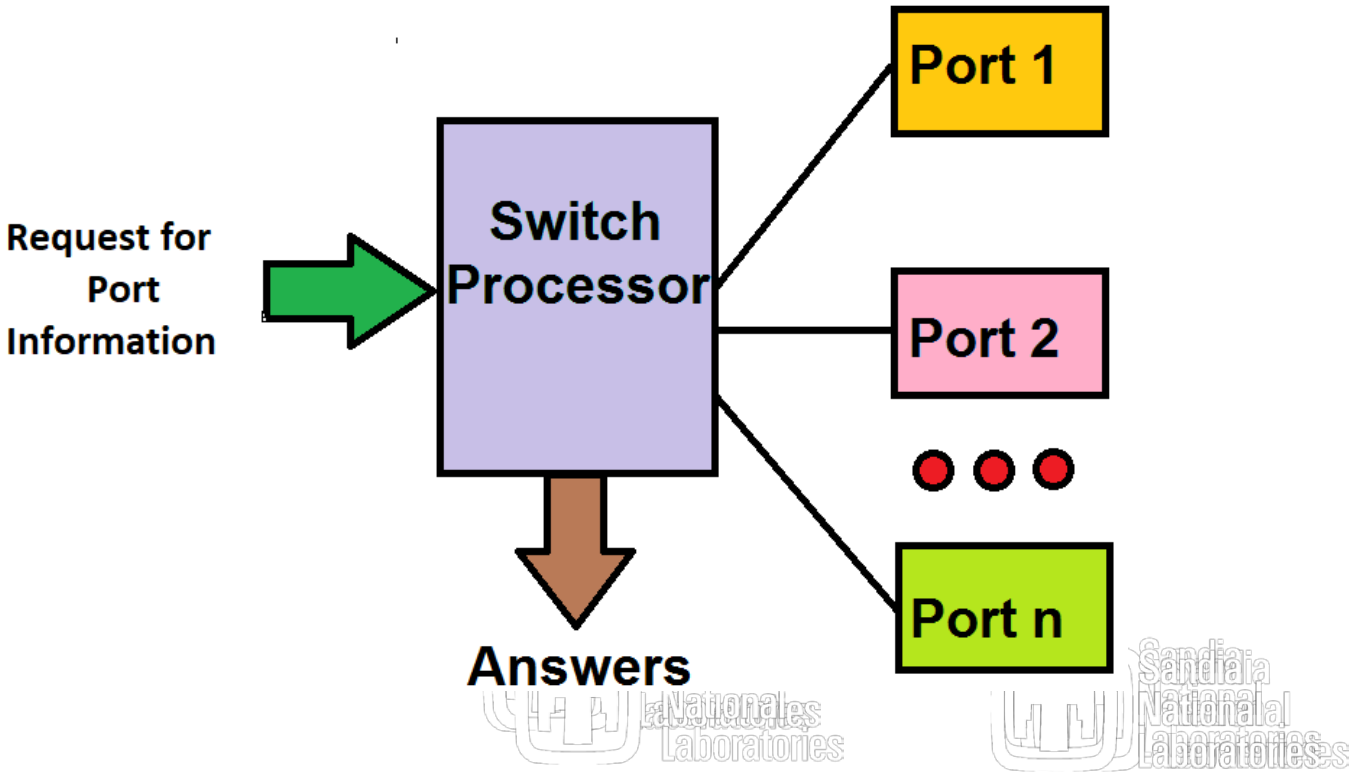
CHALLENGE OF PULLING DATA FROM BIG HPC FABRICS

- **We want to create the least interference to network traffic for running applications.**
- **We want the minimal retrieval time for our queries.**

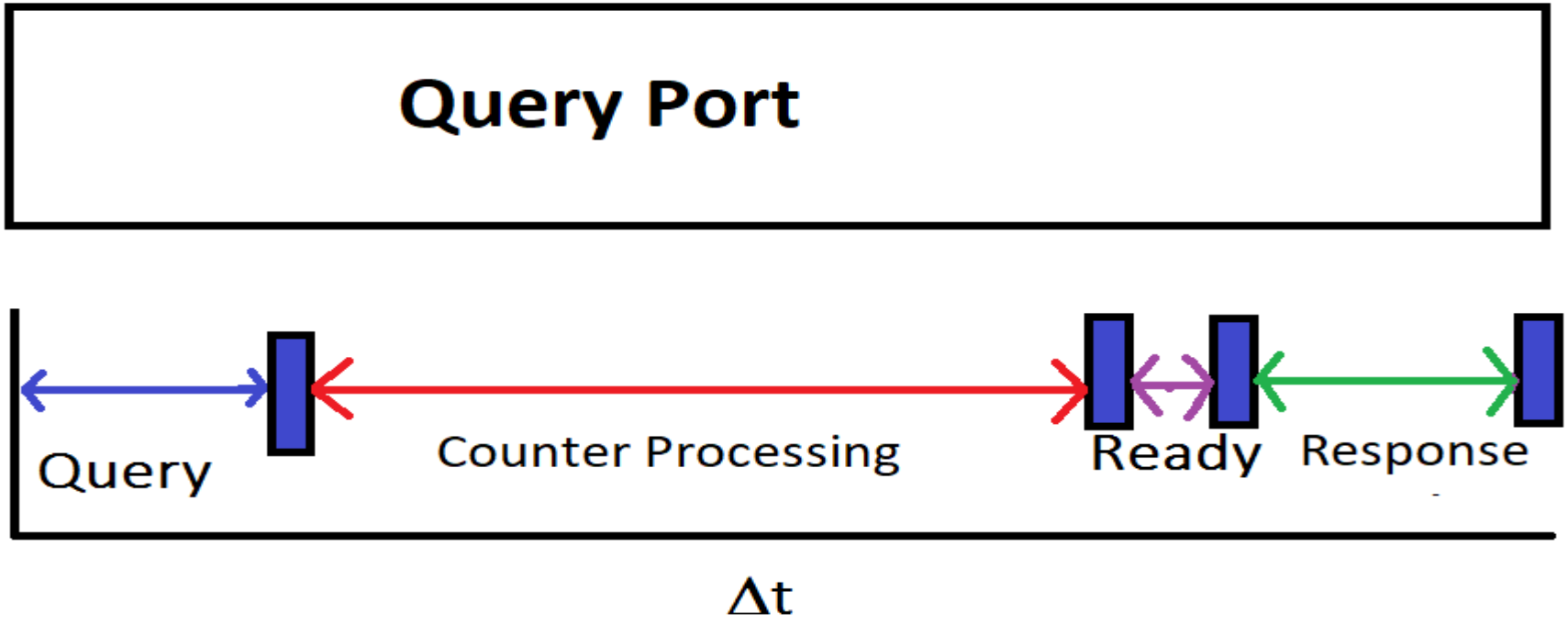


CHALLENGE OF PULLING PERFORMANCE DATA FROM BIG HPC FABRICS

- **Requests are made to the switch and then the switches retrieve performance metric data.**

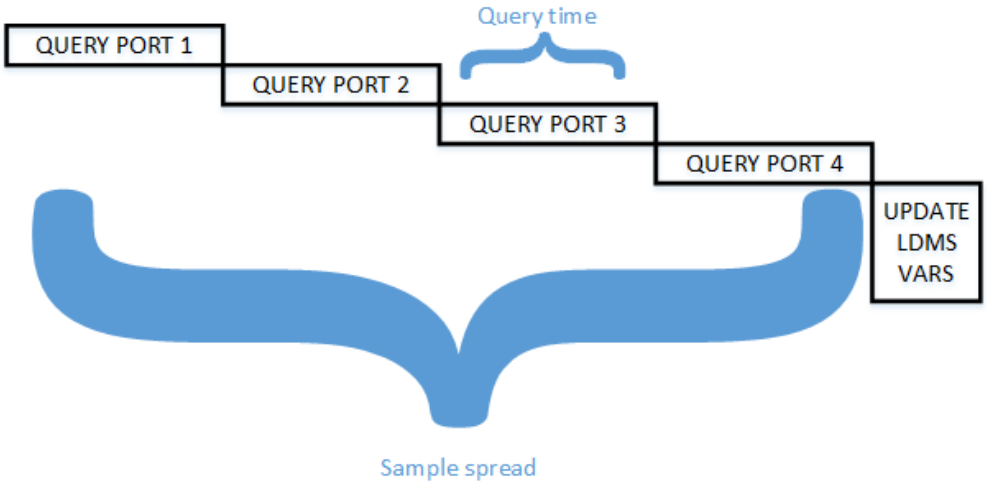


CHALLENGE OF PULLING PERFORMANCE DATA FROM BIG HPC FABRICS



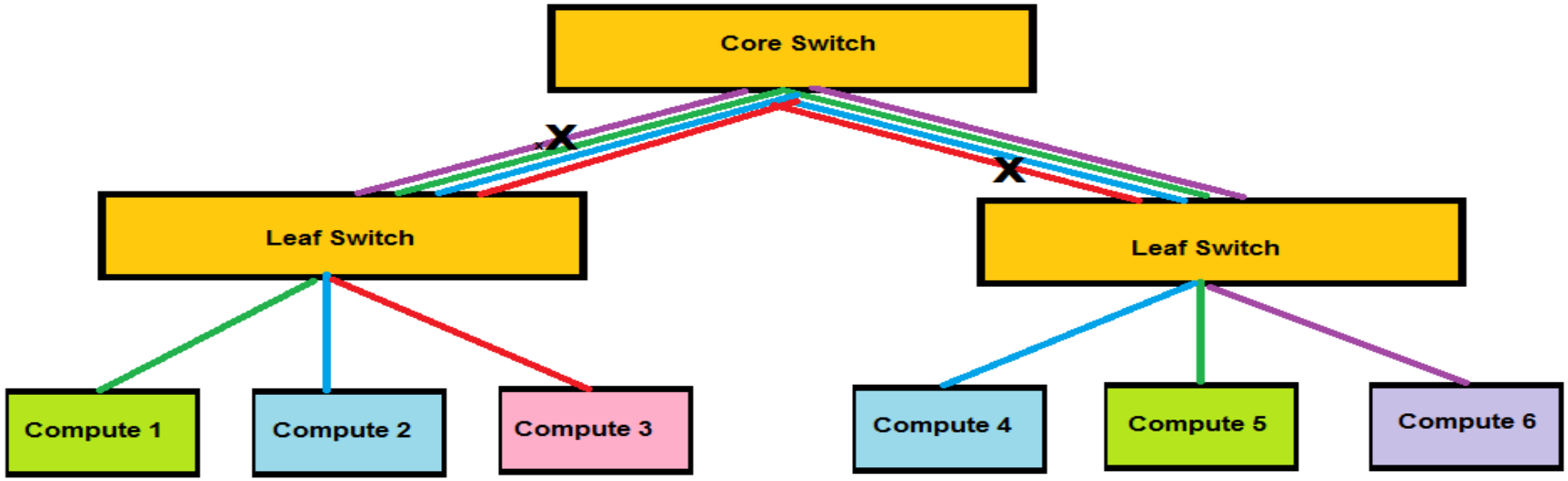
CHALLENGE OF PULLING DATA FROM BIG HPC FABRICS

- **For a sampler on a single node serially querying a list of IB ports, we define spread as the time interval between the start of the first port query made and the end of the last port query made.**



CHALLENGE OF PULLING DATA FROM BIG HPC FABRICS

- **Previous experiments showed us that gathering switch port information from closely connected samplers is better than having queries traverse the fabric to a far switch.**
- **Previous experiments showed us that up to 1 Hz sampling rates do not negatively affect application traffic.**

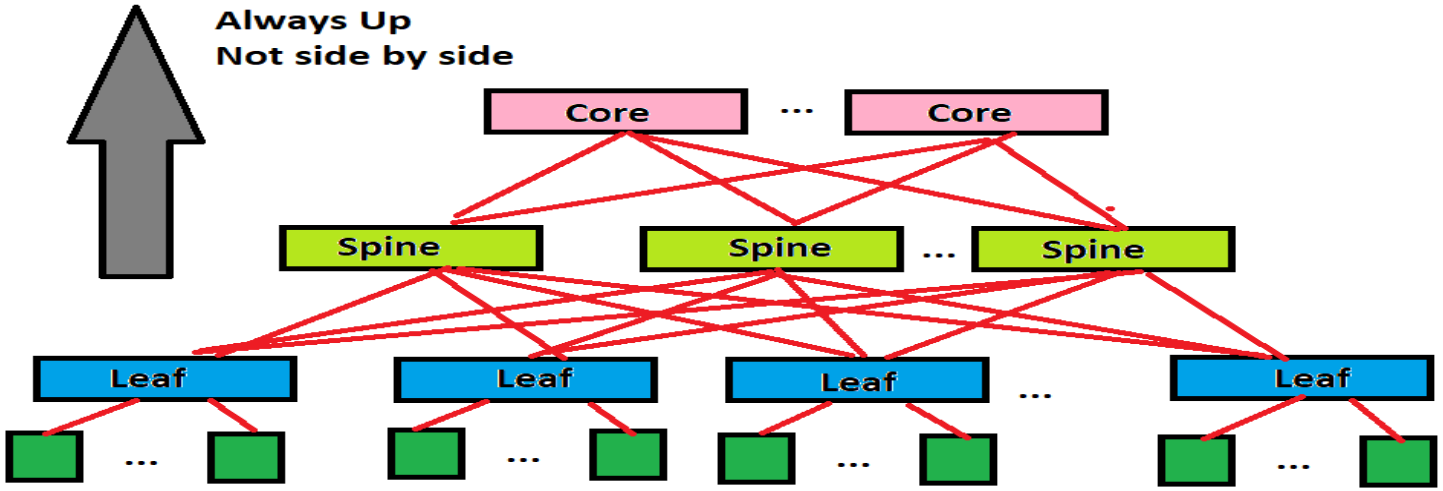


EXPERIMENTS

- **Skybridge----Top 500 rank of 381, 1848 Compute Nodes (6/2017)**

EXPERIMENTS

- **A very large 3-tier Fat Tree**
- **Sampling in our demonstration is performed using Skybridge Administrative Nodes.**
- **268 Switches, 9648 Switch Ports**



RESULTS

RESULTS

- **Individual port query time statistics for 10 Samplers on Skybridge:**

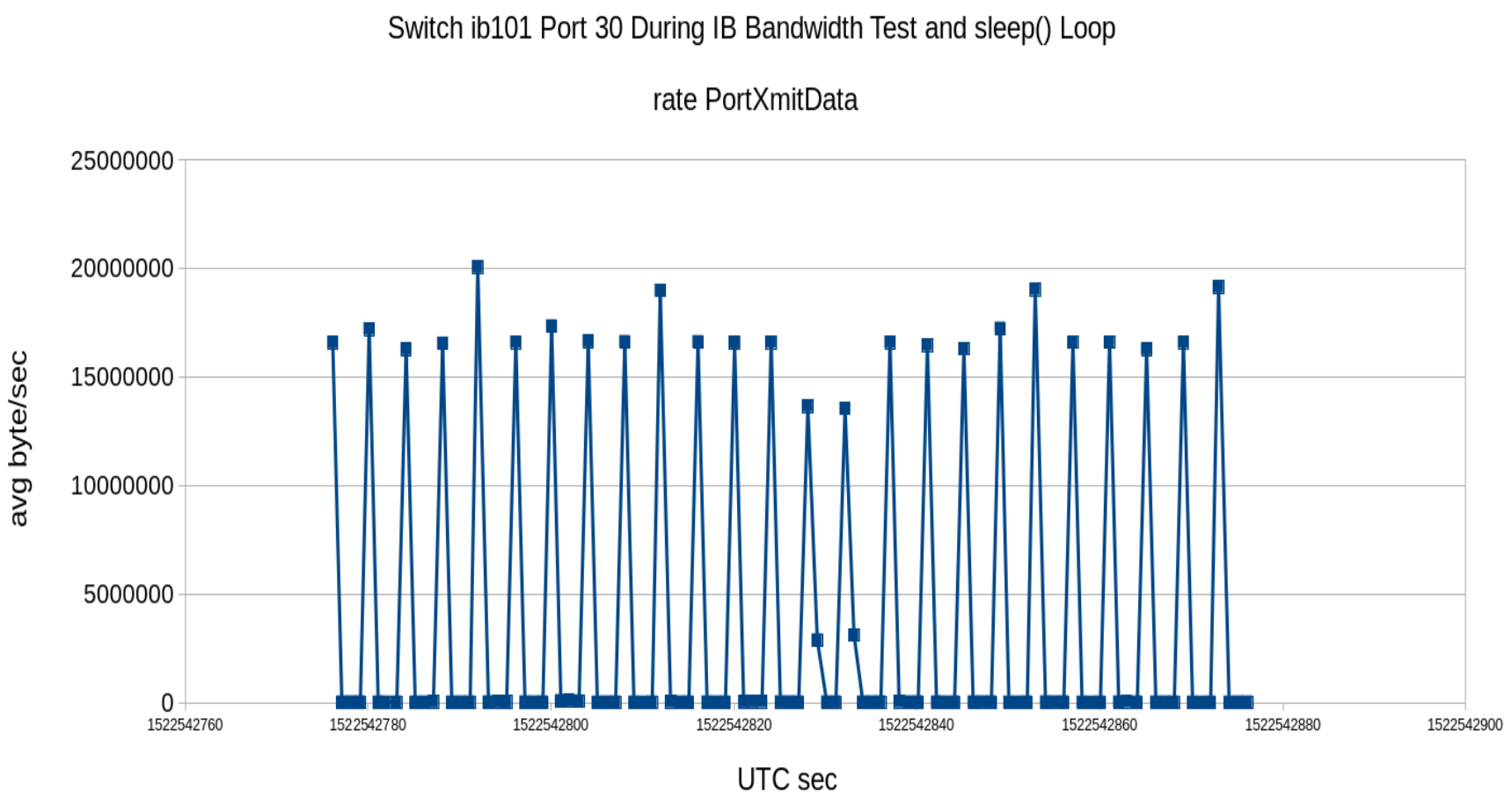
  - Retrieval time for each switch port
    - avg 0.00014
    - min 0.000048
    - max 0.013 **<== 75 Hz maximum practical sampling frequency.**

  - Time for a sampler to collect its share of ports:
    - min 0.105
    - max 0.224
    - avg 0.149

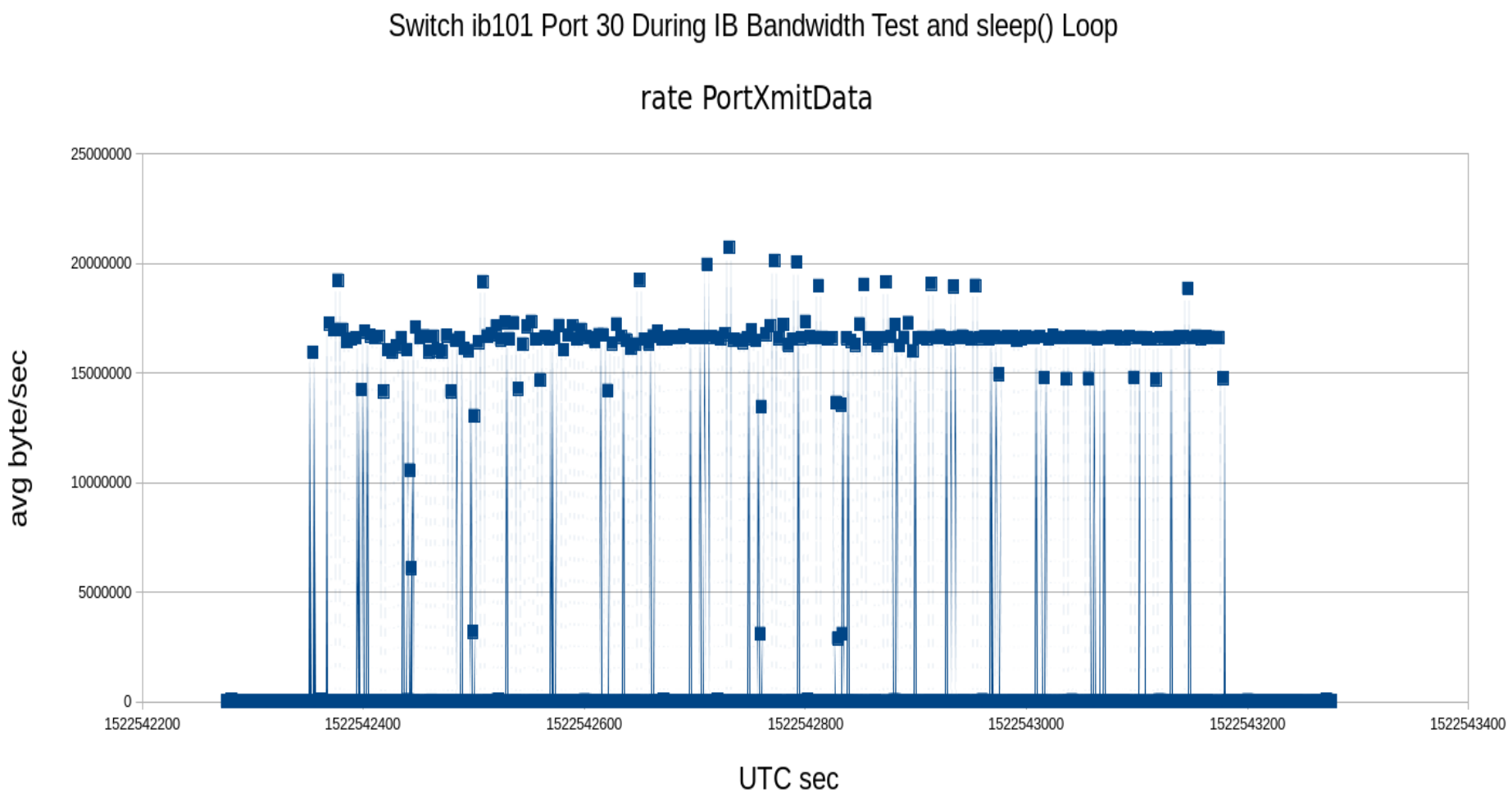
RESULTS

- **Port query time statistics for 1 Sampler on Skybridge**
  - Retrieval time for each switch port
    - avg 0.00065 s
    - min 0.000074 s
    - max 0.0038 s
  - Time for a single sampler to collect all ports on all switches:
    - min 6.05 s
    - Max 6.42 s
    - avg 6.17 s
- **No IB errors were detected during the tests (we checked).**

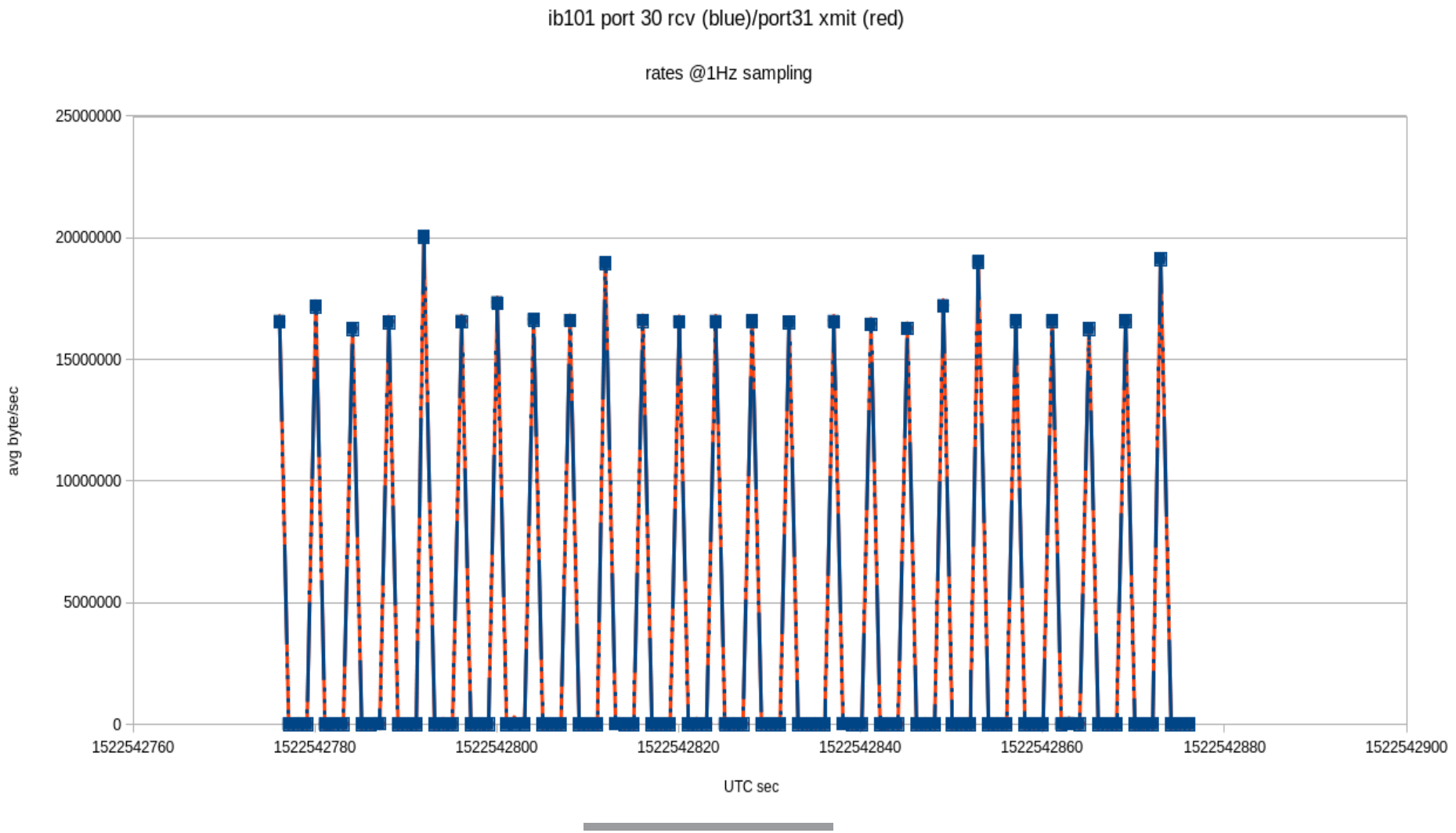
RESULTS (3 MINUTES)



RESULTS (30 MINUTES)



RESULTS (2 MINUTES)



CONCLUSIONS AND ACKNOWLEDGMENTS

CONCLUSIONS

- **We can scan the entire fabric on a large system in fixed time intervals.**
  - A Single IBFabric Sampler running on a Single Skybridge Admin node, sampling all of the Skybridge InfiniBand switches can be done every 20s
  - When we have samplers running concurrently on 10 Skybridge Admin nodes, sampling can be done at 1Hz.
  - If we sample one switch per compute node, sampling can be done at 10 Hz.
- **We were able to see network performance data for our test traffic.**
- **We can sample a full suite of performance and error metrics from the switches without inducing errors.**
- **We saw VL15 drops on the Slurm and OpenSM node on ~1 minute periodic basis. *Which service that is running in the background is causing this?***

ACKNOWLEGEMENTS

Steve Monk, Mark Schmitz, Joe Mervini

QUESTIONS?

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THANK YOU

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