



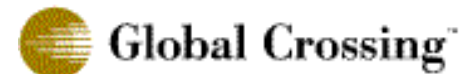
---

# QoS Aware Monitoring & Measurement

**Steven Van den Berghe**



**Richard Egan**  
**Hamid Asgari**



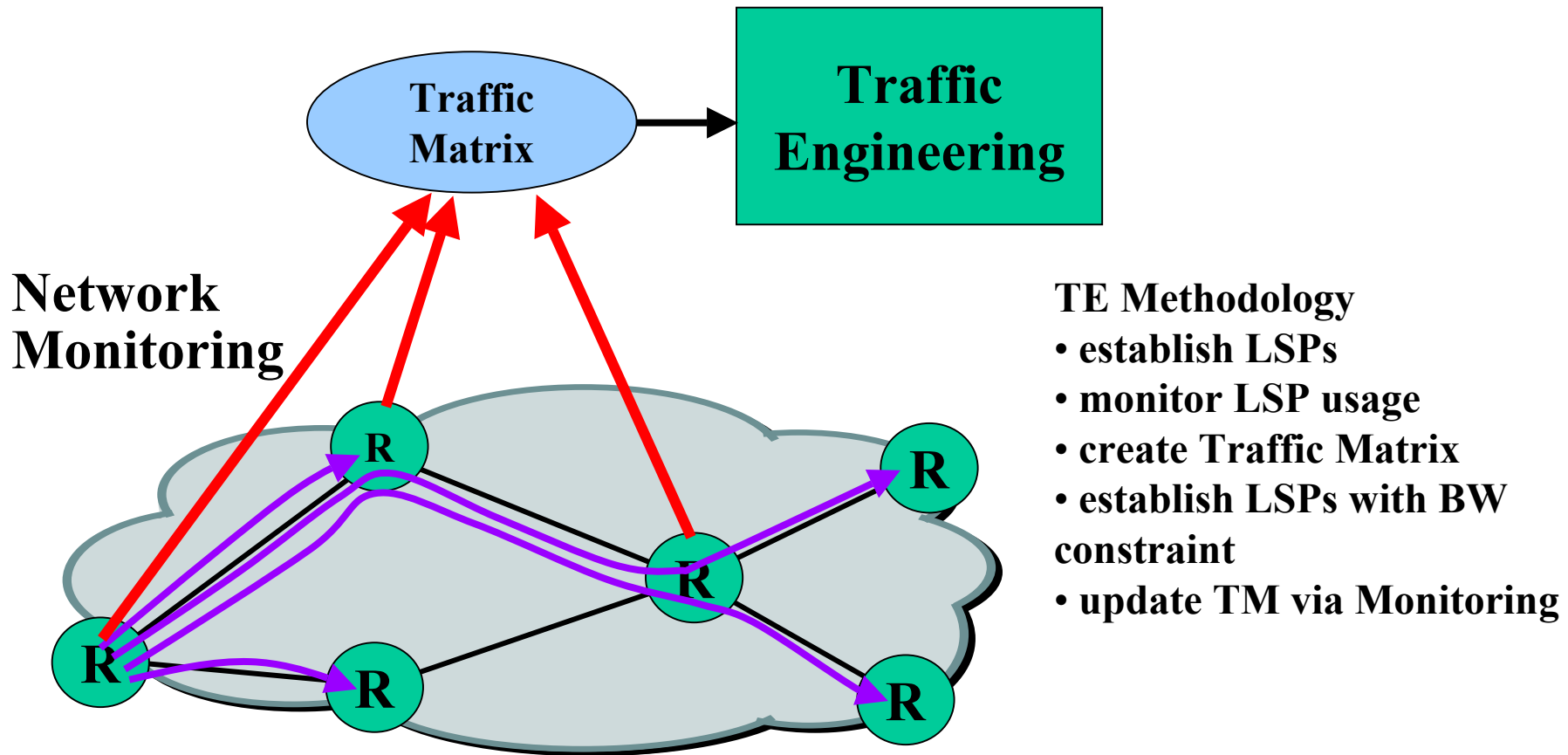


# Presentation Outline

---

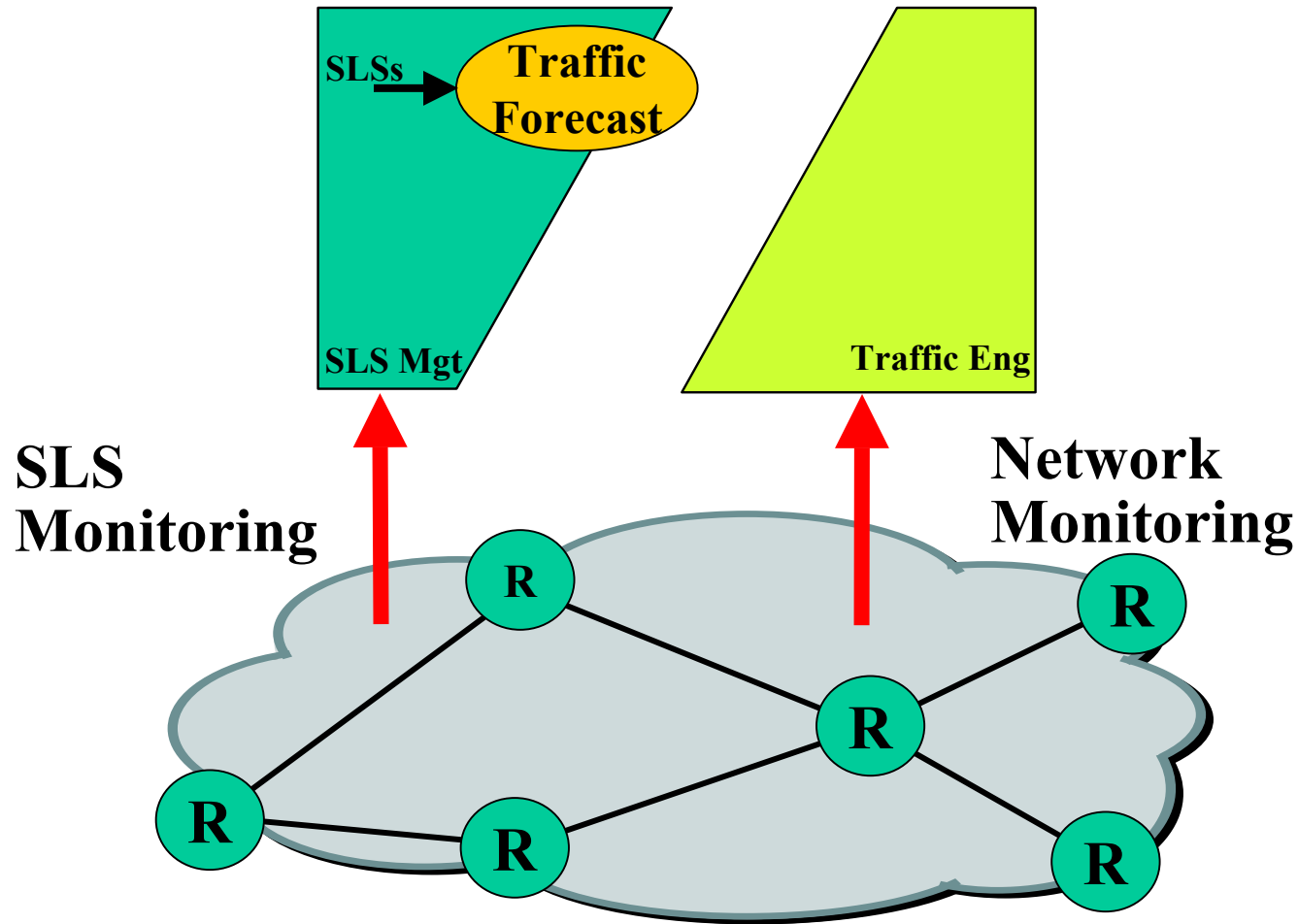
- **Role of Monitoring**
- **Architecture**
- **Design**
- **Results**
- **Scalability Features**
- **Outcomes**
- **Conclusions**

# Role of Monitoring - Current





# Role of Monitoring - TEQUILA





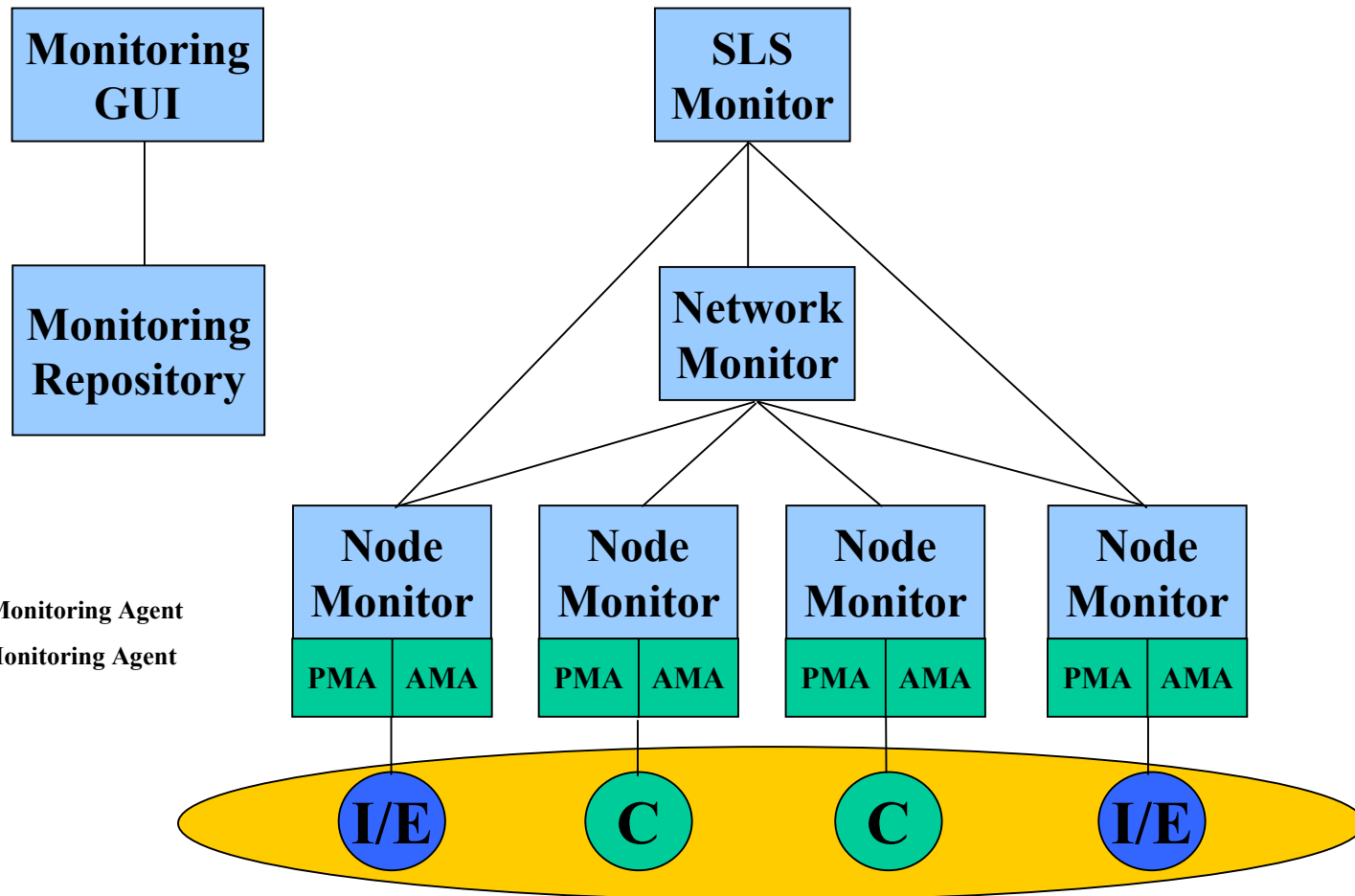
# Network Monitoring

---

- **To assist Dynamic TE to adapt to:**
  - Congestion / under-utilisation
- **Two primary components**
  - **Node Monitor**
    - contains the active/passive measurement agents
    - performs all edge2edge measurements
  - **Network Monitor**
    - builds a physical & logical network view
    - derives path/network measurements from hop by hop results
- **Relevant Metrics**
  - OneWayLoss, OneWayDelay
  - PHB Bandwidth Usage, PHB Packet Discard
  - Throughput



# Monitoring Architecture



PMA Passive Monitoring Agent  
AMA Active Monitoring Agent



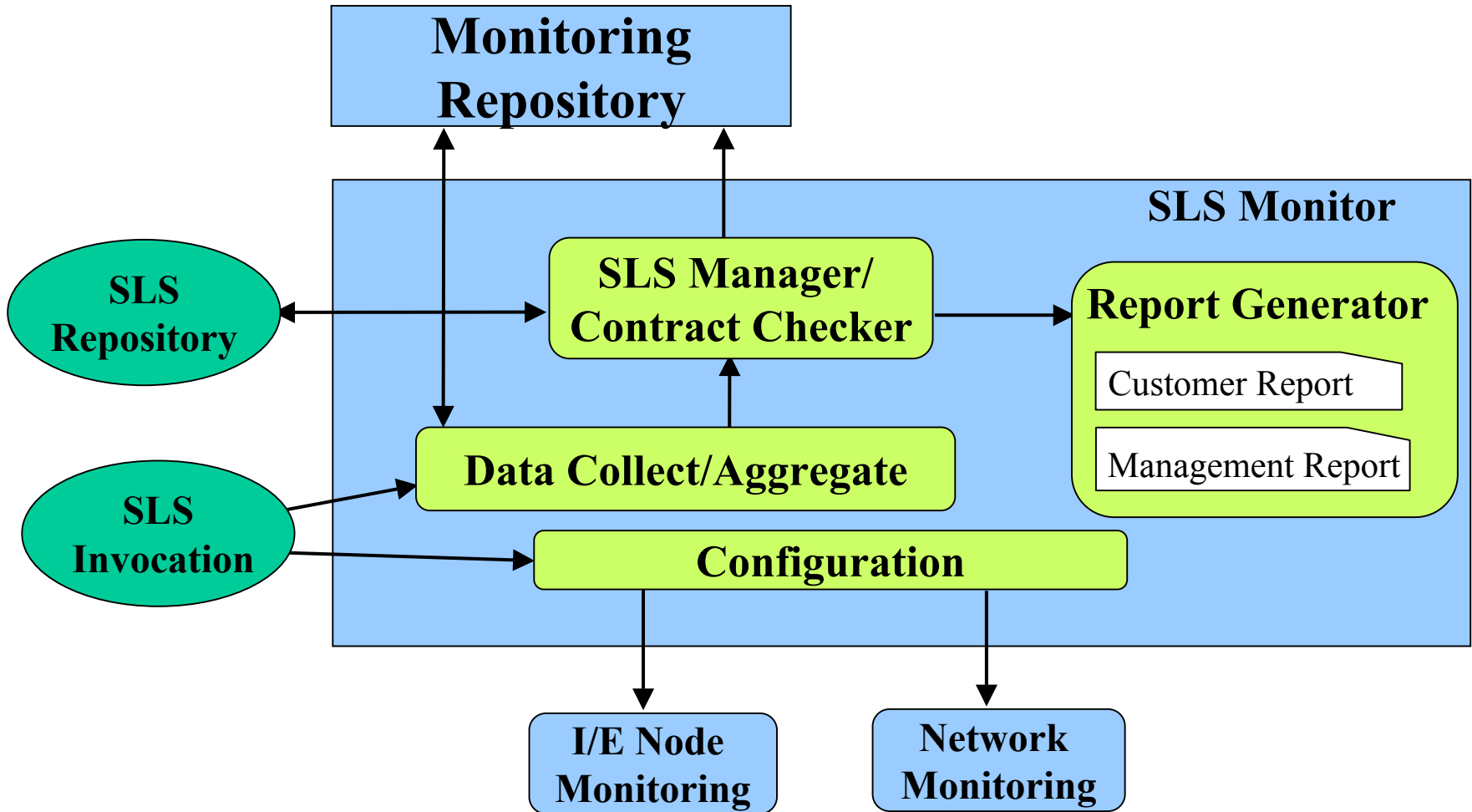
# SLS Monitoring

---

- **In-service verification of customer services**
- **Provides SLS usage information to Traffic Forecasting**
- **SLS Monitoring is a client of Network Monitoring**
- **SLS Monitoring is a centralised Component**
- **Relevant metrics**
  - **OneWayLoss**
  - **OneWayDelay**
  - **Throughput**
  - **Offered Load**



# SLS Monitoring



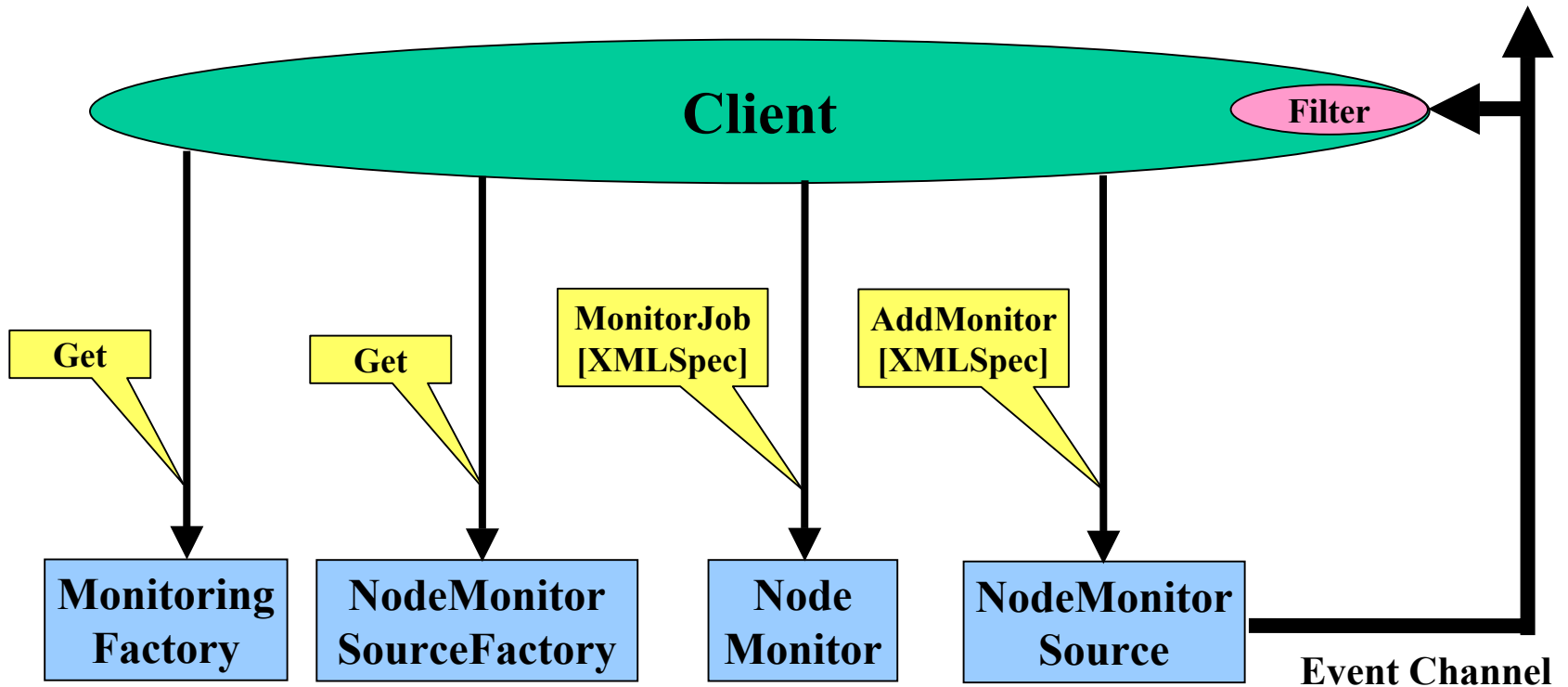




- **Common Interface for Node & Network Monitoring**
  - Register
  - Configure
  - Execute
  - Report Results
- A **Monitor** is created to measure a particular metric (e.g. throughput at a particular node).
- A **MonitorJob** is created to specify conditions (e.g. threshold crossings) under which notification events are generated.

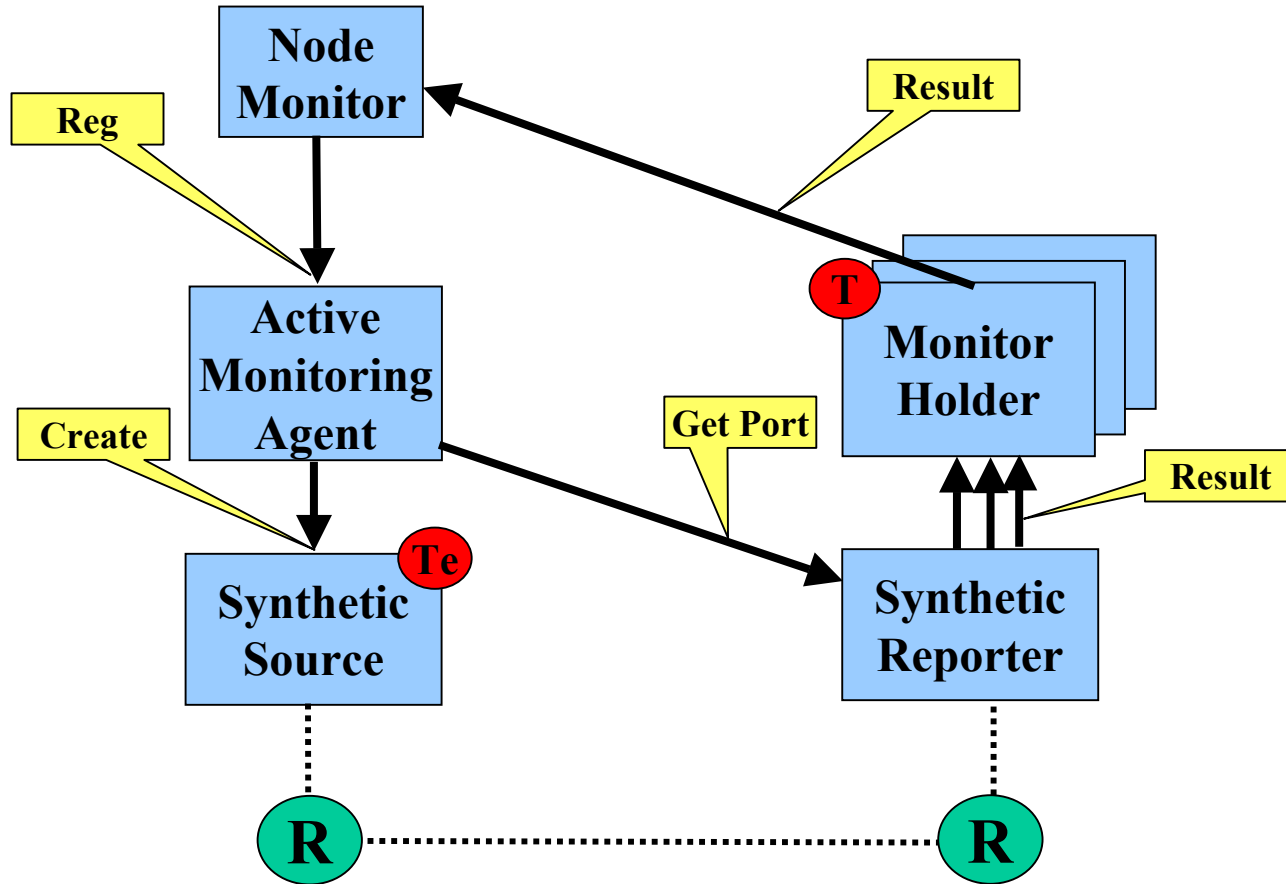


# Creating a Node Monitor





# Creating an Active Monitor





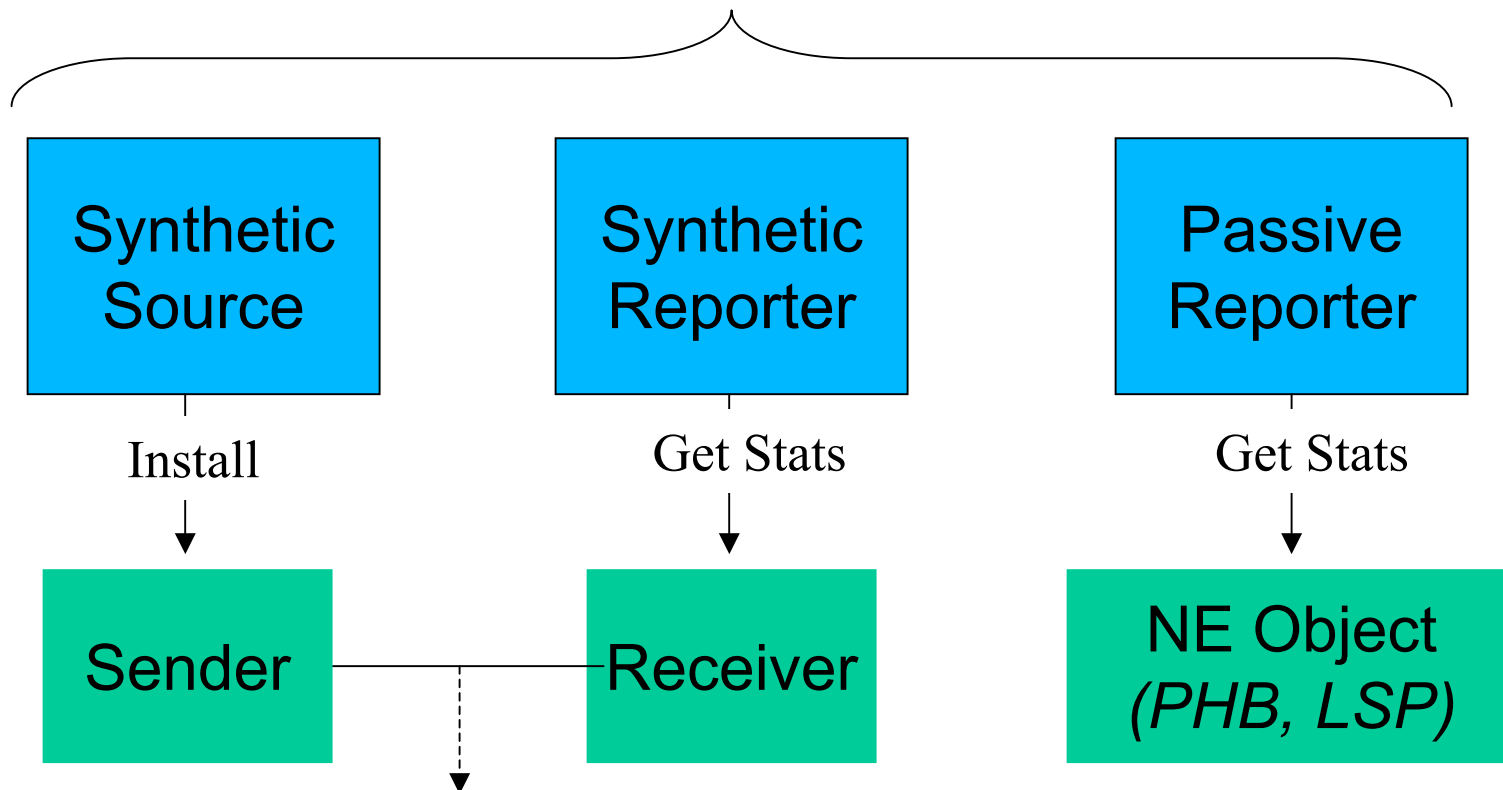
# Configuring Node Monitoring

---

- **State-of-the-art:**
  - **Passive Monitoring configured through SNMP, (emerging) COPS feedback reports, proprietary polling**
  - **Active Monitoring**
    - **Through signaling (One Way Delay Protocol)**
    - **“Top-Down”: through SNMP (emerging from IETF RMON wg)**
- **Tequila Approach: non-signaling**
  - **Same configuration methodology for active and passive**
  - **Extra features in OWDP-protocol (e.g. inter-domain related) are no requirement for intra-domain**
  - **Same configuration methodology as other low-level Tequila components (e.g. tunnel establishment and PHB configuration)**



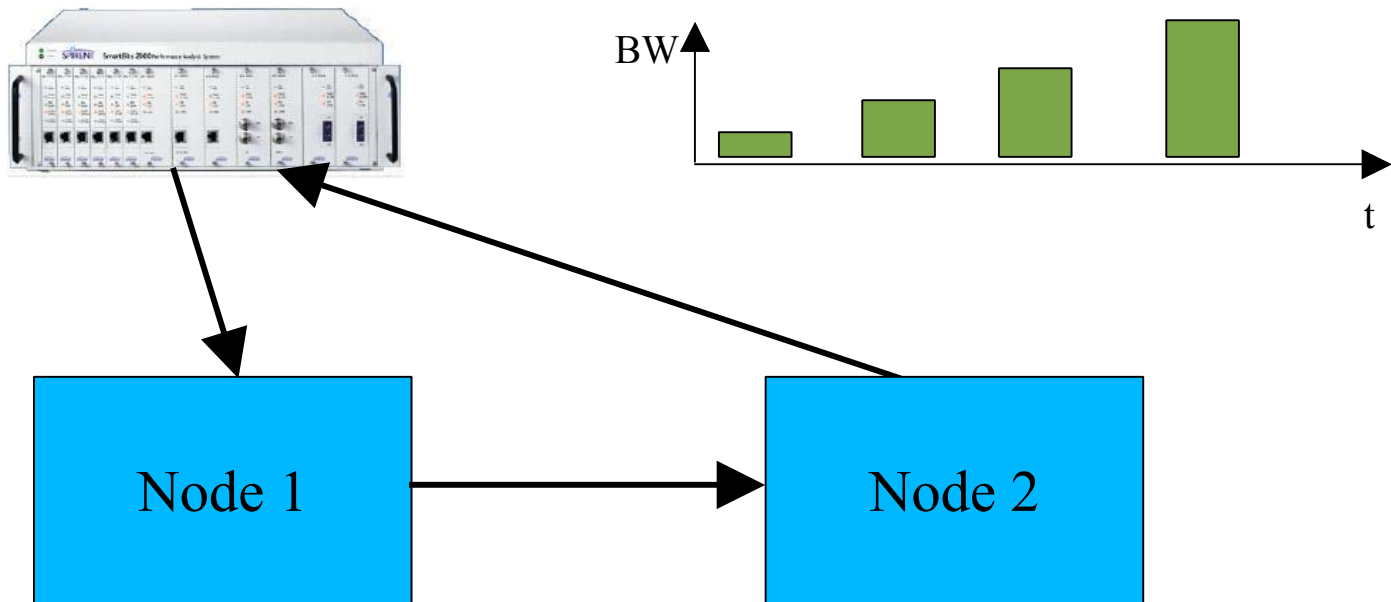
# Basic Entities

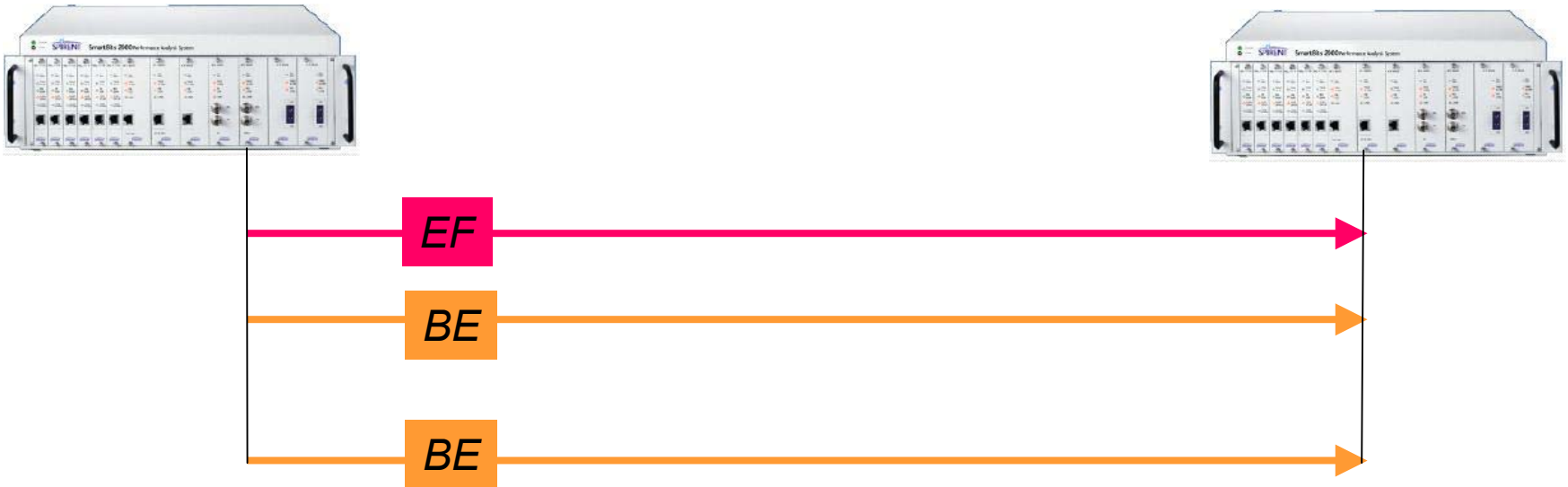


Connection determined by IP-addresses and  
Destination UDP address

## SmartBits:

- Generates traffic between 1 and 50 Mb/s (step 10Mb/s)
  - no congestion, just functional observation
- Test time: 60s per step

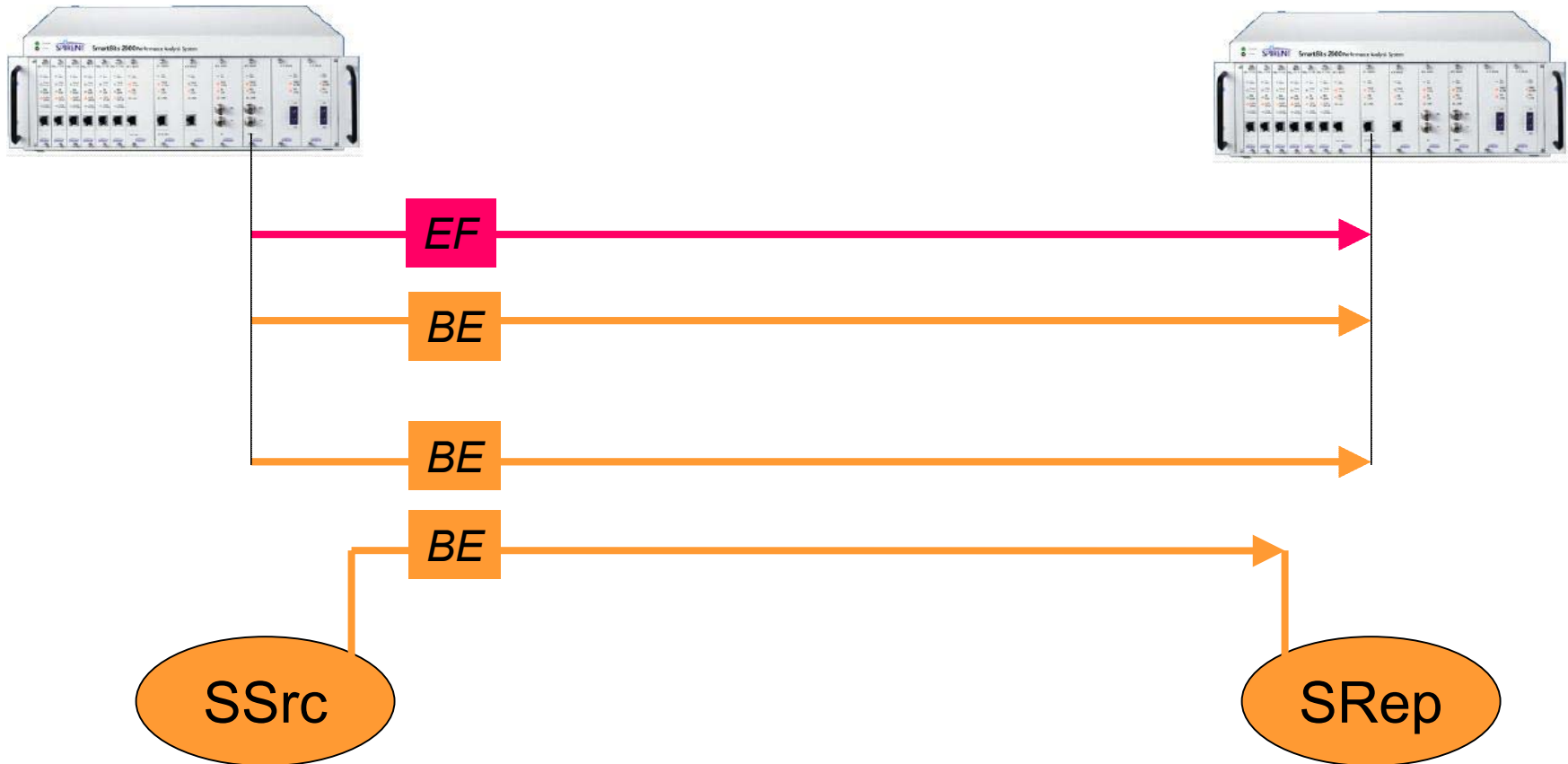




Divided into 3 Streams



# Active Measurement



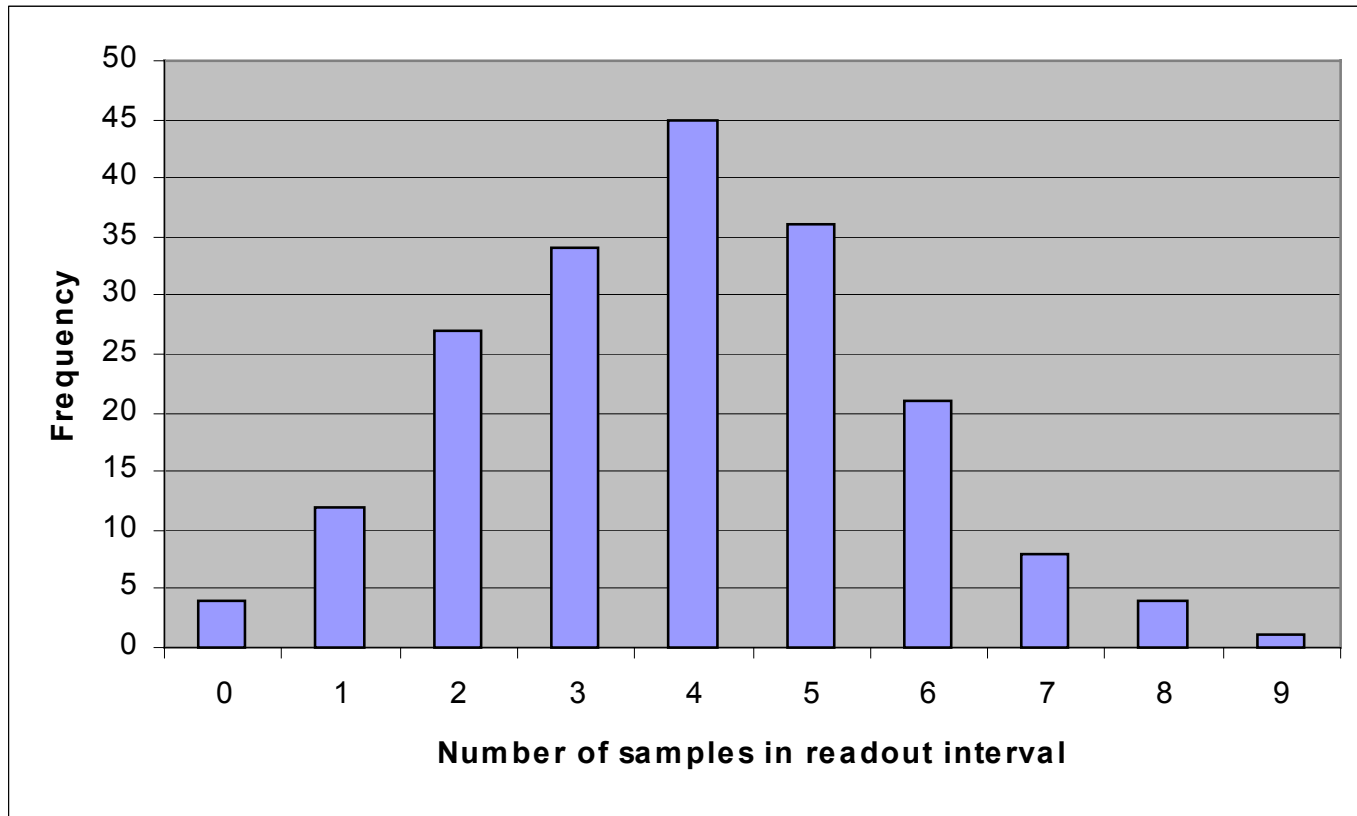
**2 packets/sec**

**Average Delay  
over 2 secs**





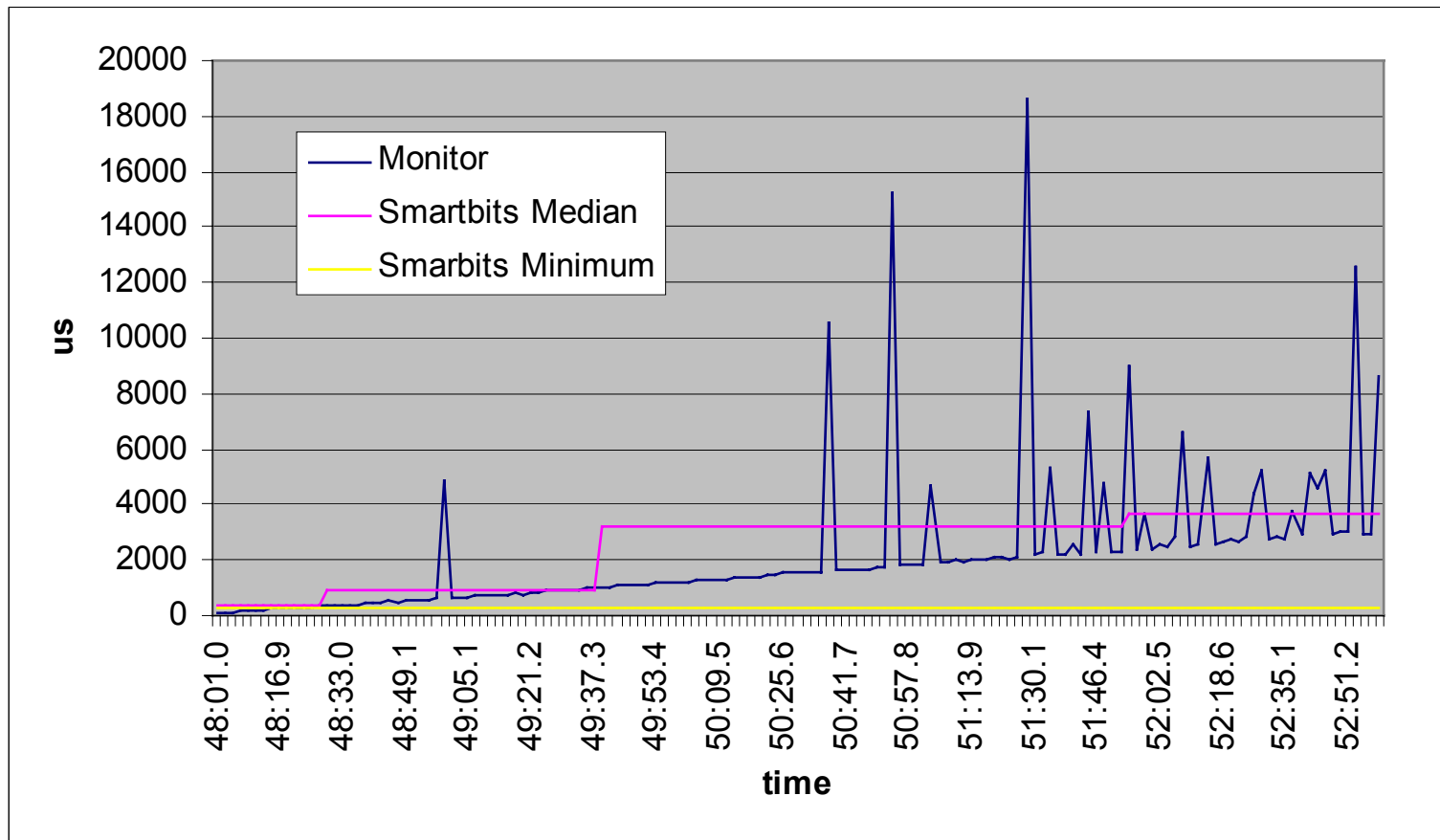
# Active Measurement



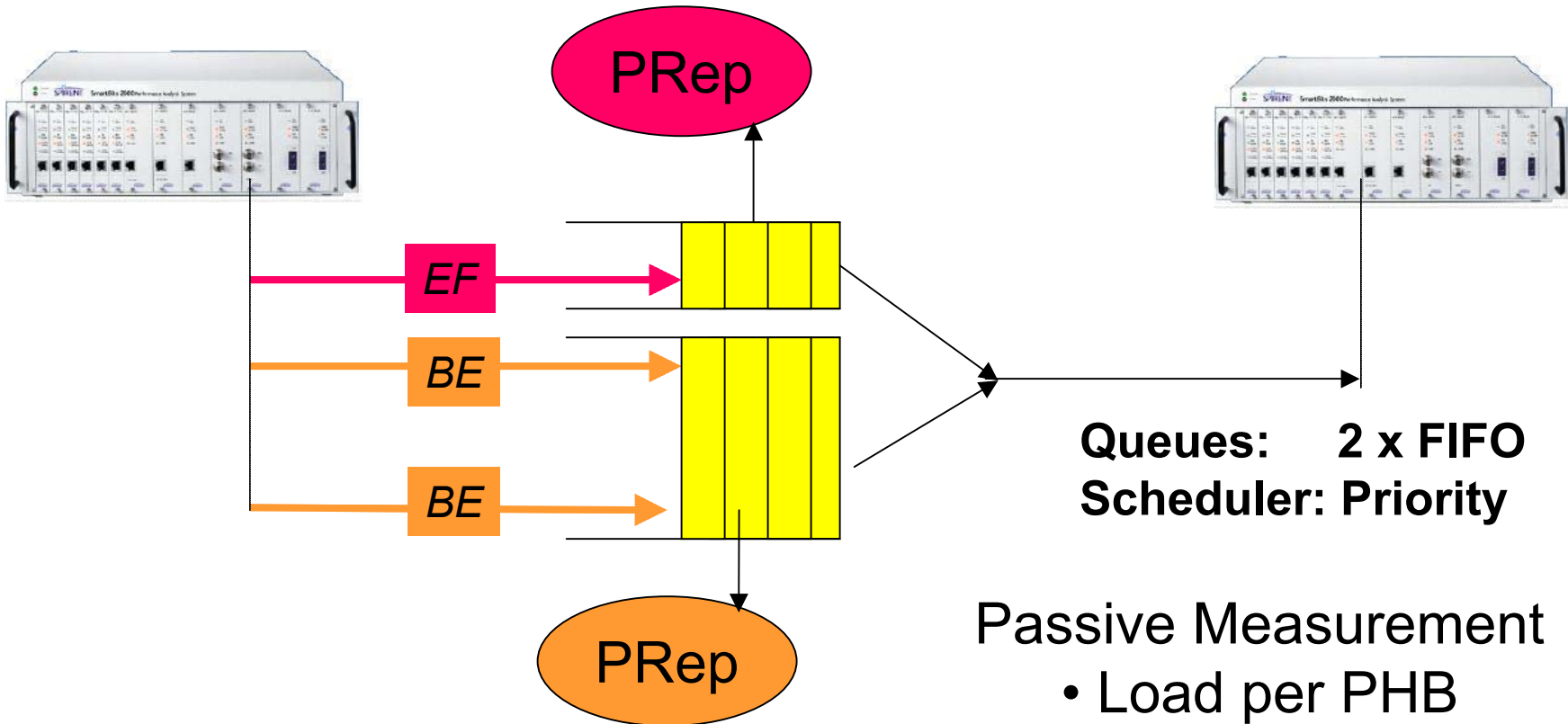
## Exponential Inter-arrival



# Active Measurement



# Passive Measurement

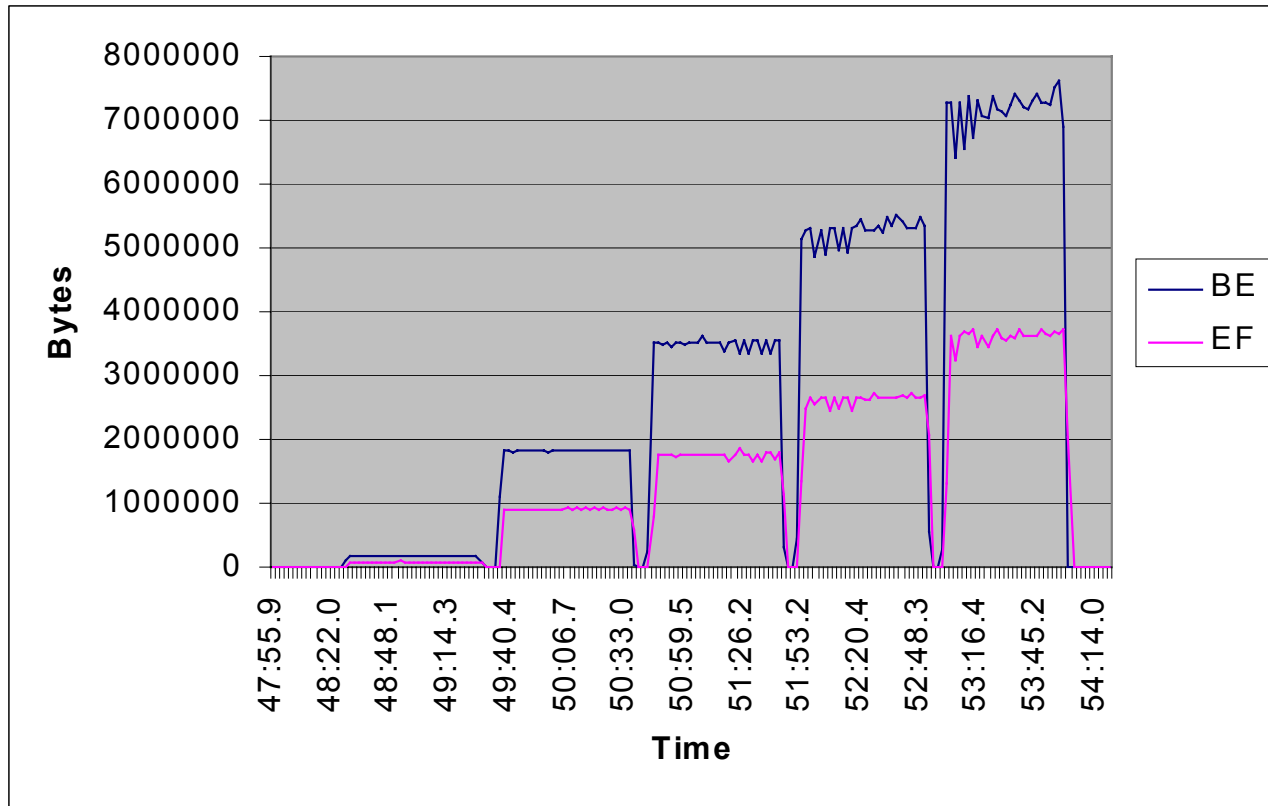


Passive Measurement

- Load per PHB
- Readout = 2 sec

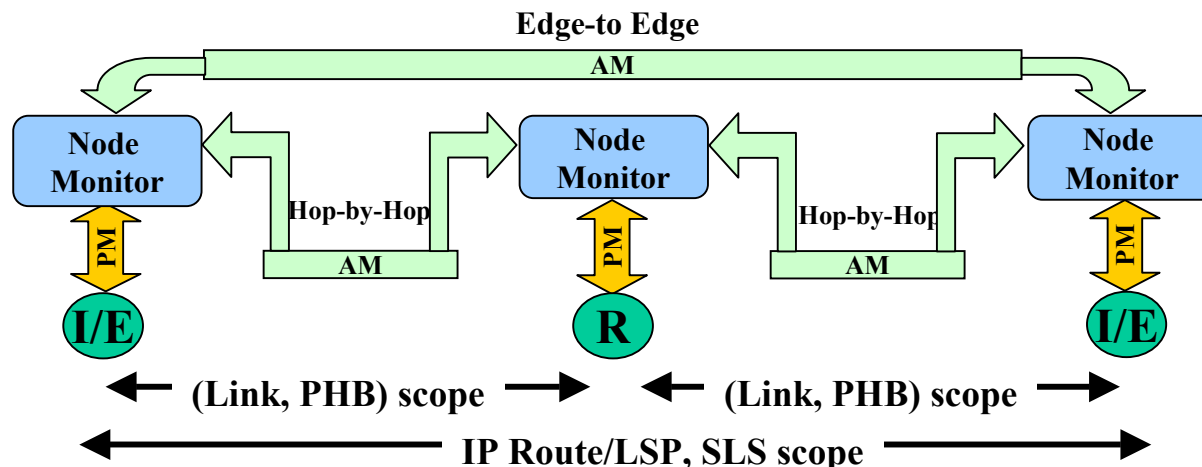


# Passive Measurement



**Final Ratio**    **BE : 66.63%**  
                          **EF: 33.37%**

- **SLS Monitor uses Network Aggregate Measurements**
  - Per LSP monitoring is more scalable than per SLS
  - Combine with per-SLS Ingress/Egress measurements
    - throughput / offered load
- **Use Hop by Hop Measurements**
  - Reduce volume of synthetic traffic
  - Aggregate hop measurements to get E2E measurement





# Scalability (2)

---

- **Distributed Probes**
  - Event notification
  - Client interface enables shared use of probes
  - (near) Real time response time



# Observations

---

- **Intra-domain only**
  - Sufficient for most business services (VPN, VLL...)
  - OWDP Control Signalling not needed
- **Access Network not addressed**
  - a limitation as AN adds delay and loss
  - out of scope for TEQUILA
- **Node Monitor Agents not integrated in routers**
- **Burden on Ingress/Egress routers**



# Publications

---

- **A Monitoring and Measurement Architecture for Traffic Engineered IP Networks**
  - IST 2001, Tehran, Sept 1-3, 2001
- **A Framework for Internet Traffic Engineering Measurement**
  - <draft-ietf-tewg-measure-01.txt>
  - Official TE WG document
  - Last version before 'Final Call' for Informational RFC





# Conclusions

---

- **Solution for**
  - Dynamic TE
  - SLS Monitoring
- **Design Features**
  - Common interface for Node & Network Monitoring
  - Common configuration approach for Active & Passive Agents
  - Separation of Monitor & MonitorJob
- **Scalability Features**
  - Flexible SLS Monitoring based on E2E or Hop by Hop
  - Network Monitoring based on event notification