

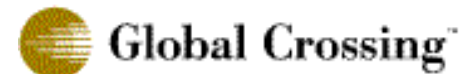


QoS Aware Monitoring & Measurement

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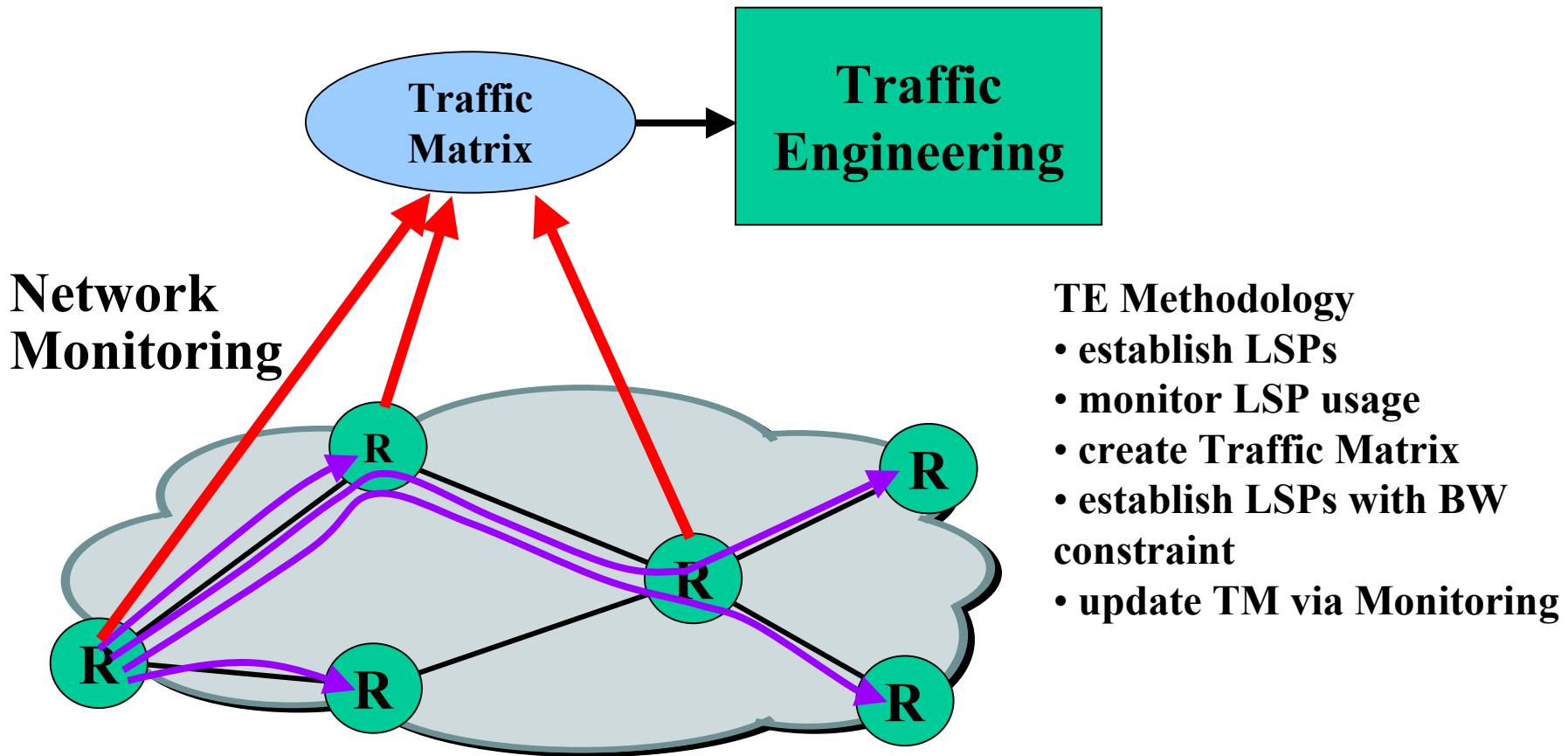




Presentation Outline

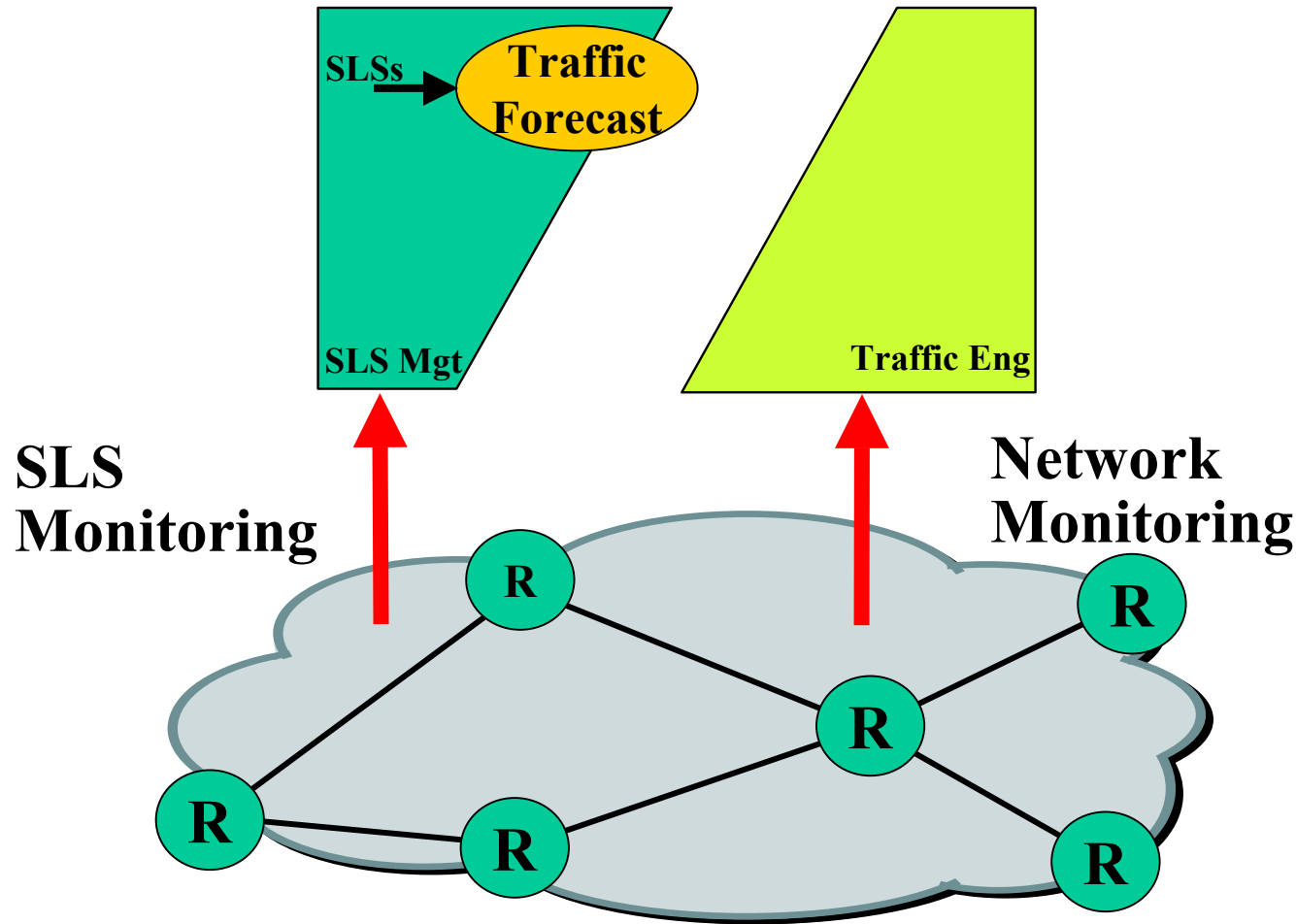
- **Role of Monitoring**
- **Architecture**
- **Design**
- **Results**
- **Scalability Features**
- **Outcomes**
- **Conclusions**

Role of Monitoring - Current





Role of Monitoring - TEQUILA



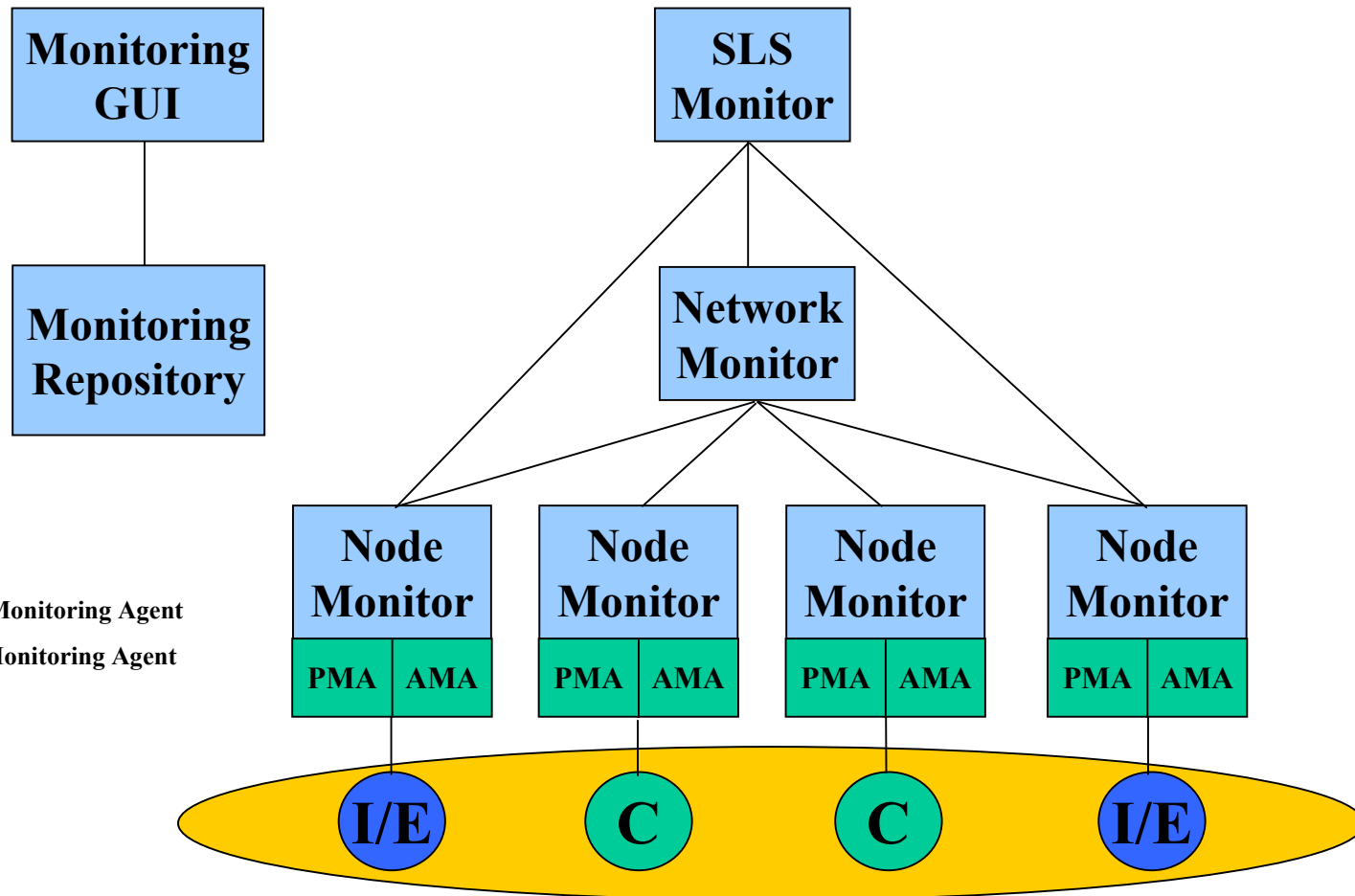


Network Monitoring

- **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

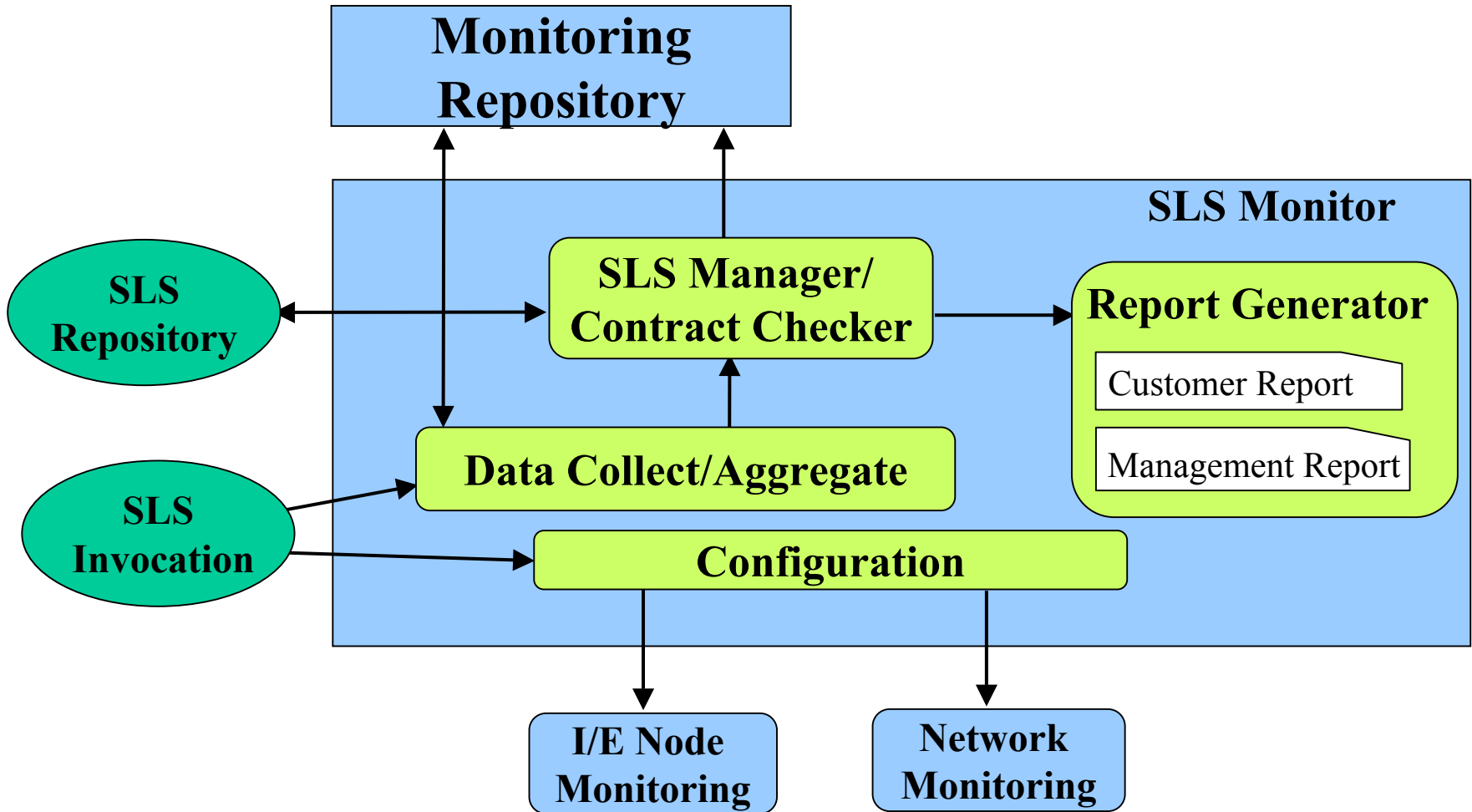


SLS Monitoring

- **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

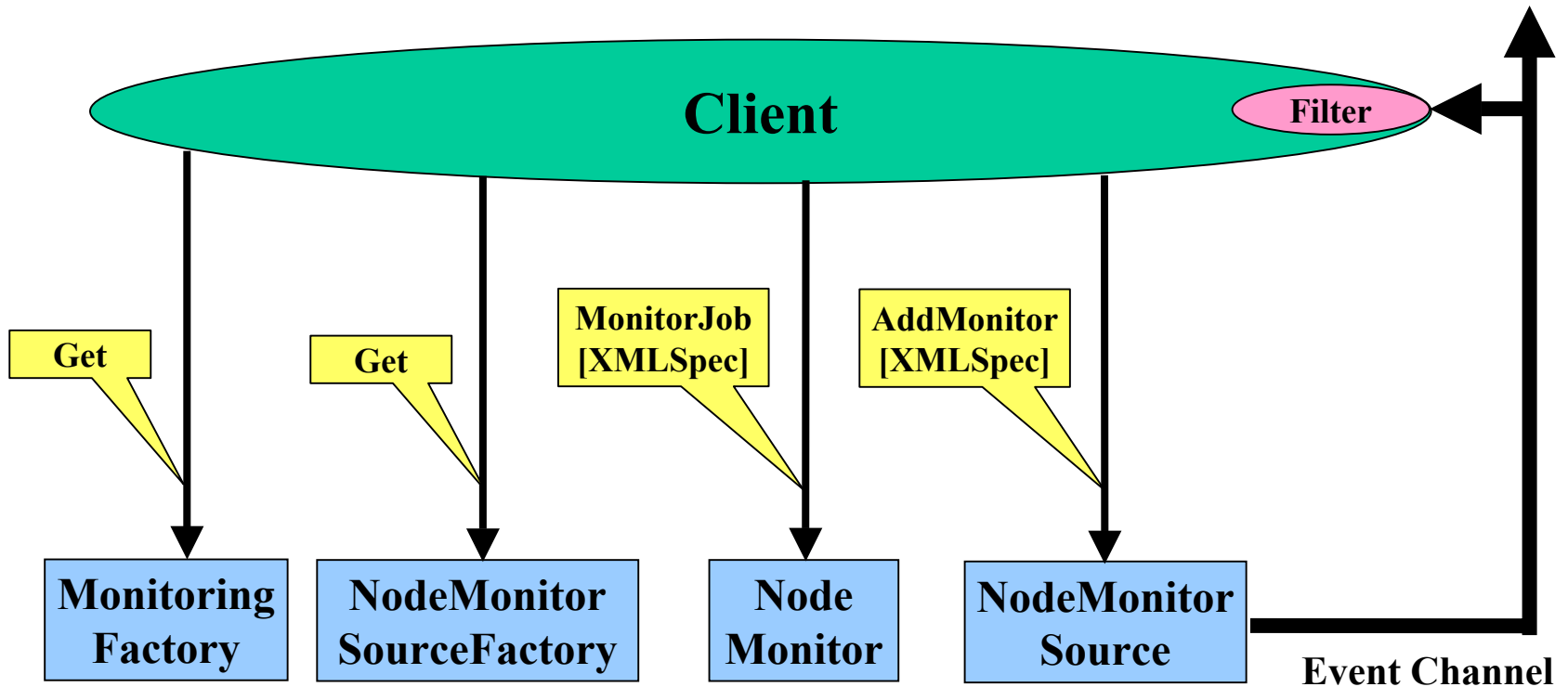




- **Common Interface for Node & Network Monitoring**
 - Register
 - Configure
 - Execute
 - Report Results
- A **Monitor** is created to measure a particular metric (e.g. throughput at a particular node).
- A **MonitorJob** is created to specify conditions (e.g. threshold crossings) under which notification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

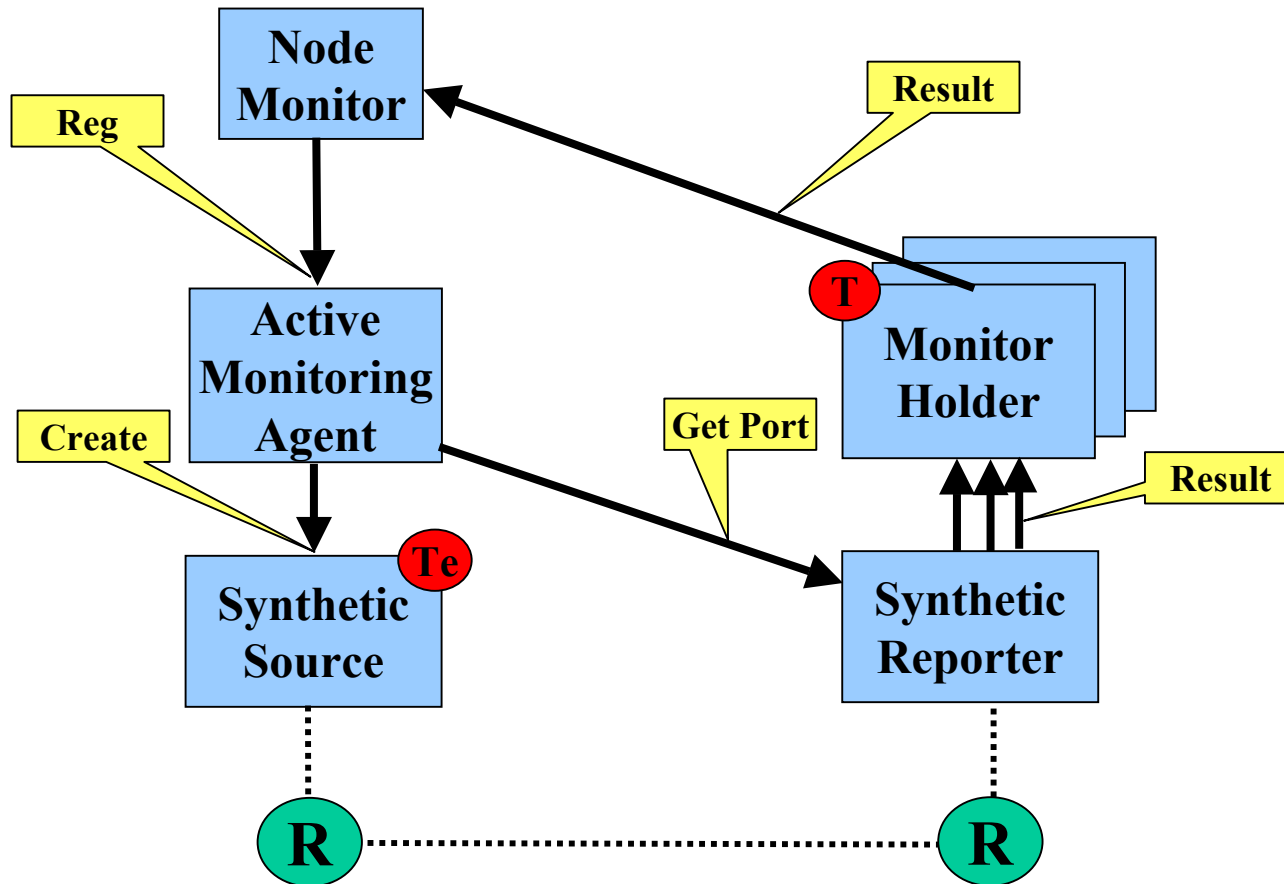


Creating a Node Monitor





Creating an Active Monitor



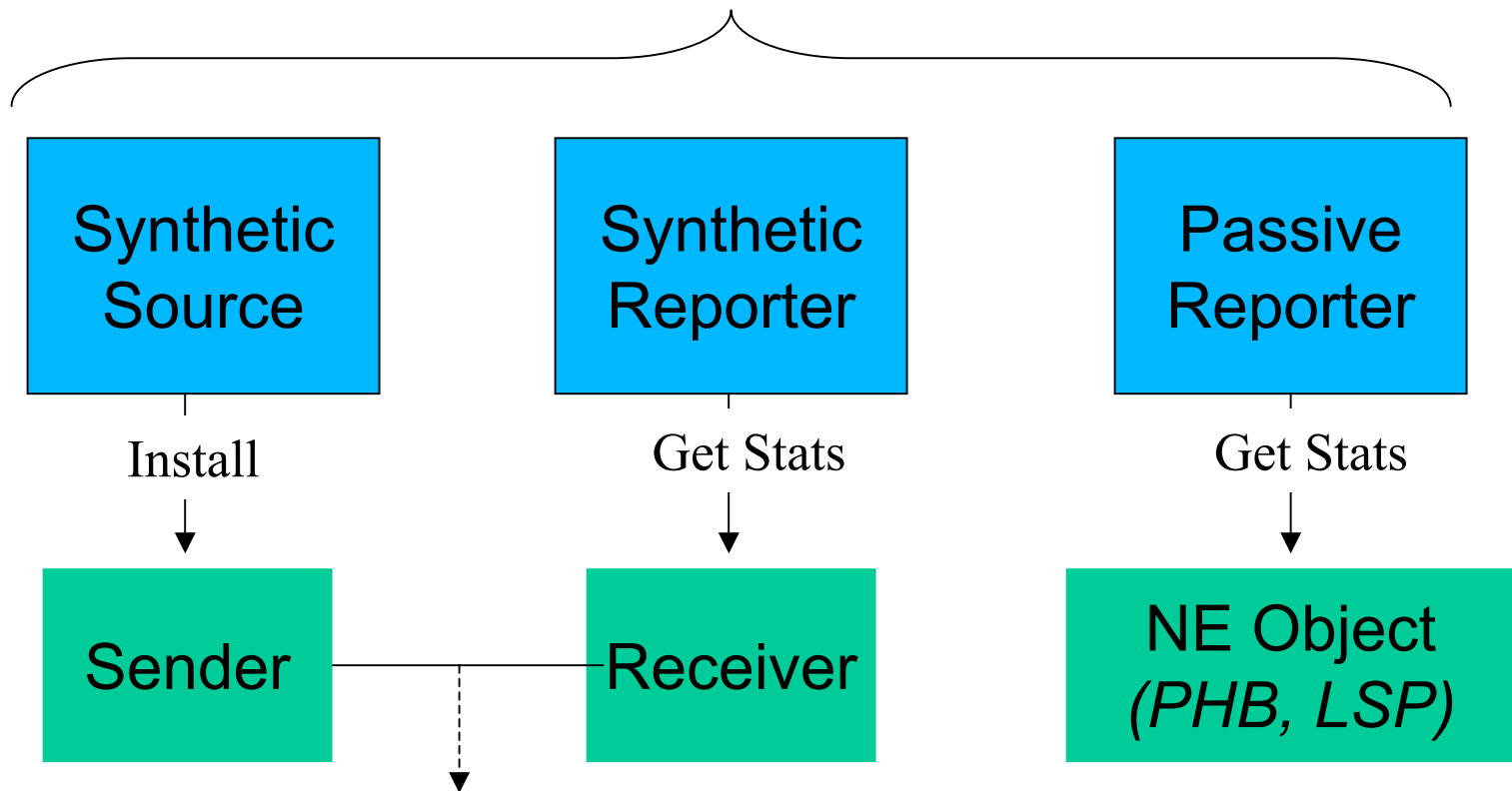


Configuring Node Monitoring

- **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)**



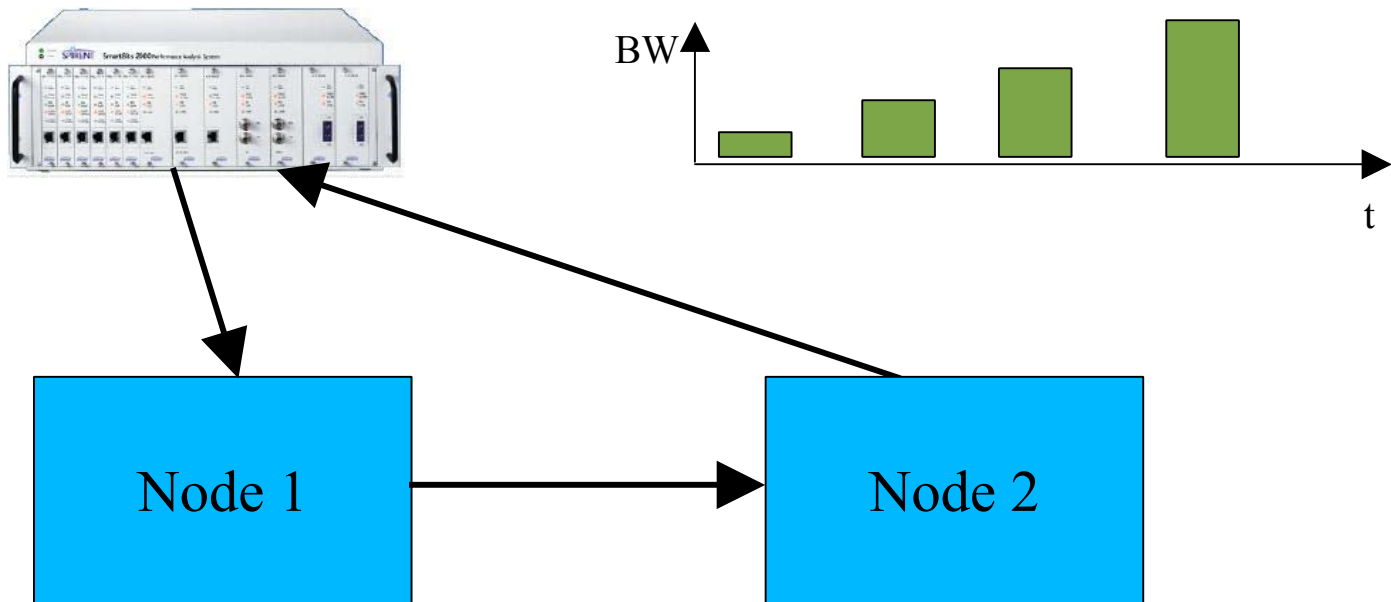
Basic Entities

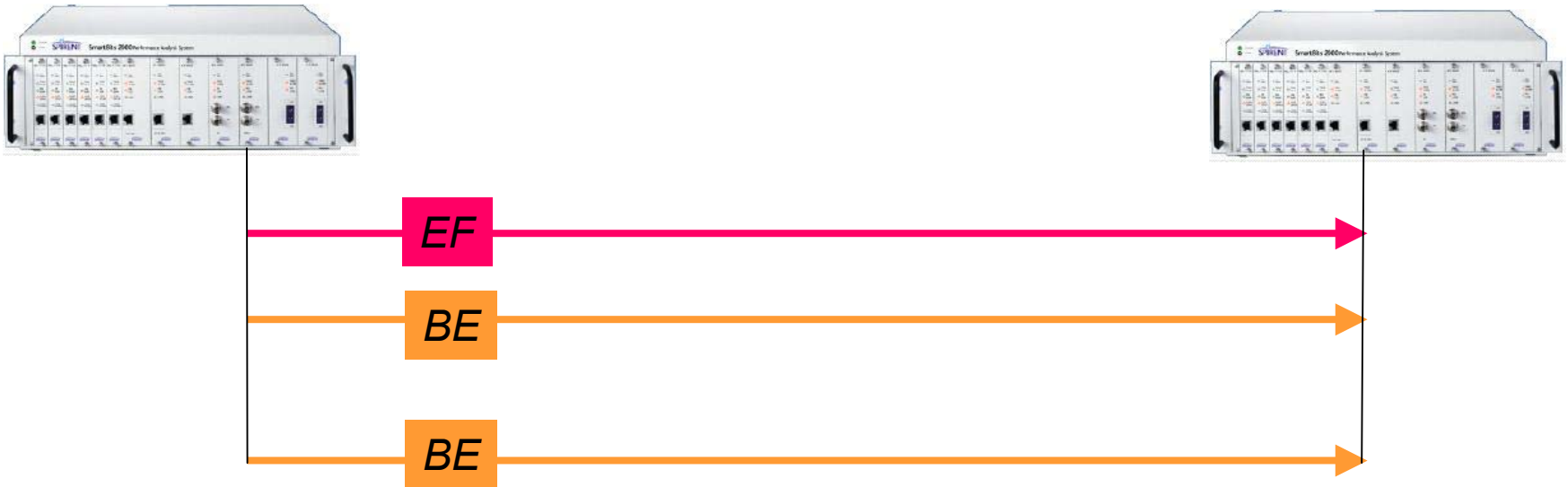


Connection determined by IP-addresses and
Destination UDP address

SmartBits:

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

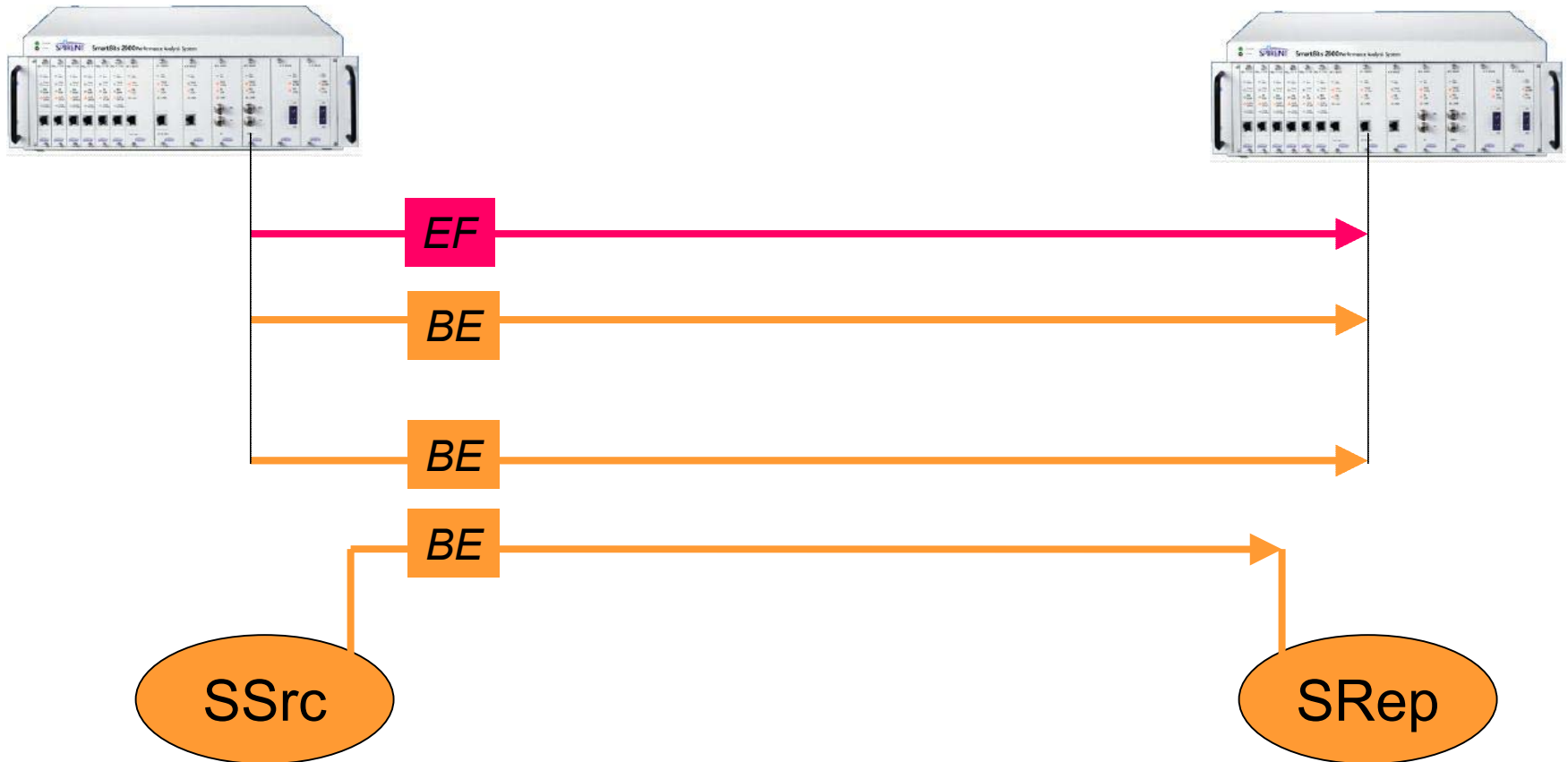




Divided into 3 Streams



Active Measurement

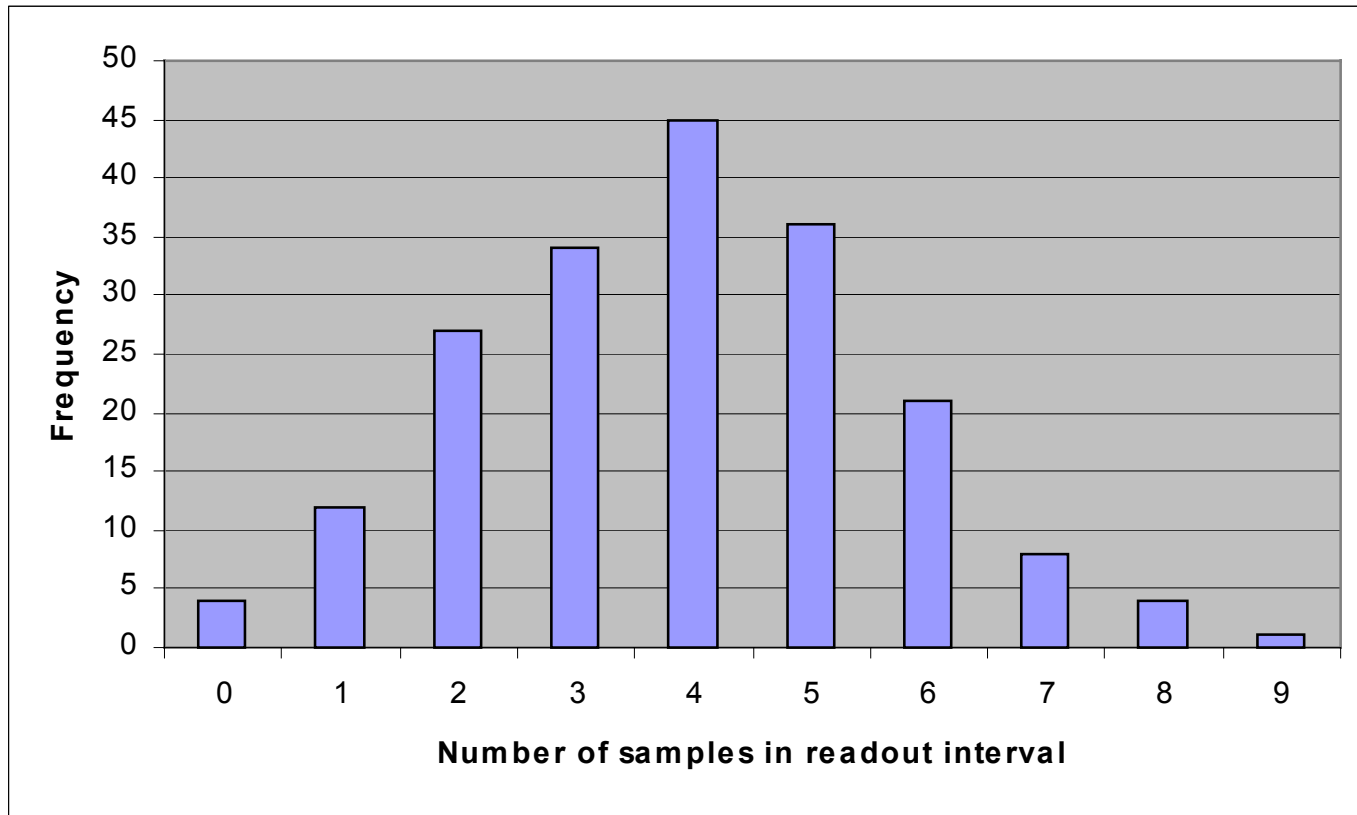


2 packets/sec

**Average Delay
over 2 secs**



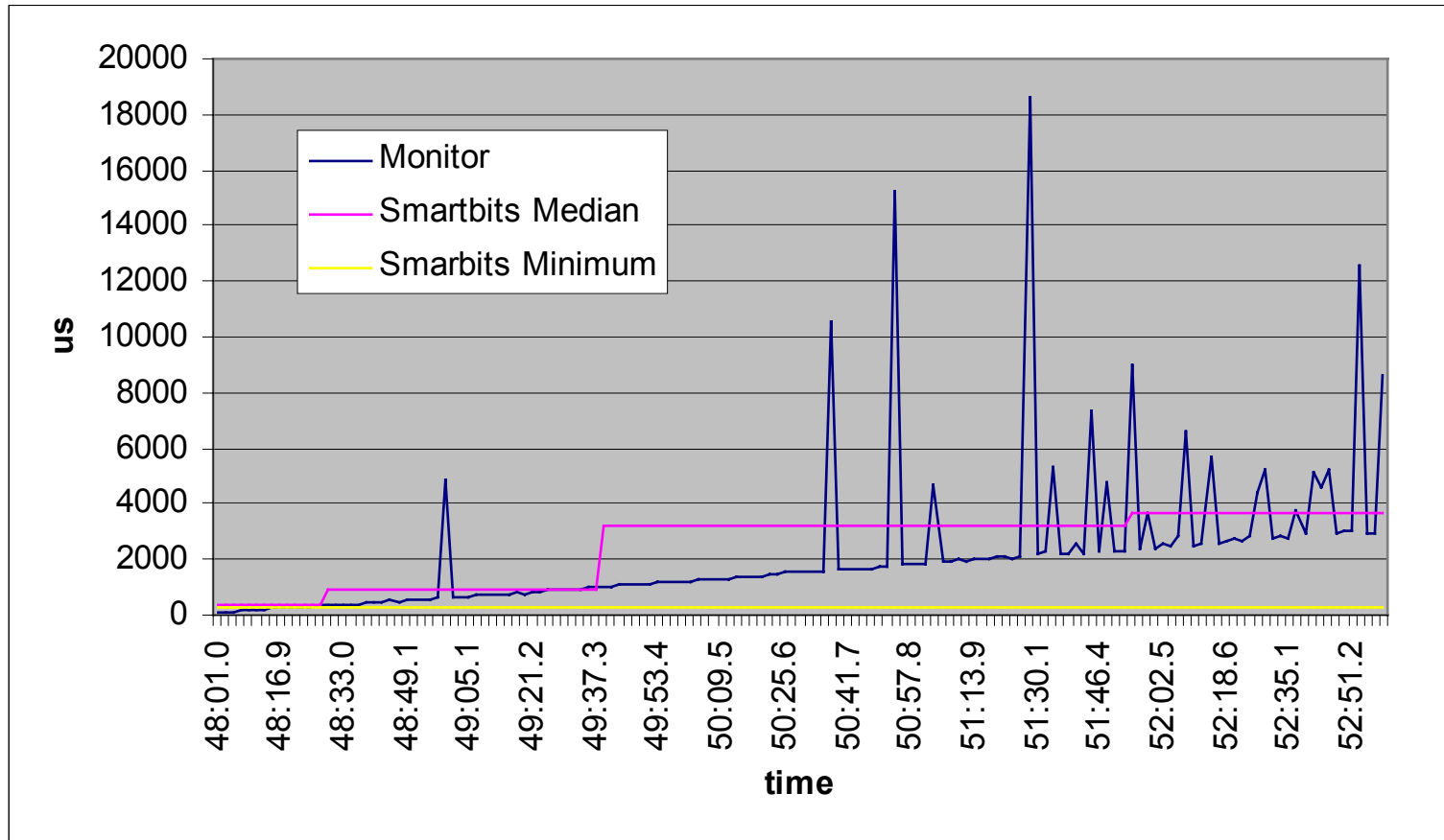
Active Measurement



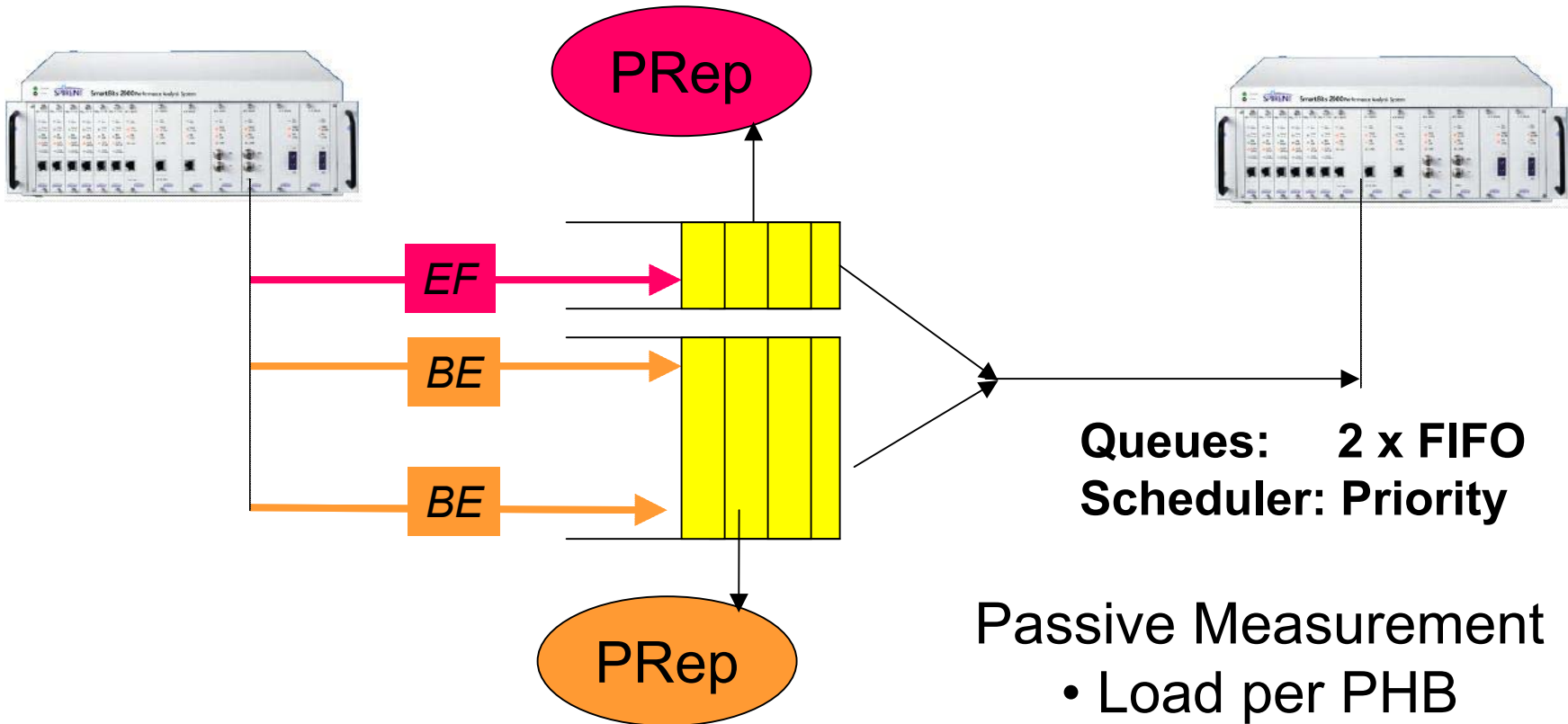
Exponential Inter-arrival



Active Measurement



Passive Measurement

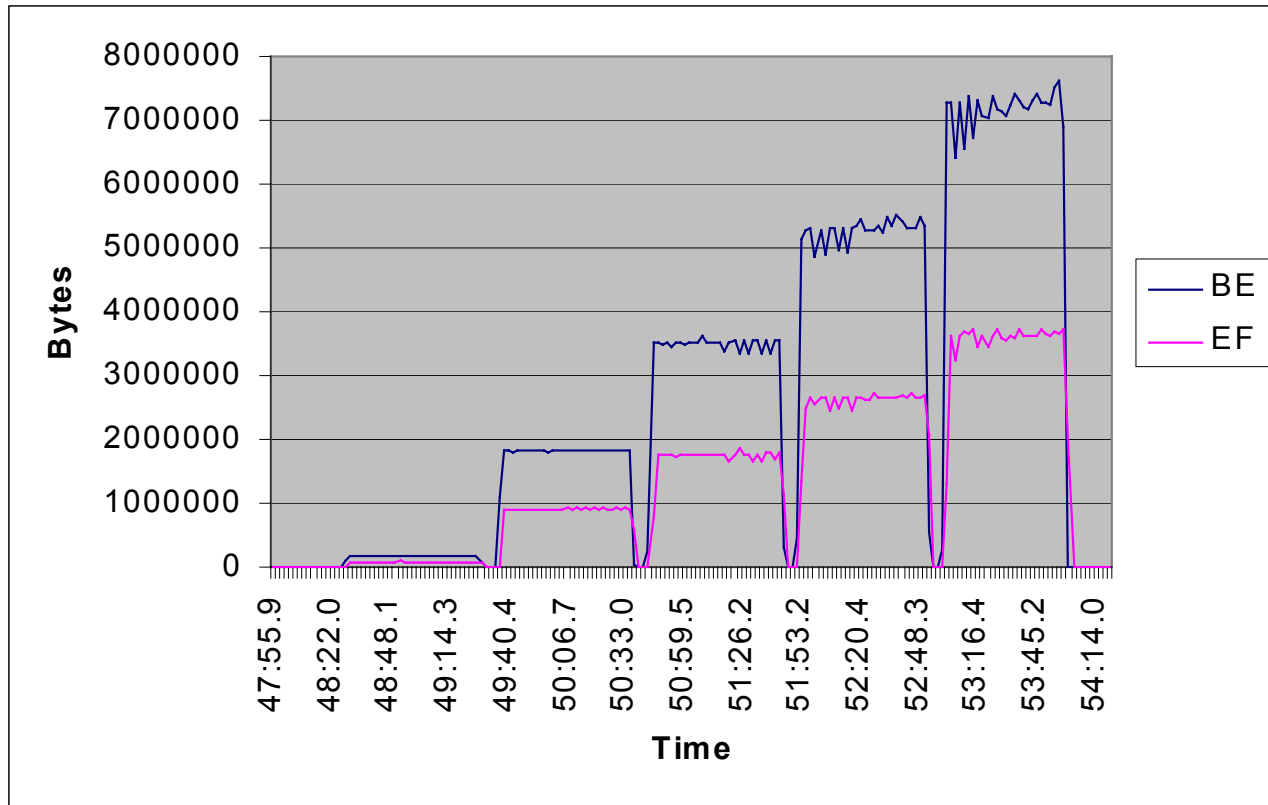


Passive Measurement

- Load per PHB
- Readout = 2 sec

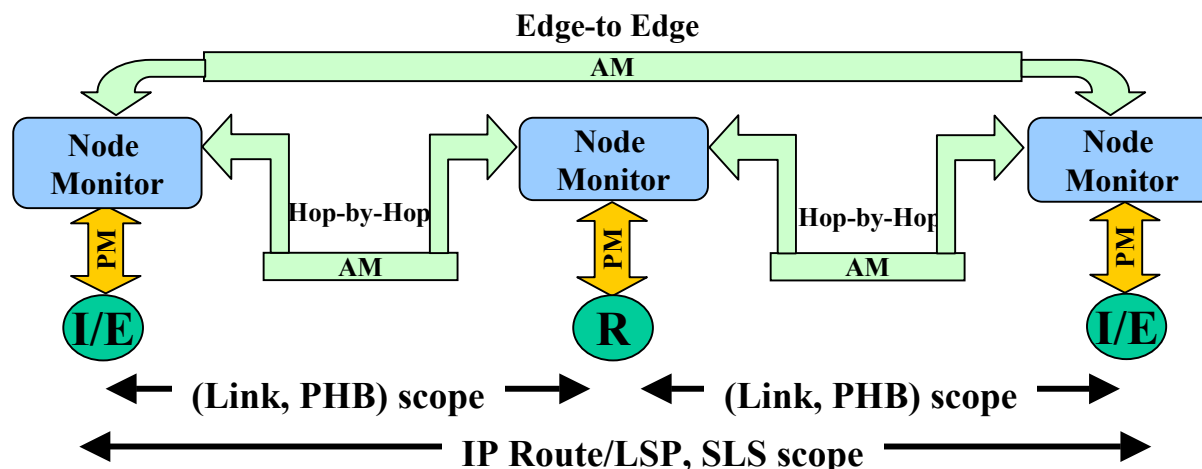


Passive Measurement



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