



# A Unified Model for Bandwidth Adaptation in Next Generation Transport Networks

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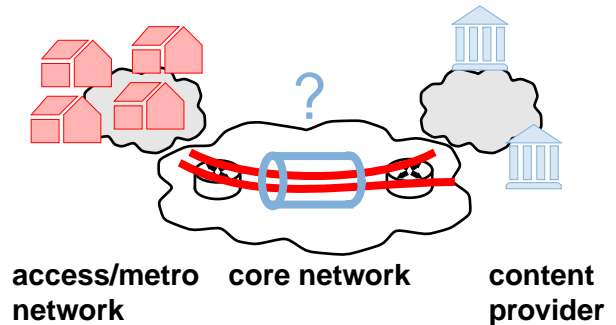
1st IEEE International Workshop on Bandwidth on Demand  
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# Motivation

## Emerging customer services

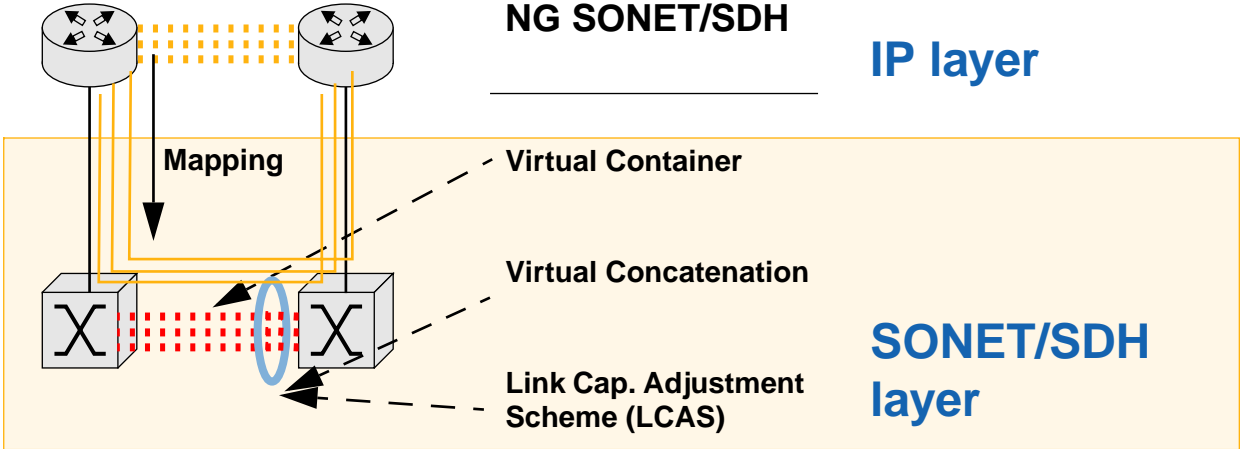
- **Bandwidth hungry multi-media applications (VoIP, HD video streaming)**
- **Rising user access bandwidth (e.g. DSL, Ethernet, FTTX)**
- ➔ **QoS support**
- ➔ **Burstiness moves from access to core network**
- ➔ **Traffic demands are unpredictable in time and space**



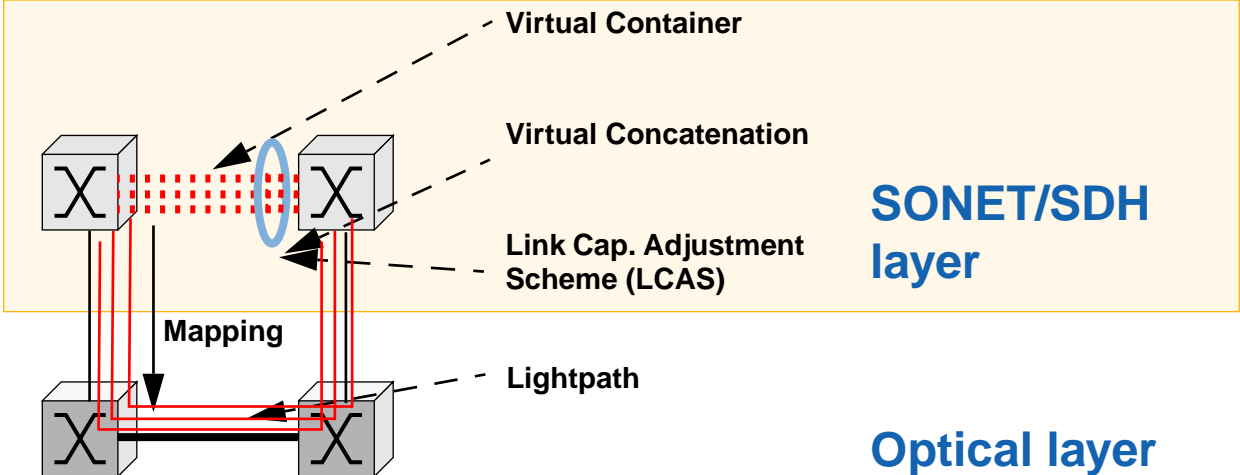
## Measurement-based bandwidth control

- ➔ **Unified Bandwidth Adaptation Model**
  - Independent of underlying transport technology
  - QoS Differentiation
- ➔ **Performance evaluation**

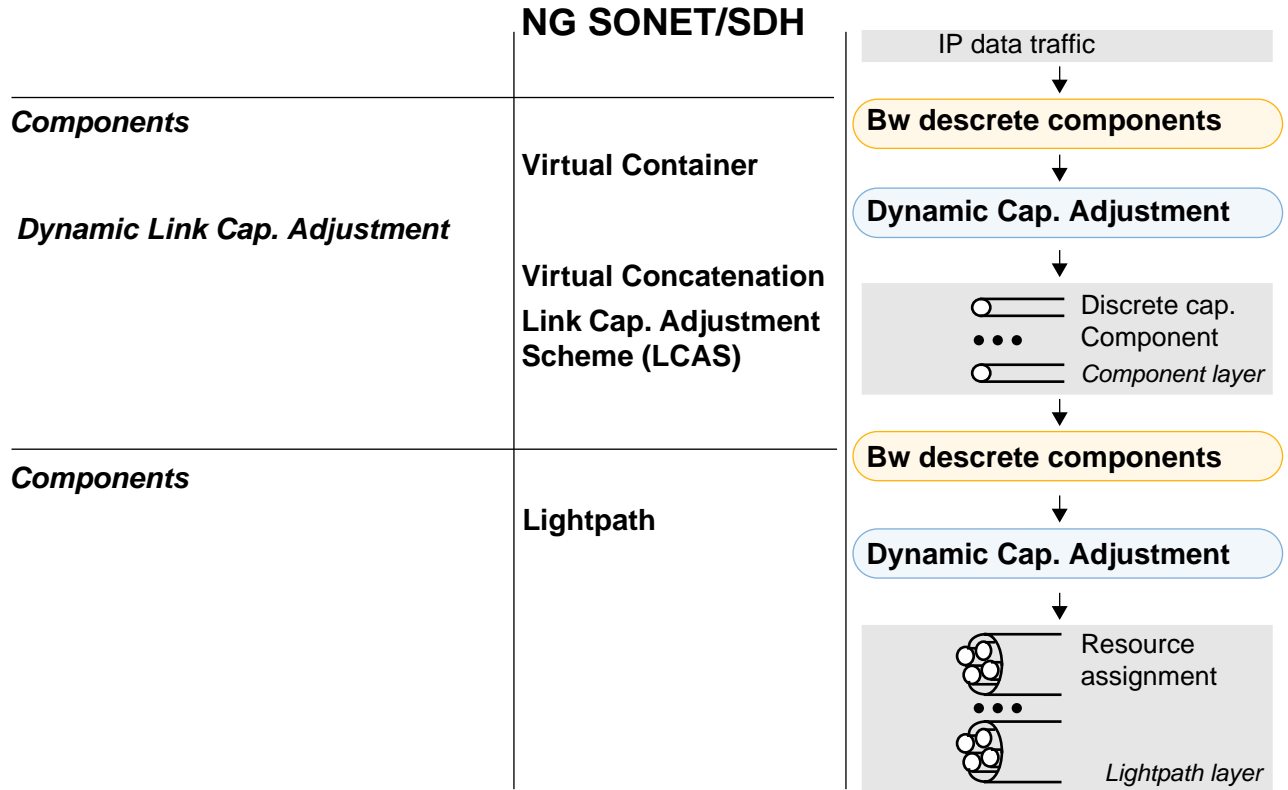
# Network Architecture



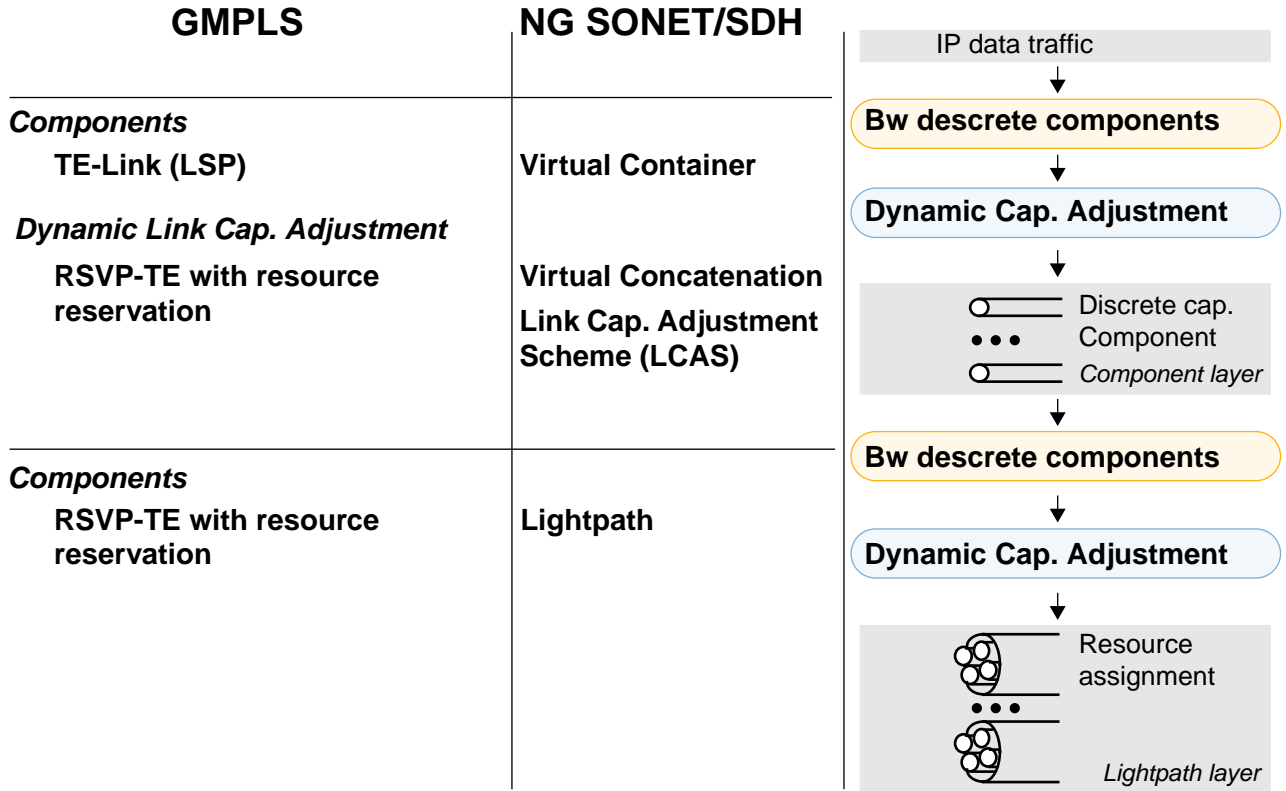
# Network Architecture



# Unified Adaptation Model



# Unified Adaptation Model



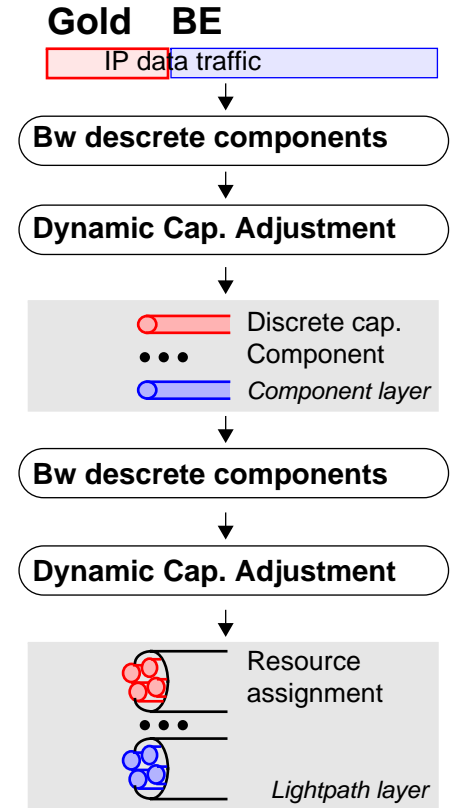
# Unified Adaptation Model

## Service Differentiation

- **Two service classes (Best Effort, Gold)**
- **Components are assigned one service class**
- **Gold class**
  - guaranteed bandwidth (at the expense of the BE class)
  - special protection service (dedicated resources)

## Dedicated resource assignment

- ➔ **A lightpath is assigned one service class**



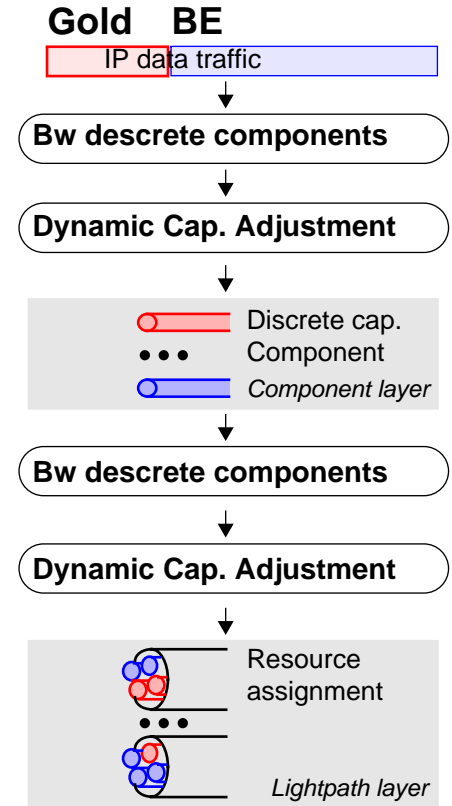
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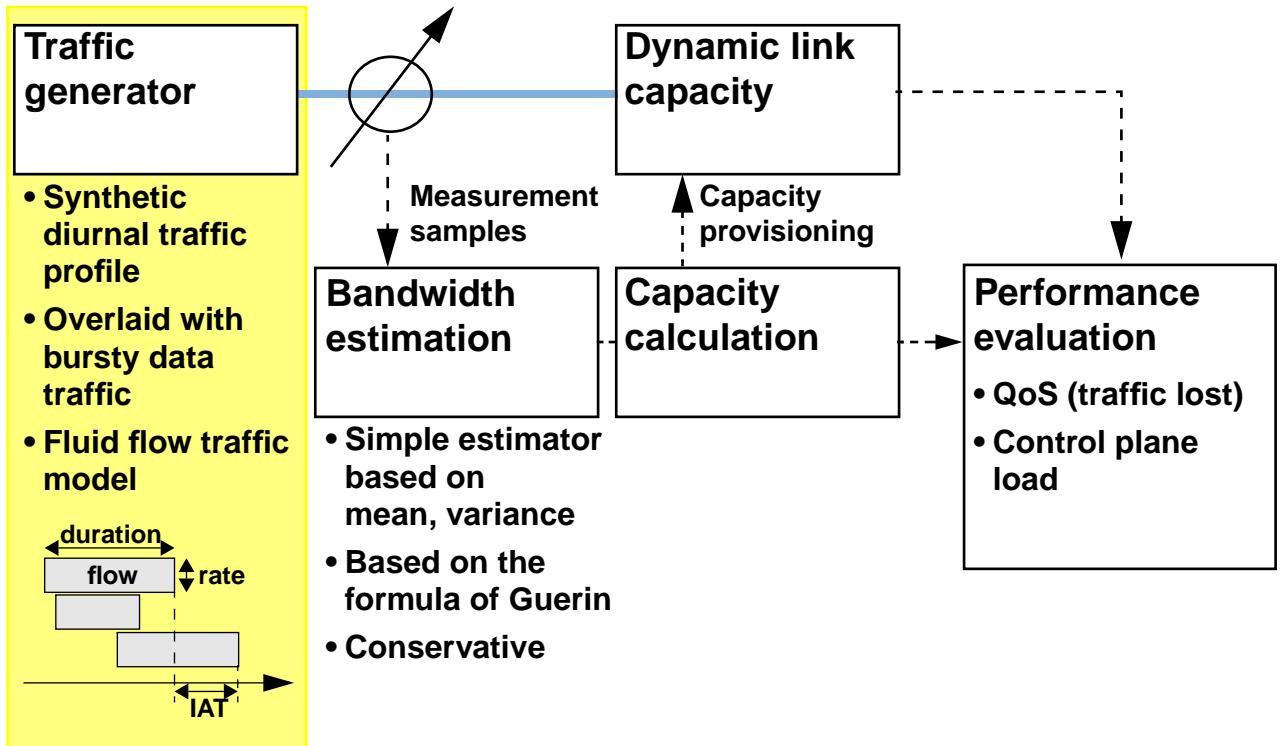
## Shared resource assignment

- ➔ **Components per lightpath are mixed**



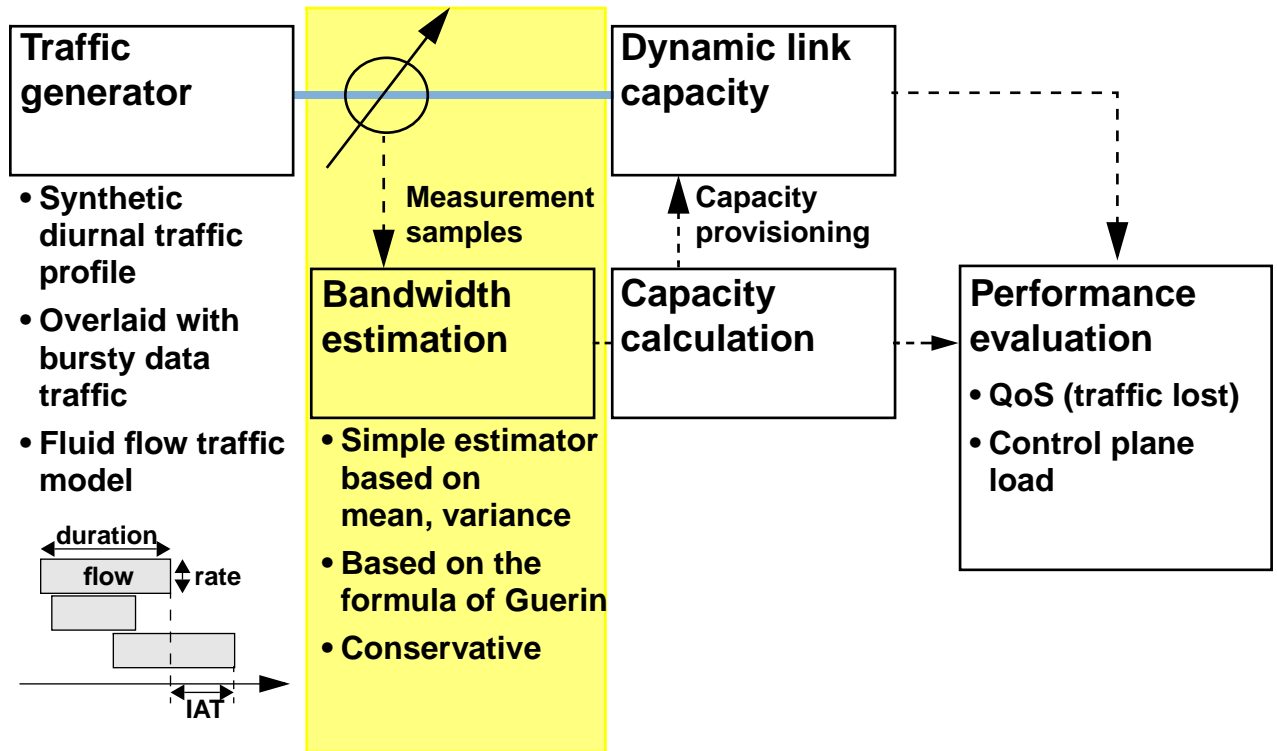
# Performance Evaluation

## Simulation Model



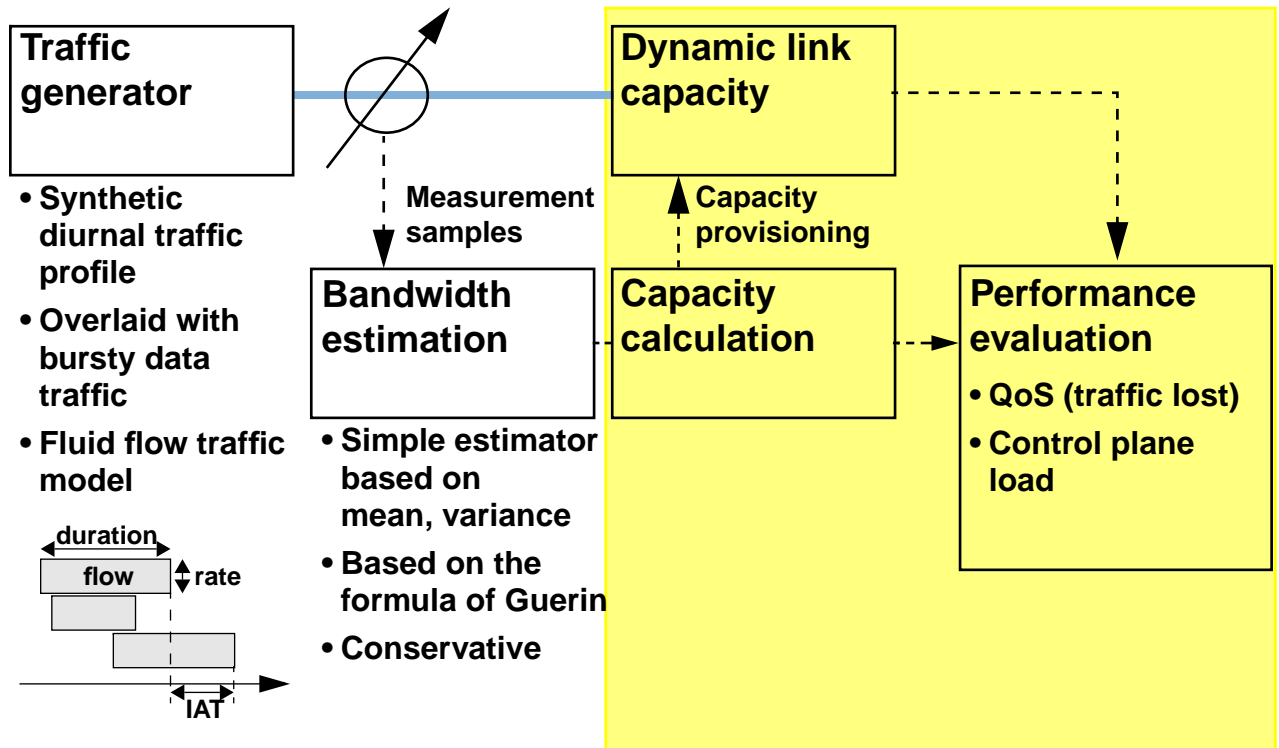
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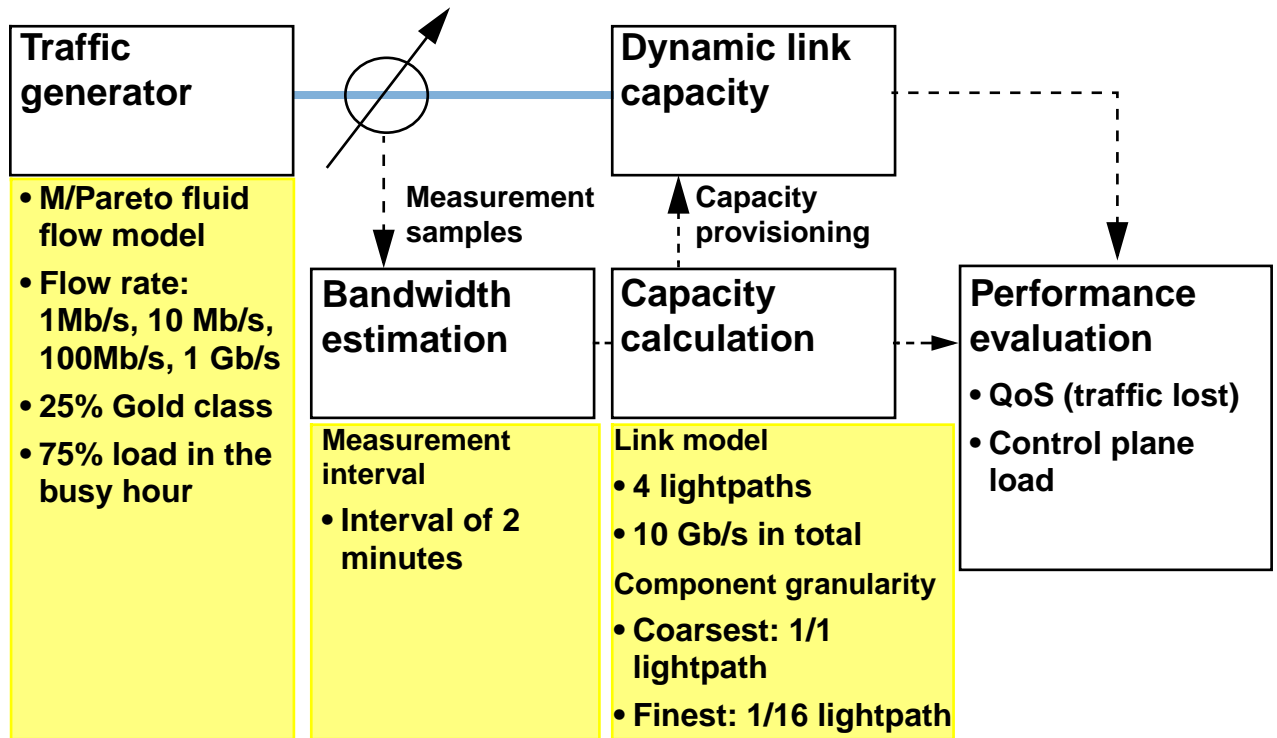
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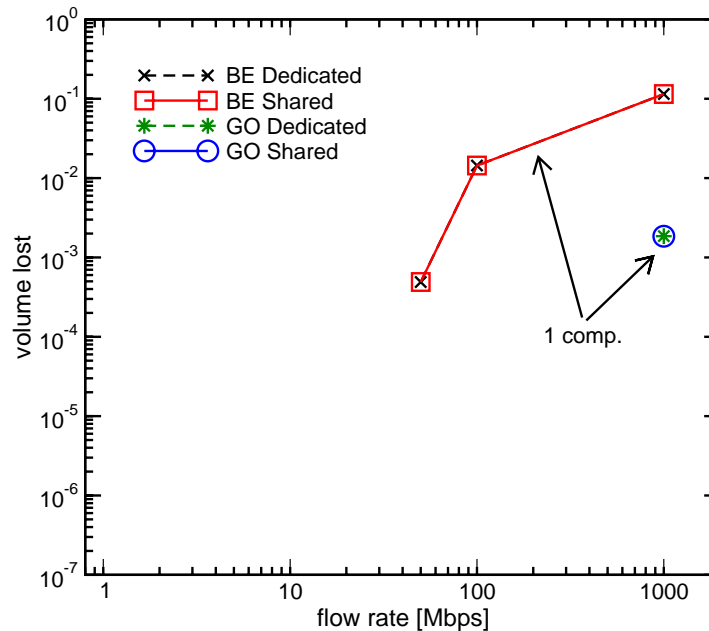
## Simulation Parameters



# Impact of increasing access rate

**Finest and  
coarsest  
granularity**

**Shared and  
dedicated  
resources**

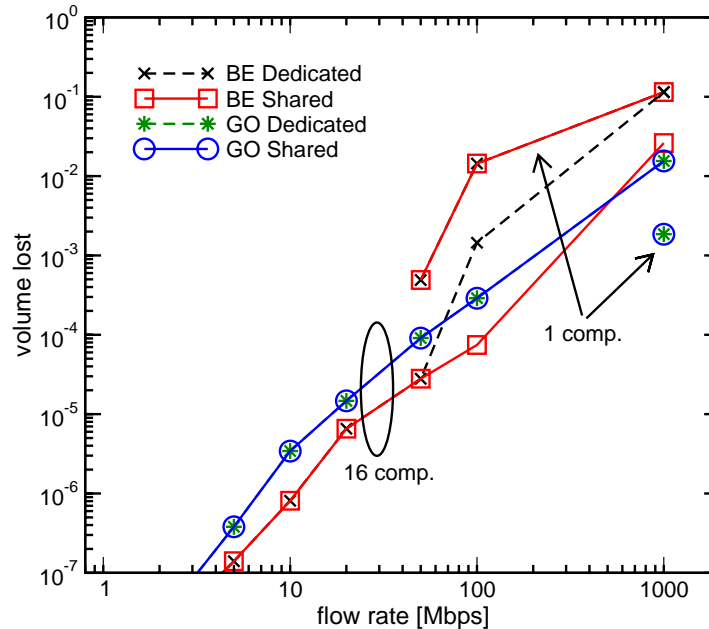


- **Shared and dedicated resource assignment collapse**
- **Gold class provides reasonable QoS and causes huge losses to BE**

# Impact of increasing access rate

**Finest and coarsest granularity**

**Shared and dedicated resources**

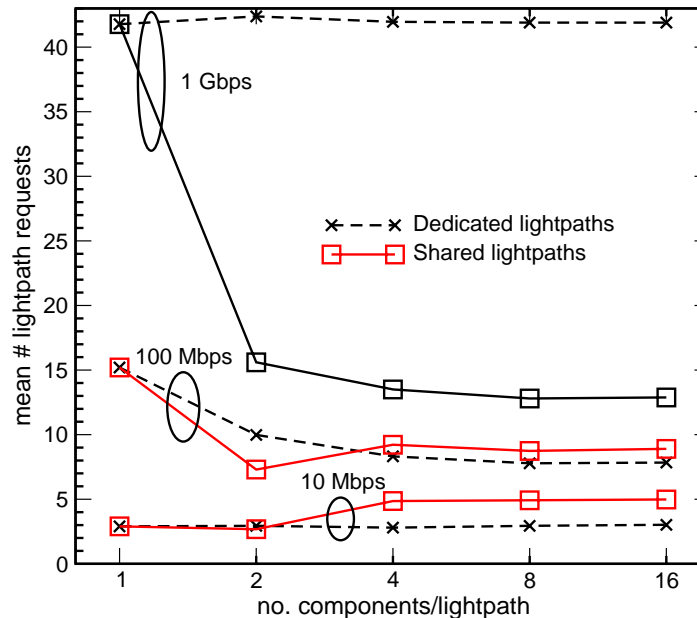


- **Estimation error also causes losses in low access rate scenarios**
- **Discrete bandwidth granularity and estimation error let Gold traffic loss exceed BE traffic loss**

# Impact on control plane load

**Decreasing  
component  
granularity**

**Increasing  
access rates**



- **Coarse granularity and bursty traffic requires high number of lightpath requests**
- **Shared and dedicated resources behave very similar, except in very bursty scenarios**

# Conclusion

- **Introduction of a unified model for bandwidth adaptation in NG networks**
- **Performance Evaluation**
  - Impact of increasing access rate and component granularity on QoS
  - Service differentiation and impact of resource sharing
  - Study on control plane load
- **QoS improvements or bandwidth savings in comparison to a scheduled approach can be achieved**
- **Improvements highly depend on traffic burstiness**
- **Resource sharing is more suited than dedicated resources**
- **Advanced controllers to reduce estimation error**
- **Real traces**