

# Event Building System with using Switching Network

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# DAQ System (Data acquisition system)

# DAQ System

## DAQ (Data Acquisition) System

- Acquisition
  - A/D Conversion, Trigger, Event building
- Storage
- On-line Analysis
- On-line Monitor
- Control

# DAQ System Type

## Type

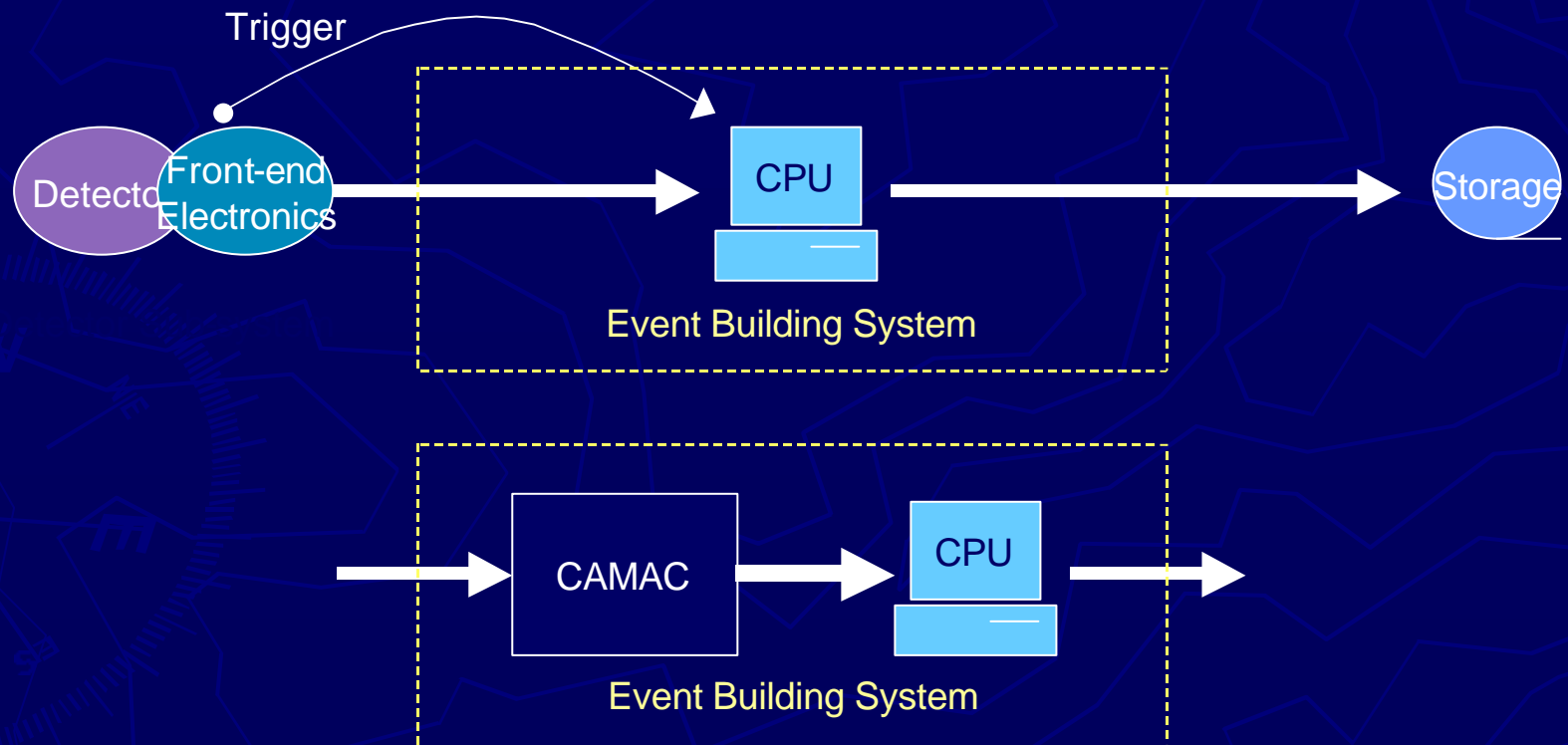
- Single Detector / Single CPU System
- Multi Detector / Single CPU System
- Multi Detector / Multi CPU System

Depends on size of experiments;

- Detector size ( # of read-out channels )
- Trigger frequency
- Total event size ( event fragment size )

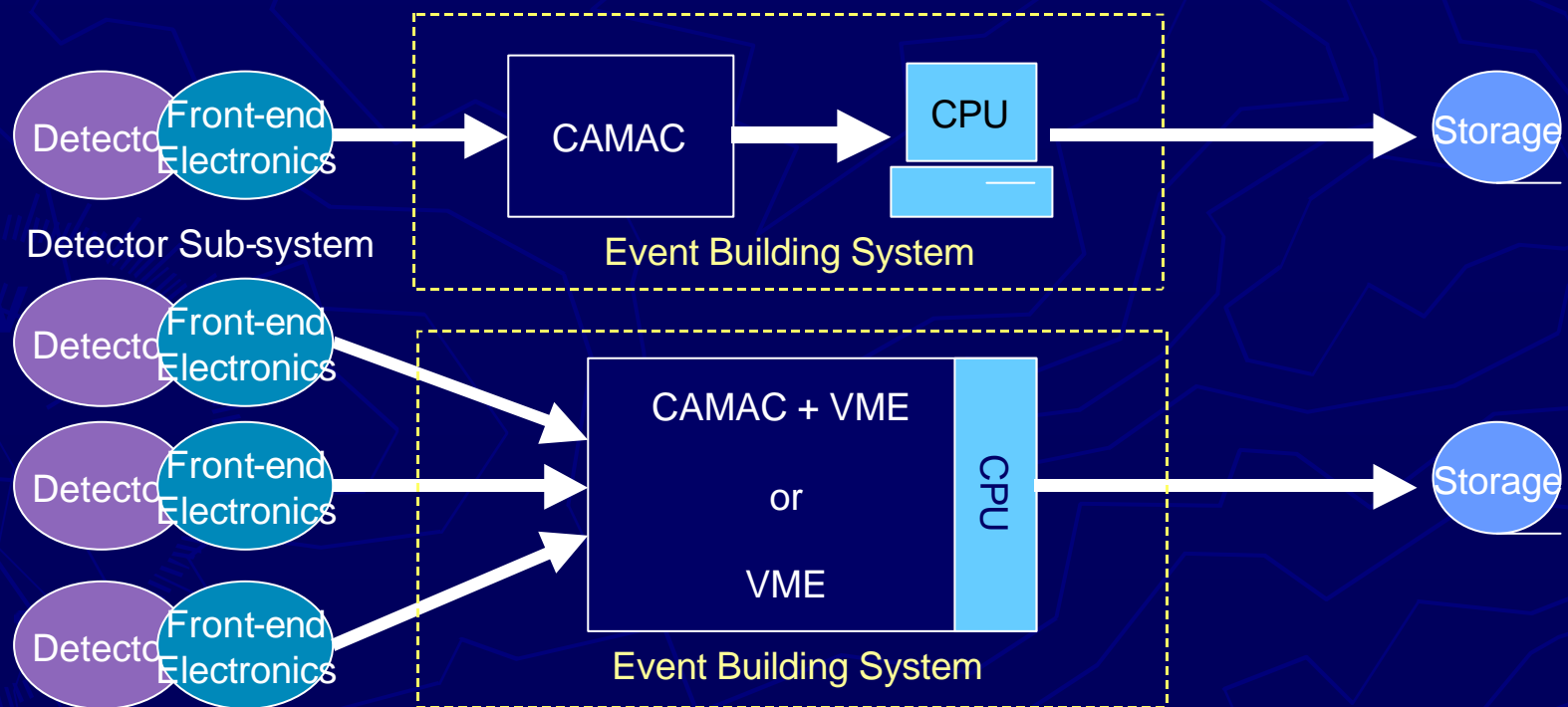
# Single Detector / Single CPU System

EX.: Detector - CAMAC - CPU - Storage



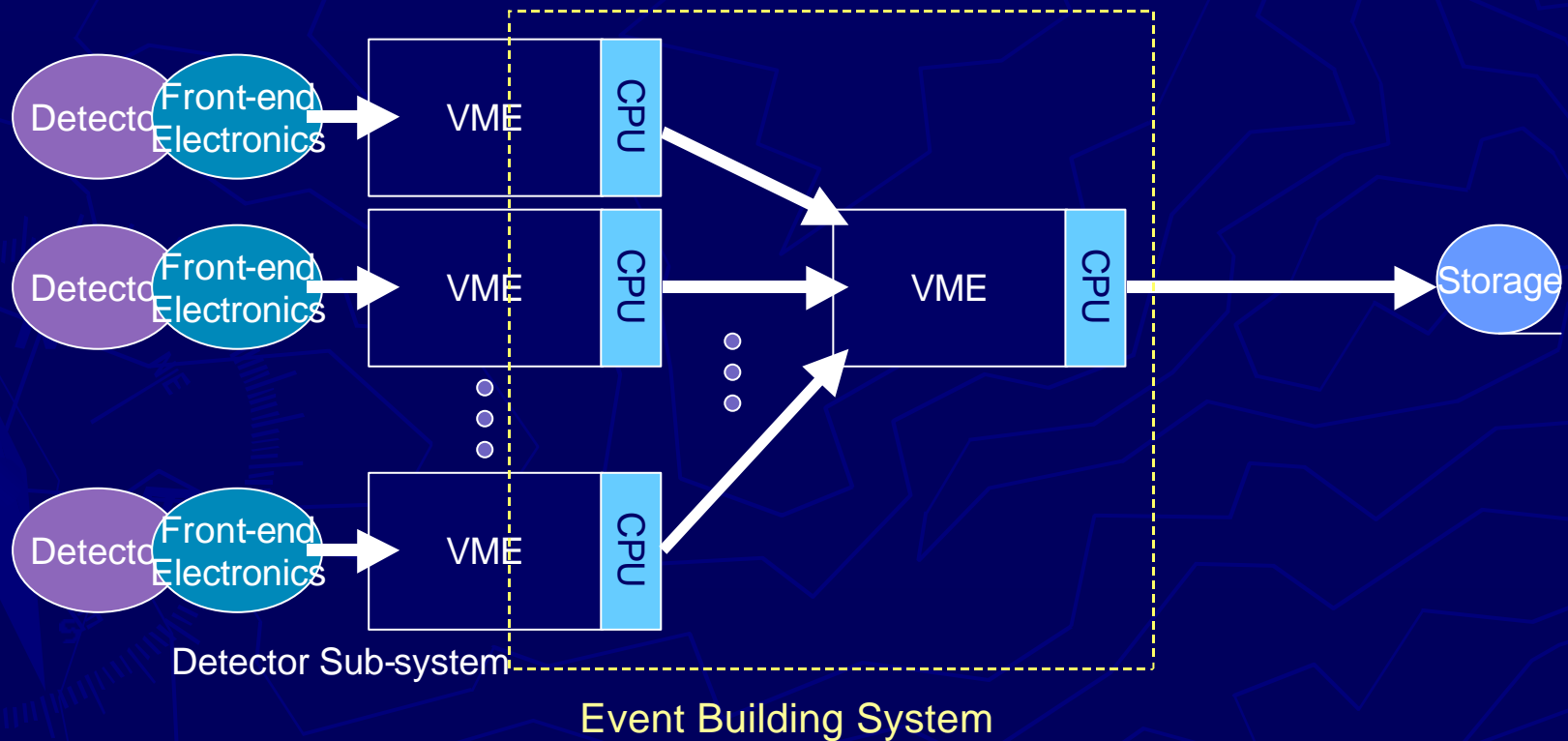
# Multi Detector / Single CPU System

Ex.: Detectors - CAMAC / Fastbus / VME - CPU  
- Storage



# Multi Detector / Multi CPU System (1)

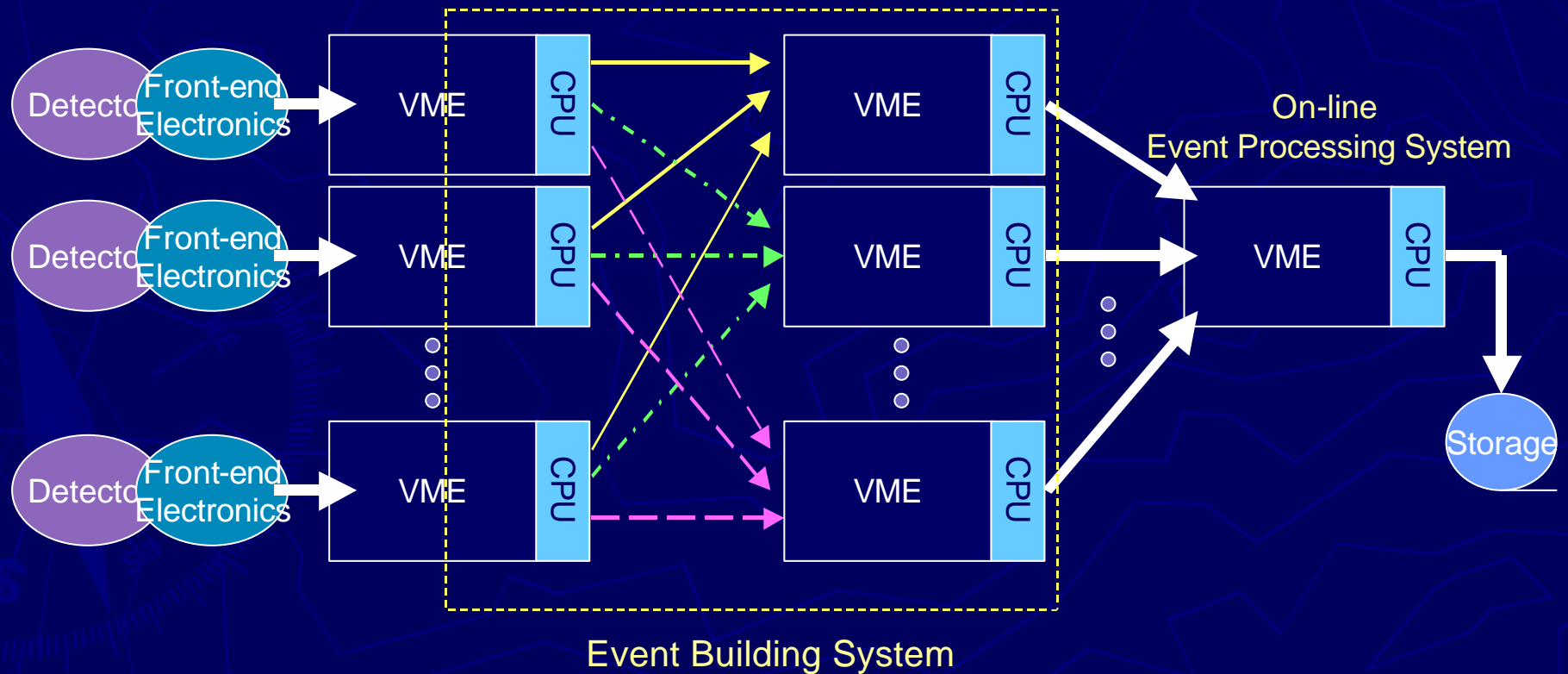
EX.: Detectors - CAMACs / Fastbuses / VMEs  
- CPUs - Storage





# Multi Detector / Multi CPU System (2)

EX.: Detectors - CAMACs / Fastbuses / VMEs  
- CPUs - Storage



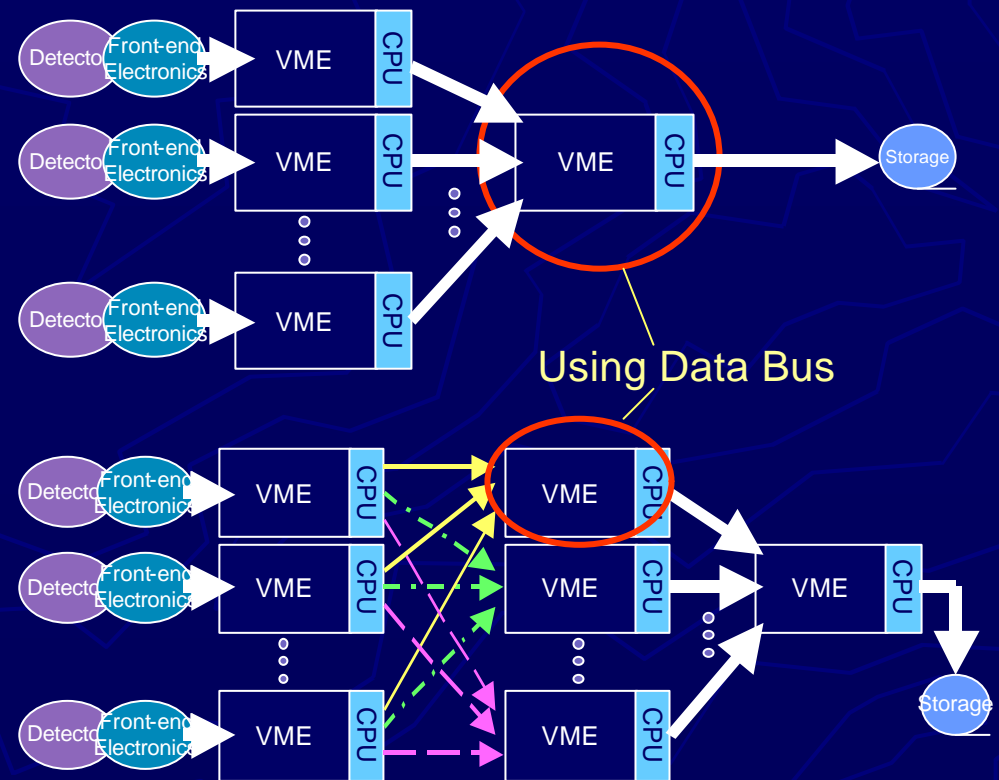
# Event Building System

# Bus-based Event Builder

## Multi Detector (Crate) - Multi CPU

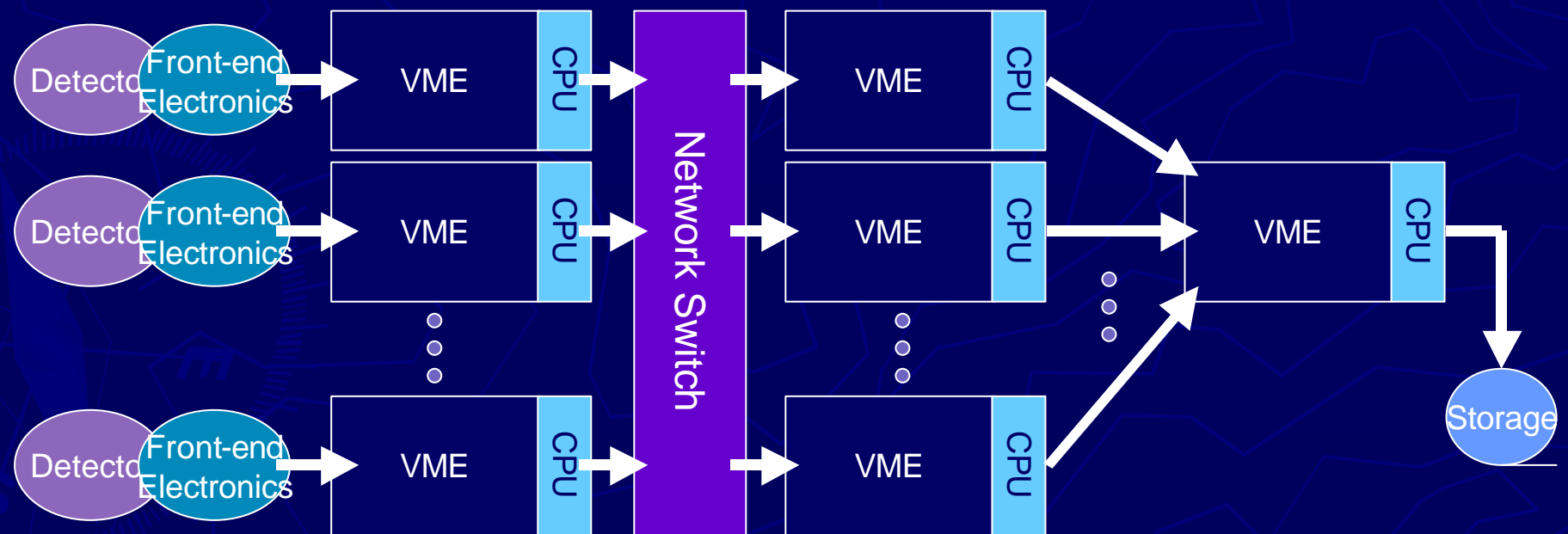
### Problems

- Bus bottleneck
- Lots of I/F
- Complicated connection



# Switch-based Event Builder

Using network switches  
instead of data buses



Event Building System

# Switch-based Event Builder

## Switch → Switching network

- Custom-made switch (Non Standard)  
BELLE (first version of DAQ)
- Commodity switch (Standard)  
PHENIX • CDF II • ATLAS • CMS • ...

## Switching network

- HIPPI (High Performance Parallel Interface)
- FCS (Fiber Channel System)
- ATM (Asynchronous Transfer Mode)
- Gigabit Ethernet

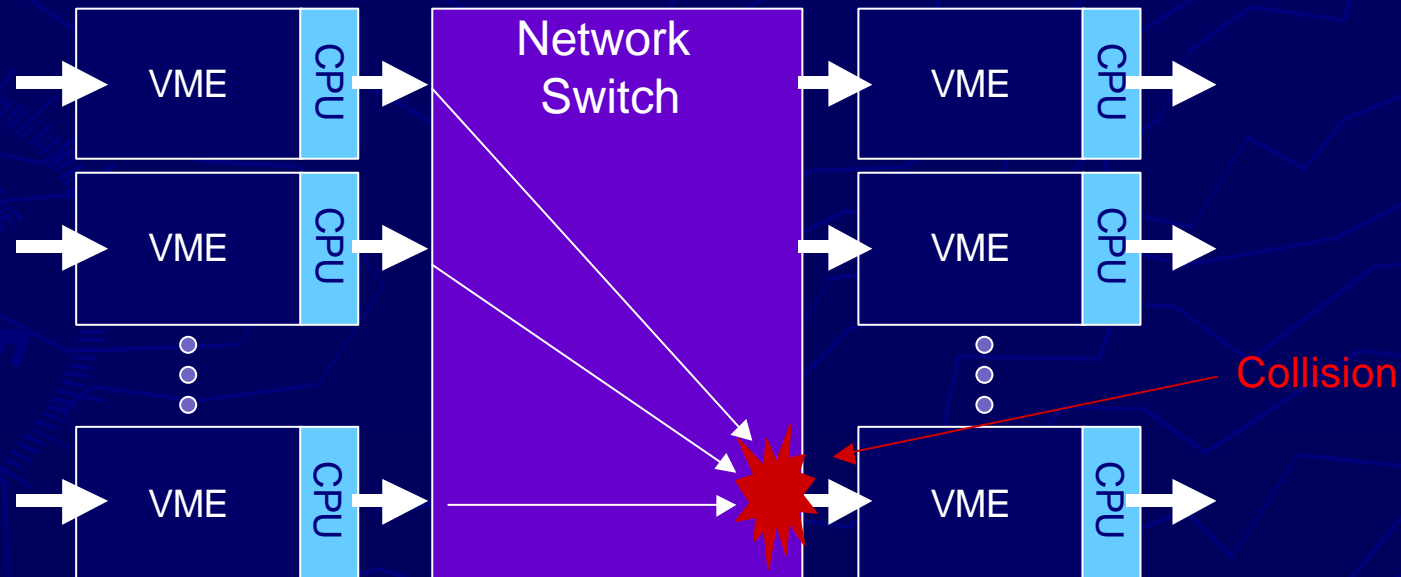
# Switch-based Event Builder

## Switching Network Problems

Bottleneck of switches

Data congestion

- Event fragment collision



Event Building System

# Switch-based Event Builder

## Collision Problem

- Buffers in the transfer and/or receiver side OS
- Buffers in the network switch

## Reason

- Data are transferred to the same destination at the same time.



- Can analyze the phenomena with queuing theory in a simple case

# Switch-based Event Builder

## Solution

- Traffic Shaping
  - Data Shuffling when transferring
- Global Traffic control
- QoS (Quality of Service) control
  
- On-demand data transferring from destinations ( pull type system )



# EB Architecture

# Event Building Architecture

## Push Architecture

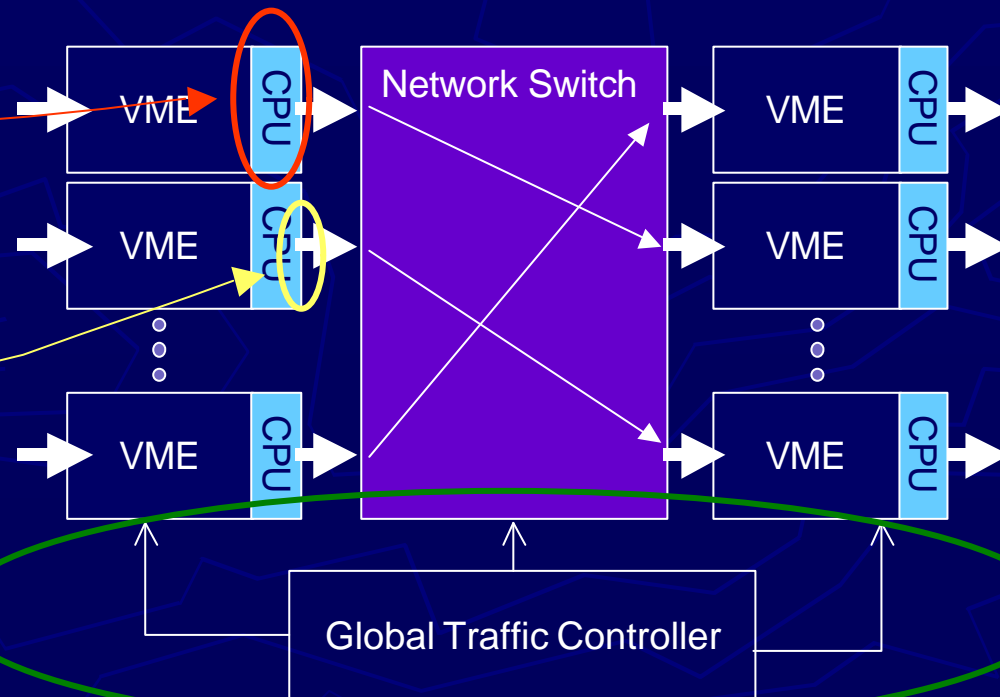
- Data are transferred when ready to transfer
- Doesn't take into account the status in receiver sides
- Transfer timing is decided by transfer sides.

## Pull Architecture

- Data are transferred when ready to receive
- Transfer timing is decided by receiver sides.

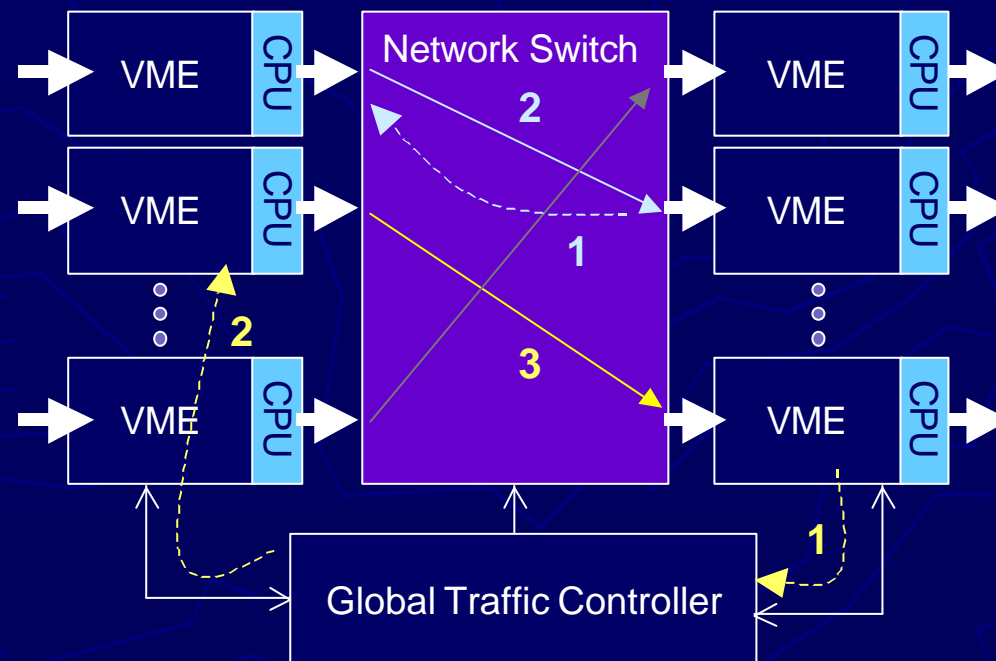
# Push Type EB system

Traffic Shaping  
Global Traffic Control  
QoS Control



# Pull Type EB System

Direct on-demand Type  
Via Controller on-demand Type



# ATLAS DAQ

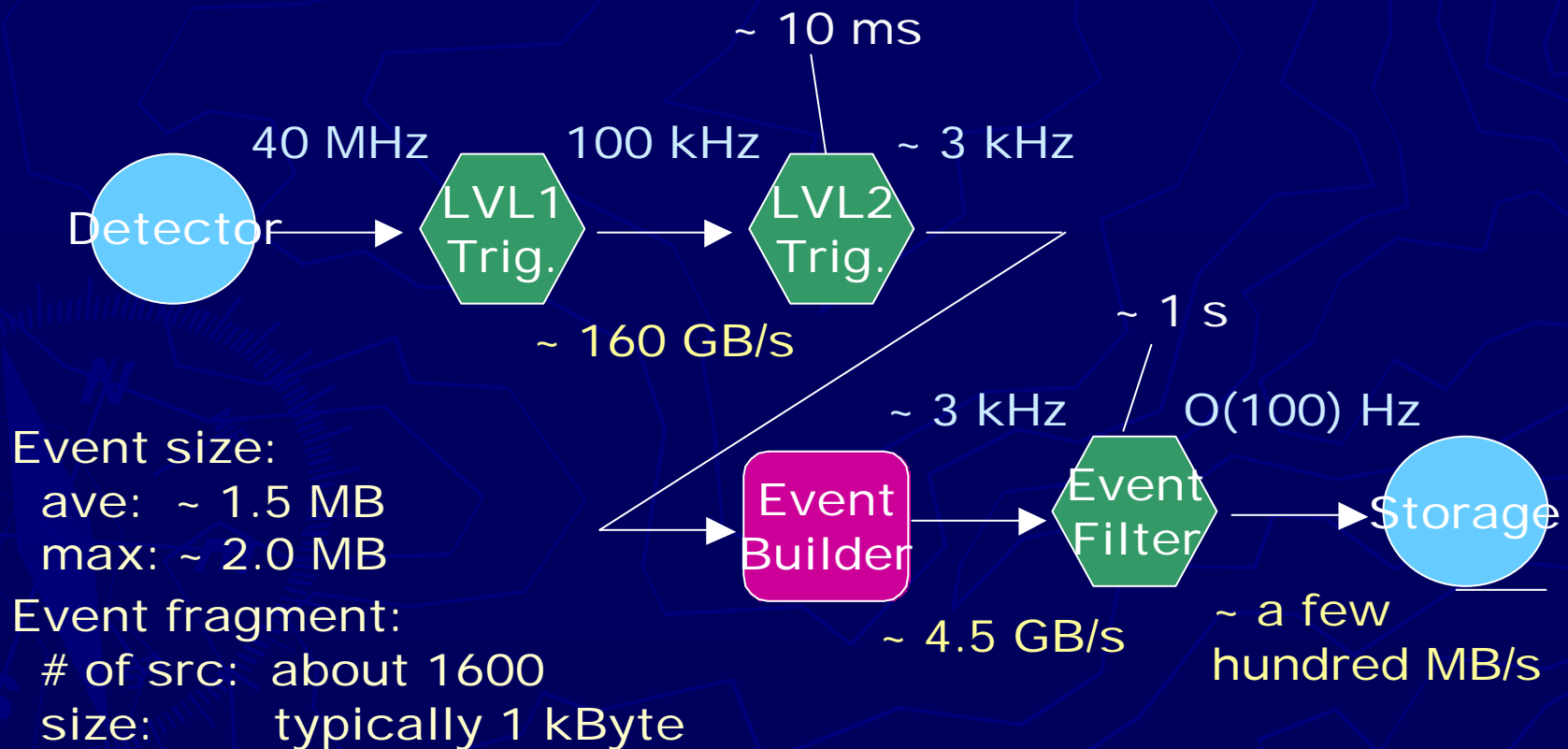
# ATLAS DAQ (Overview)

## Overview

- DAQ (Data Acquisition)
  - DataFlow
  - Online Software
- HLT (High Level Triggers)
  - LVL2 Selection
  - Event Filter
- DCS (Detector Control System)

# ATLAS DAQ (Parameters)

## ATLAS parameters of T/DAQ system



# ATLAS DAQ

## (Event Builder parameters)

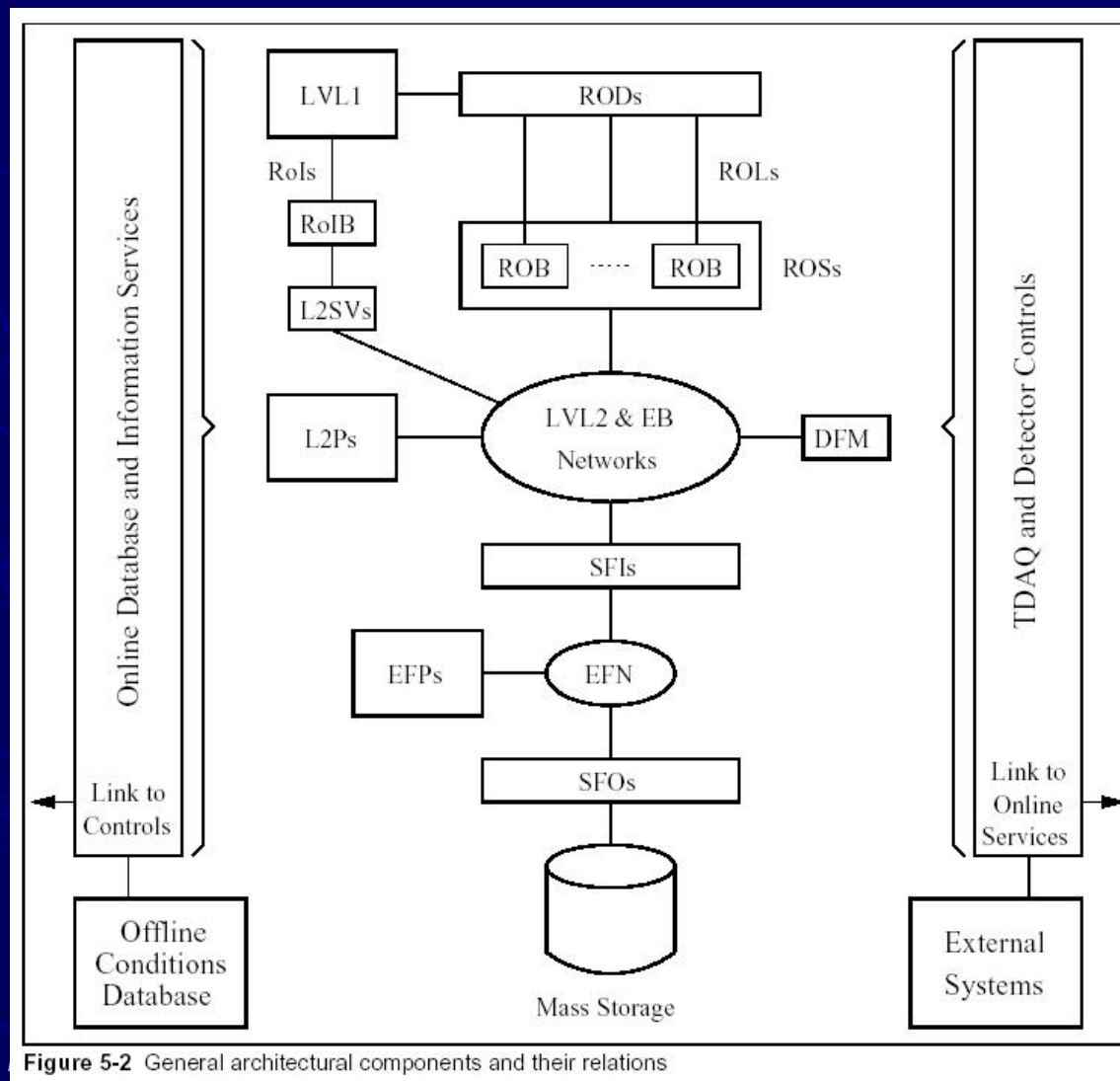
### Important Parameters of Event Builder (typical values)

- # of sources 50 - 150
- # of destinations 50 - 100
- fragment data size 10 - 30 kByte
- Input rate 3 kHz
- Data proc. rate 4.5 GByte/sec





# ATLAS DAQ (Architectural components)

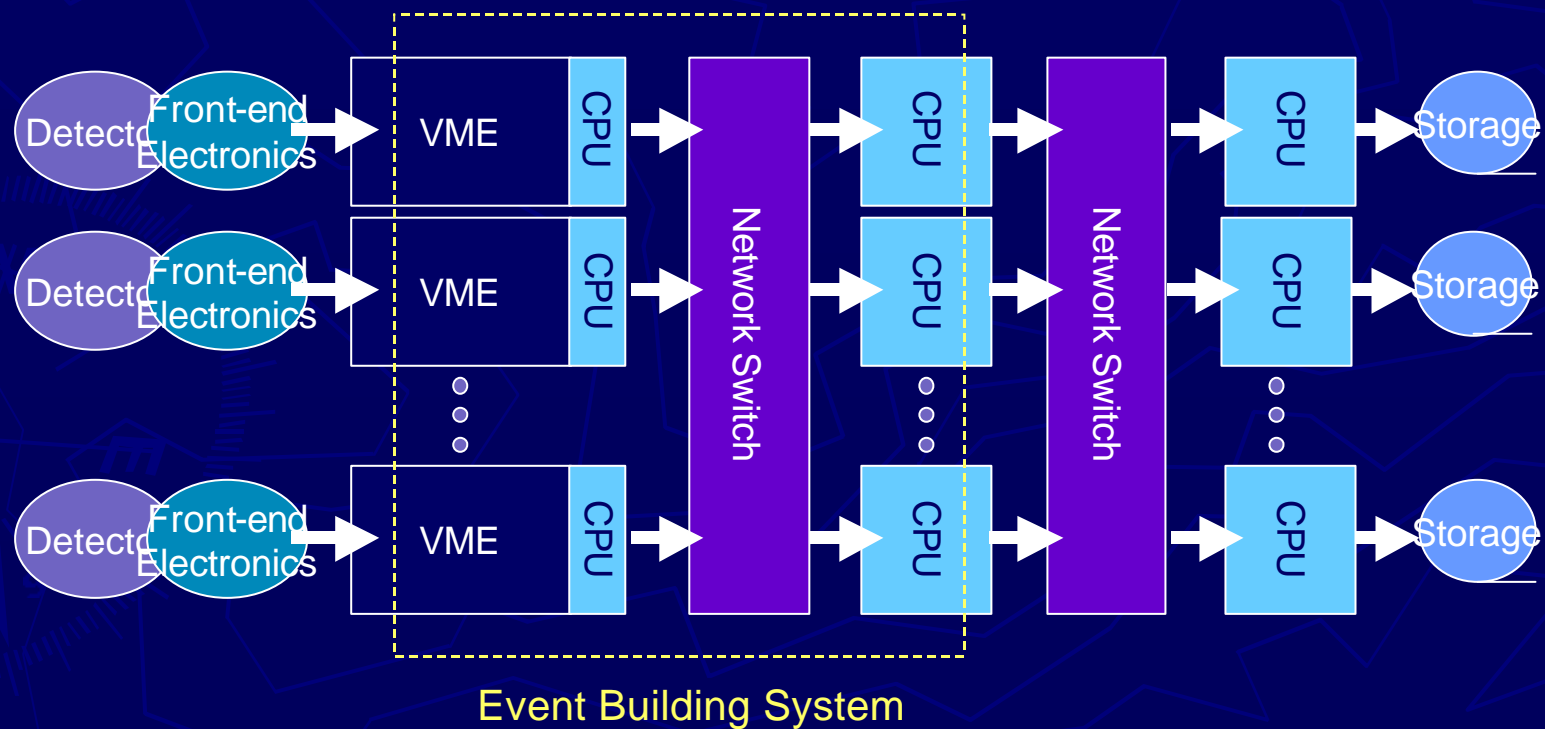


From ATLAS TDAQ Technical Design Report (07.2003)

# ATLAS DAQ (Event Building System)

## Event Building System

- Switch-Based Event Builder



# QoS Technology

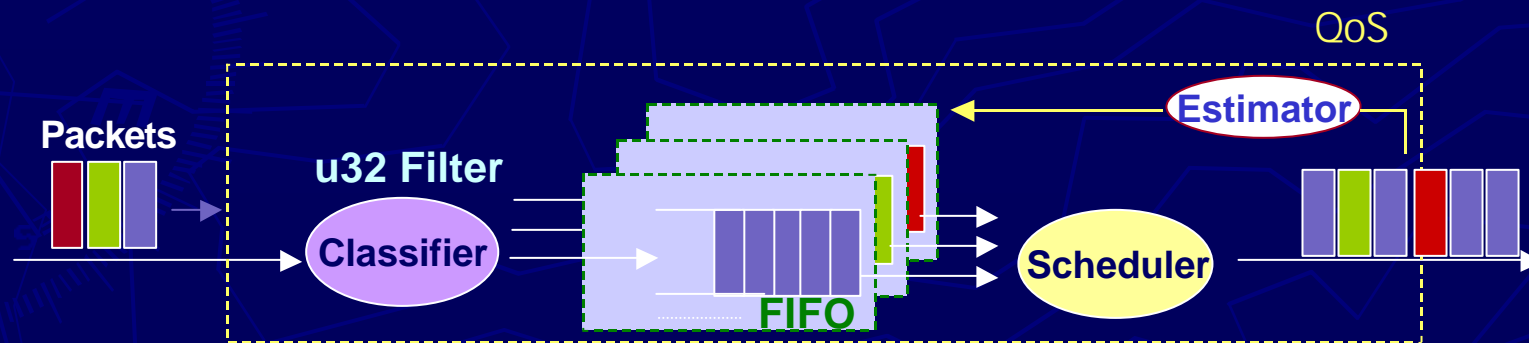
# QoS Control Technology

the technology to control data traffic on a per node basis.

- Bandwidth Allocation, Error Rate, Transfer Latency, ...

Classification

Queue Management and Scheduling



# QoS Control Technology (2)

## The QoS control technology

- Congestion avoidance on data path
- Guaranteed bandwidth of control path and data path
- Bandwidth management for unbalanced data paths

## Which part can QoS be applied in?

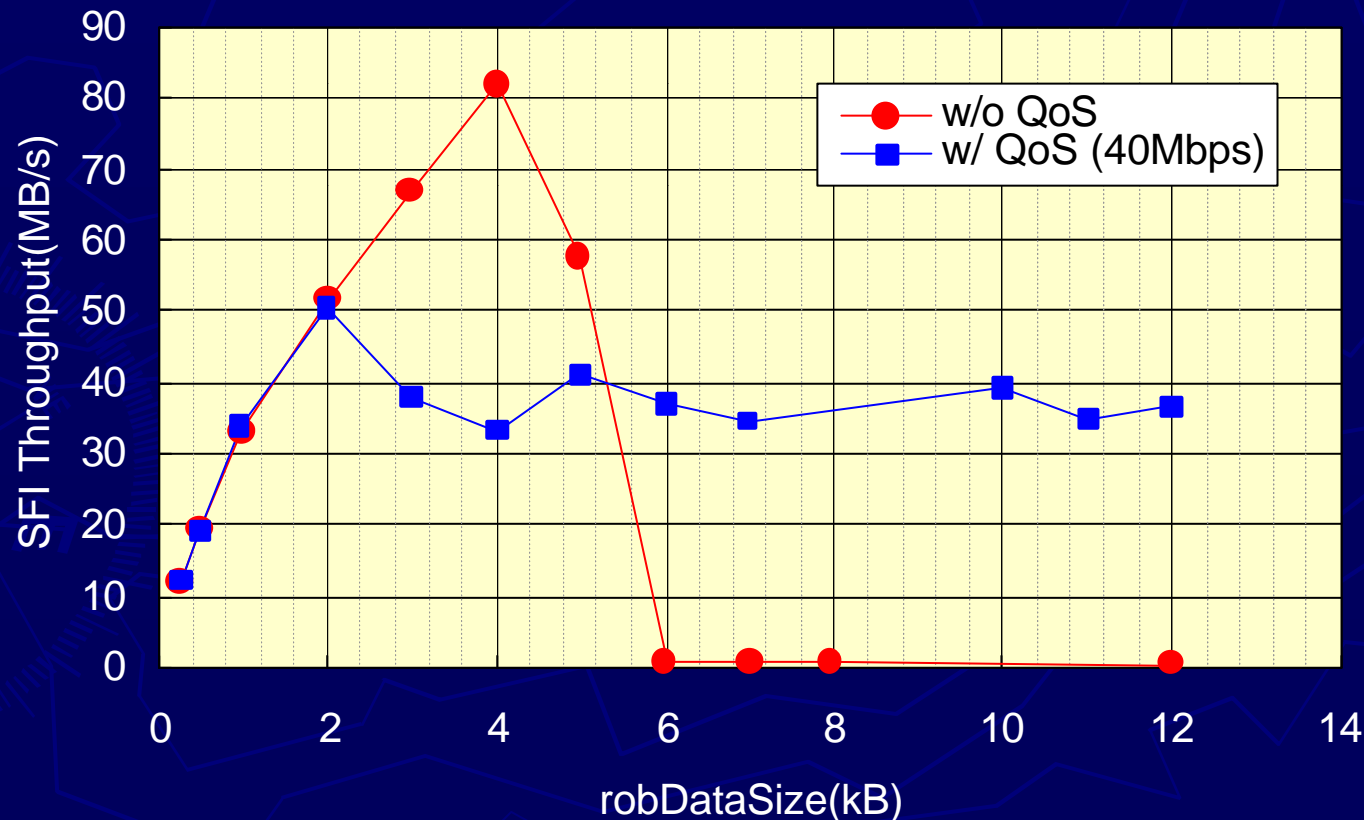
- Source nodes transfer data to destination nodes with a bandwidth control.

Bandwidth allocation with QoS makes no collision in the network.

# Performance Measurements w/ QoS and w/o QoS

Preliminary result:

- QoS can avoid the collision in Push architecture



# Summary

## DAQ System

- Single Detector / Single CPU System
- Multi Detector / Single CPU System
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## Event Building System

- Bus-based EB System
- Switch-based EB System

## Event Building Architecture

- Push type architecture
- Pull type architecture

## DAQ Example – ATLAS DAQ

## QoS Technology