Tier-2 and Tier-2 Centers

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Tier-2 and Tier-3 Centers

A Tier-2 center in CMS is approximately 1MSI2k of computing

- Tier-3 centers belong to university groups and can be of comparable size

A Tier-2 center in CMS ~200TB of disk

- Currently procuring and managing this volume of storage is expensive and operationally challenging
  - Requires a reasonably virtualization layer

A Tier-2 center has between 1Gb/s and 10Gb/s of connectivity

- This is similar between Tier-2 and Tier-3 centers

In the US planning a Tier-2 supports 40 Physicists performing analysis

- This is a primary difference between a Tier-2 and a Tier-3

Tier-2 centers are a funded effort of the experiment

- The central project has expectations of them

Surviving the first years

The computing for CMS is hardest as the detector is being understood

- The analysis object data for CMS is estimated at 0.05MB
  - An entire year's data and reconstruction are only 300TB
- Data is divided into ~10 trigger streams and ~50 offline streams
  - A physics analysis should rely on 1 trigger stream
  - A Tier-2 could potentially maintain all the analysis objects for the majority of the analysis streams

Unfortunately, until the detector and reconstruction are completely understood the AOD is not useful for most analysis and access to the raw data will be more frequent

- The full raw data is 35 times bigger
- Given the CDF experience, we should expect about 3 years to stabilize
- People working at Tier2 centers can make substantial, but bursty requirements of the data transfers

Analysis Selections

When going back to the raw data and complete simulation, analysis selections on a complete trigger streams

- 1% selection on data and MC would be 4TB, 10% selection would be 40TB
  - Smaller by factor of 5 if only the offline stream can be used
- There are an estimated 40 people working at a Tier-2
  - If half the people perform the small selections at the level of twice a month
    - This already 50MB/s on average and everyone is working asynchronously
    - The original analysis estimates were once a week
    - 10% selections will happen
  - 100MB/s x 7 Tier-2s would be ~6Gb/s from a Tier-1

Size of selections, number of active people and frequency of selections all have significant impact on the total network requirements

- Can easily arrive at 500MB/s for bursts.

Tier-3 Connectivity

Tier-2s are a resource for the physics community.

- Even people with significant university clusters at home have the opportunities to use Tier-2
- The use of Tier-3s for analysis is foreseen in the model, but

The number of active physicist supported at a Tier-3 center is potentially much smaller than a Tier-2

- 4-8 people
- This leads to smaller sustained network use
  - but similar requirements to T2s to enable similar turn-around times/ latencies for physics datasets copied to T3 sites for analysis

Analysis Connectivity

In order to satisfy their mission as a primary resource for experiment analysis the Tier-2 need good connectivity to the Tier-1 centers

- Data is served from Tier-1 computing centers.
  - Each Tier-1 is assigned a share

The connectivity between the Tier-1 and Tier-2 centers can be substantially higher than the Tier-0 to Tier-1 rates

- Already in CSA06 the incoming rate to FNAL is half the outgoing rate to Tier-2 centers
- The network that carries the Tier-2 traffic is going to be instrumental to the experiment's success.

The Tier-2 traffic is a more difficult networking problem

- The number of connections is large
- There are a diverse set of locations and setups

Current Tier-2 Status in the US

The Tier-2 centers in the US are supposed to reach 50% complexity by the end of the year

Currently

Site	Batch Slots	CPU (kSI2K)	Disk (TB)
Caltech	256	330	55
Florida	240	320	25
MIT	80	88	40
Nebraska	256	360	58
Purdue	228	295	32
UCSD	213	318	98
Wisconsin	428	547	91
TOTAL	1701	2258	399

All centers expect to be connected over 10Gb/s links to campus by the end of the year.