

Simulation of O2 offline processing - tools and models

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Simulation of O2 data processing

- Online & Offline simulation challenges
 - Scalability (network simulation model)
 - Omnet++
 - New simulation components
 - Our contribution

Simulation tool/model scalability

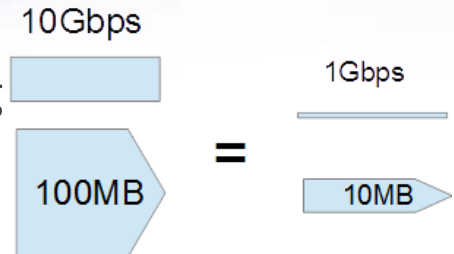
- O2 simulation <-> Omnet++
 - Already used for O2 simulation development -> tool of choice (?)
 - Simulation core is C++ based (good starting point)
 - Lots of features (modules) - make it powerful but a steep learning curve
 - INET framework - for simulating real-time network traffic
 - High temporal accuracy (TCP/Ethernet level) - required for network design
 - TCP level simulation of large HPC data processing : time prohibitive if it includes a lot of data movement
 - Already done (Charles Delort /CERN) :
 - Network simulation (**TCP level**) = ~67-69h for 18-31s
 - Full system (**high level**) = 1867s for 2000s
 - Storage (**high level**) = 3 sec for 30 days
 - Looks more than scalable ?

Simulation tool/model scalability

- Looks scalable, but:

- **High level** for Full system = TCP level with downscaling network throughput/data volume

- Incorrect protocol dynamic ? Validated ?



- **High level** for storage = **one stream at a time** for one network link

- File transfer as delayed message (bandwidth/size)
- Applicable only for some data paths / data processing scenarios

- No suitable Omnet++ module for **flow level (=fast)** network simulation

- Network topology based on message channels – no easy way to incorporate coarse network simulation

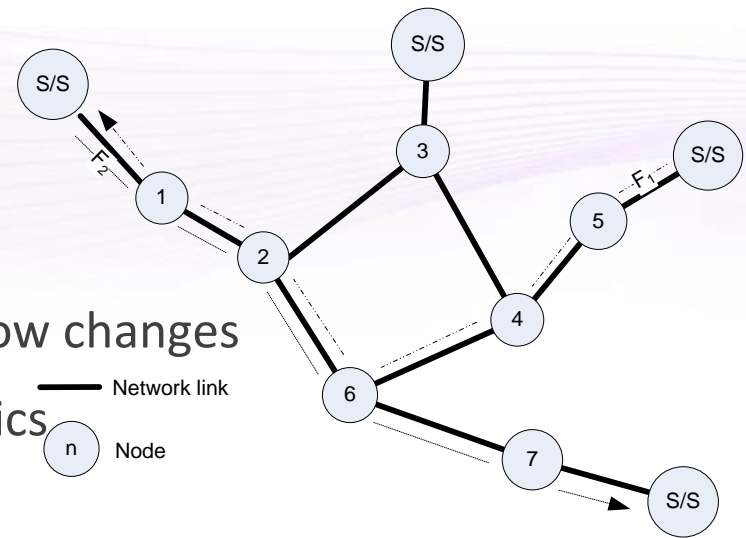
- Going to simulation of O2 Offline data processing:

- Longer simulation time periods (days, week,...)
- Few orders of magnitude larger data movement
- High level/coarse network model required

Flow level model

- Maps network as:

- bandwidth sharing links, discrete data flow changes
- includes more or less of protocol dynamics

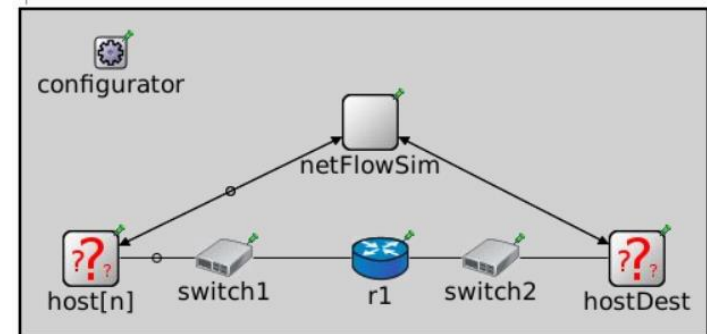


- Like SimGrid – well tested flow level model (+packet level)

- Omnet++ <- incorporate flow based model ?

- model adjusted to O2 architecture
- fast and sufficiently accurate
- used as alternative network model
- tuned using TCP level simulations

- using common network description or automatically constructed from standard Omnet++ TCP level topology



O2 Online->Offline simulation elements/models

- File catalog(s) / accounting / persistence
 - MySQL (integrate into Omnet++)
 - Other solutions ?
 - Scalability test (use of embedded version)
 - other modules are dependable -> early decision what to use
- Processing node
 - Common network & storage(?) modules with Online
 - “Offline application” sub module (job execution environment):
 - Top-down approach modelling based on measurements of job execution statistics
 - Include effects of:
 - multicore CPU or GPU data processing
 - common local storage/memory

O2 online -> offline simulation elements/models

- Data storage models
 - More detailed model for buffer storages
 - Is it scalable for longer time period simulations (offline) ?
 - Use **top-town approach based on measurements** for typical data read/write scenarios
- Other “Offline” elements:
 - **Batch system/resource broker, agent/pull model, ...**
 - Well defined behaviour (easy to model)

Our contribution & further steps- proposal

- Our contribution:
 - Incorporate into Omnet++ flow based network model
 - Create simulation modules for Offline data processing
 - File catalog/accounting/persistence,
 - Top-down modelled processing/storage modules,
 - Batch system/resource broker, agent/pull modules
- Further steps:
 - Define what FESB team should contribute
 - Become familiar with Charles existing code and define or accept already defined collaborative development standards
 - Define simulation development priorities
 - Contribute ! At CERN , out of CERN ,...