# Level 3 Trigger

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# Outline

1. History and Pre-History
2. Current Understanding
3. Revisiting Strategy
4. Summary and Conclusions

# 1. History and Pre-History

- My earliest reference is 1999 Design Report
  - Original analysis and strategy from Dave Doughty
    - Chapter 7 “Rates, Trigger and DAQ”
    - Based on experience from CLAS
      - higher-level hardware trigger expensive
      - general-purpose computers cheap
    - ➔Skip custom hardware, go with online trigger farm ➔
    - Dave called it a “Level 2” trigger then
      - We complained and he eventually switched to “Level 3”
  - Analysis performed by Dave D, Elton, Larry D and me

# History and Pre-History - 1999

| | Low Rate | High Rate |
|---|---|---|
| Event Size | 5 kB | 5 kB |
| Event Rate to L3 Farm | 10 kHz | 100 kHz |
| Data Rate to L3 Farm | 50 MB/s | 500 MB/s |
| Num Links | 20 | 20 |
| Rate per Link | 2.5 MB/s | 25 MB/s |
| Link Technology | 100 MBit Ethernet | GBit Ethernet |
| Events/s/Link | 500 | 5000 |
| Num Instr/Event for L3 | 1,000,000 | 1,000,000 |
| Processing Power/Link | 500 MIPS | 5000 MIPS |
| Num 1000 MIPS Procs/Link | 1 | 10 |
| Total 1000 MIPS Procs | 20 | 200 |

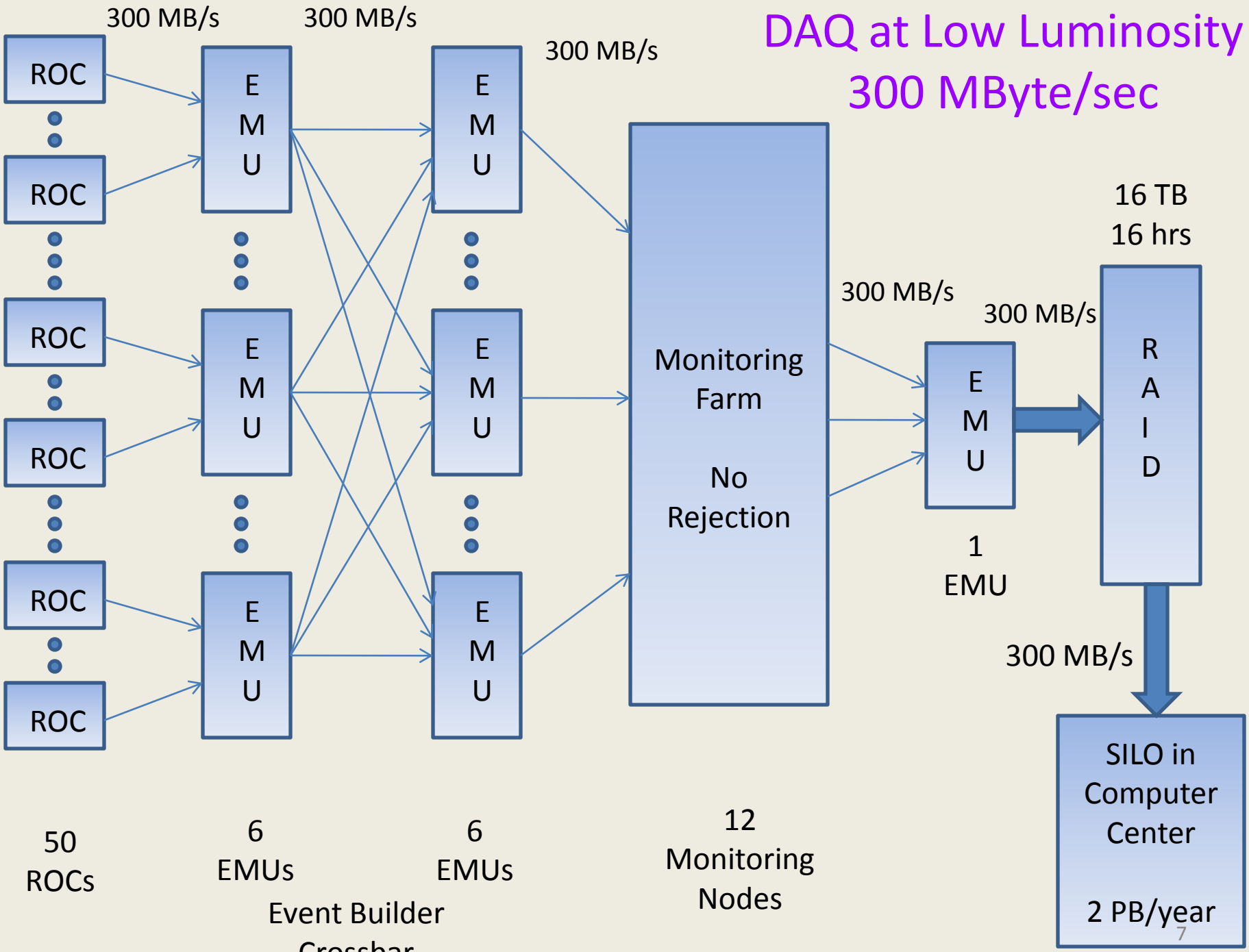
# History and Pre-History - 2002

| | Low Rate | High Rate |
|---|---|---|
| Event Size | 5 kB | 5 kB |
| Event Rate to L3 Farm | 20 kHz | 200 kHz |
| Data Rate to L3 Farm | 100 MB/s | 1000 MB/s |
| Num Links | 1 | 10 |
| Rate per Link | 100 MB/s | 100 MB/s |
| Link Technology | GBit Ethernet | GBit Ethernet |
| Events/s/Link | 20000 | 20000 |
| SPECints/Event for L3 | 0.1 | 0.1 |
| SPECints/Link | 2000 | 2000 |
| SPECints/Link x 2 | 4000 | 4000 |
| Num 200 SPECint Procs/Link | 20 | 20 |
| Total 200 SPECint Procs | 20 | 200 |

# History and Pre-History – 2008

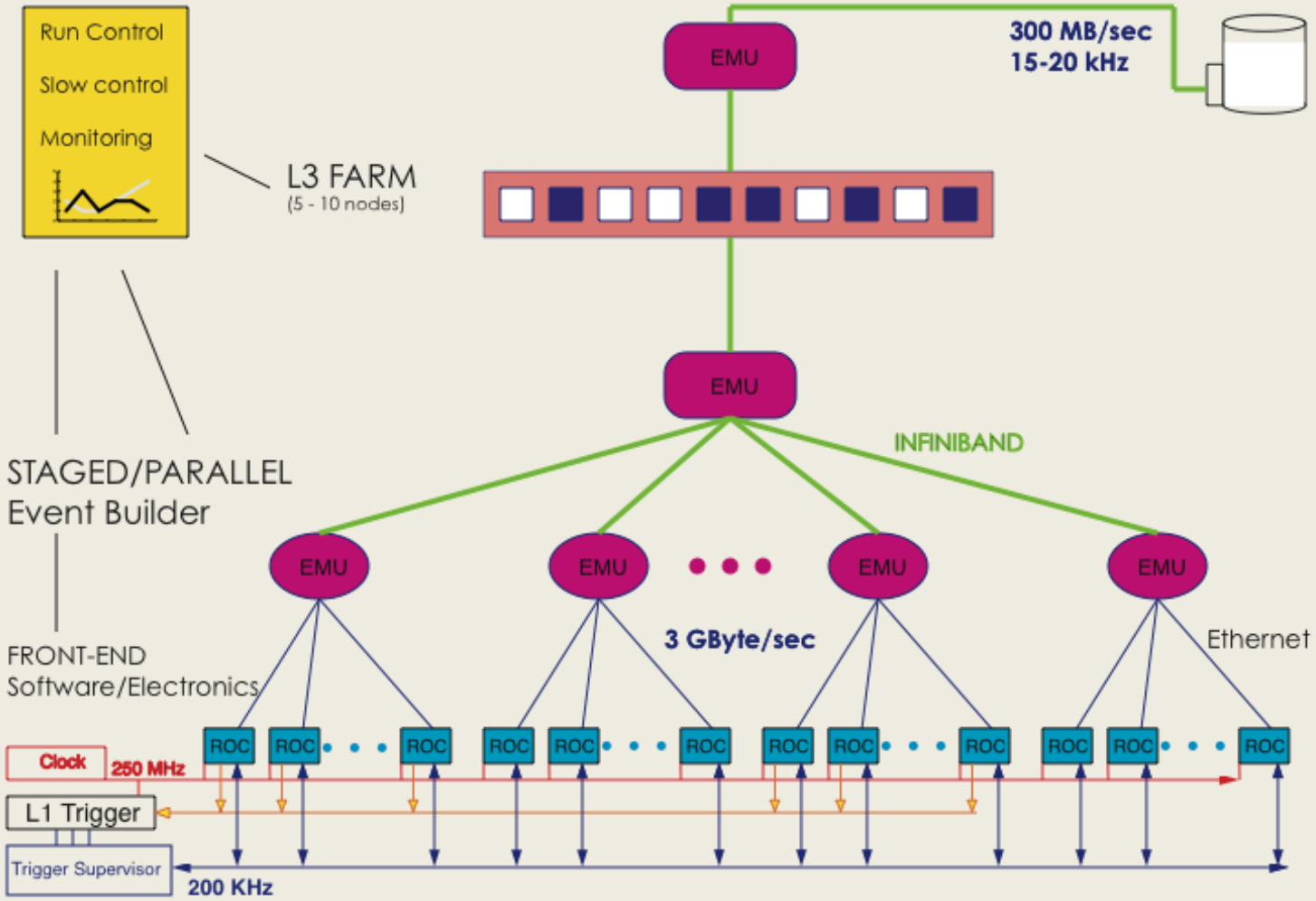
| | Low Luminosity | High Luminosity |
|---|---|---|
| L1 trigger rate | 20 kHz | 200 kHz |
| Average event size | 15 kB | 15 kB |
| Date rate off detector | 300 MB/s | 3 GB/s |
| L3 rejection | None | Factor 10 |
| Rate to storage | 300 MB/s | 300 MB/s |

# DAQ at Low Luminosity
# 300 MByte/sec



# 2. Current Understanding

- Changes and concerns since 2008 for high luminosity
  - VME backplane speed, ≤150 MB/s
    - Might have to split crates
  - L3 event classification @ 100 Hz/core
    - Need 2000 cores, not 200, for 200 kHz event rate
    - 10x faster than current Pythia reconstruction rate
  - Upgrade ROC-to-EMU network
    - ROC network board to 10 Gbit (from 1 Gbit)
    - Some concentrator switches won't handle aggregate rate


Run Control
Slow control
Monitoring
L3 FARM
(5 - 10 nodes)
EMU
300 MB/sec
15-20 kHz
EMU
INFINIBAND
STAGED/PARALLEL
Event Builder
EMU
EMU
EMU
EMU
3 GByte/sec
Ethernet
FRONT-END
Software/Electronics
ROC
Clock
250 MHz
L1 Trigger
Trigger Supervisor
200 KHz

- If backgrounds 30% larger, or 20 kB events
  - Networks and switches ok
    - 10 Gbit Ethernet, Infiniband (40 Gbit)
  - DAQ ok
    - May need additional EMU's @ $5k each
  - Storage ok
    - RAID and tape drives should handle rate

# 3. Revisiting Strategy

- Skip L3, just write 200k events/sec to tape?
  - Analysis by Dave Lawrence and Sandy Philpott
  - Data rate 3 GB/sec @ $10/TB storage
    - $300k/year for tapes, no backup
    - Tapes currently 3x more expensive
  - Tape silo
    - Would need 1-2 additional silos @ $250k each no backup
    - Assumes data in silo 4 years
  - Some network upgrades
    - Infiniband or 10GBit Ethernet or ???

# Revisiting Strategy

- Compare to L3 trigger strategy
  - $200k for the L3 farm
    - 2000 cores @ $100/core

# 4. Summary and Conclusions

- Original strategy still optimal
- Event size, data rates, cpu req's have increased
- Computing and network costs keep decreasing
- Overall L3 design easily scalable
  - Robust against increased data rate
- At most might need to
  - Split VME crates
  - Add few EMU's
  - Upgrade some network connections

# Backup

# Full Experiment Trigger