

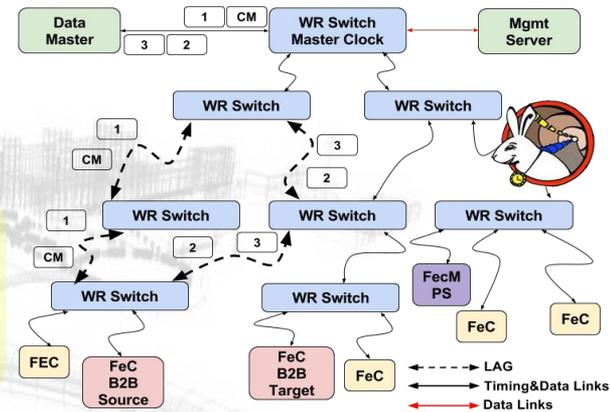


A RELIABLE WHITE RABBIT NETWORK FOR THE FAIR GENERAL TIMING MACHINE

GTM Requirements

Time Resolution	1 to 5 ns
Precision (Std Dev.)	≤10 ps
GTM Reaction Time	≤10 ms
GTM Failure Rate	3.17 10 ⁻¹²
CM Loss Rate	1 CM/year
Num FeCs	2000
Link Distance	1m to 2000m

General Timing Machine



GTM WR Network Traffic

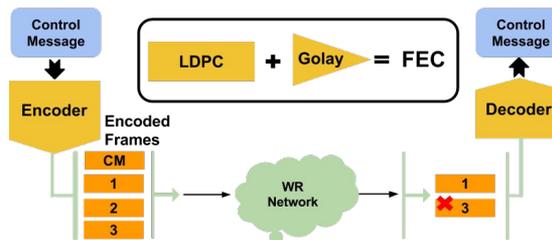
Application	Bandwidth	Max Latency	Prio	VLAN
DM Broadcast	100 Mbit/s	≤500 us / ≤ 5	7	100
B2B	25 kbit/s	≤10 ms / ≤ 5	6	100, 200
MPS	900 kbit/s	≤1 ms / ≤ 3	5	100, 300
Mgmt	~10 Mbit/s	Best Effort	4-0	400

Resilient Data Transmission

- Loss of CMs in the WR net
- Fix Bit Error in CMs
- Single Point of Failures in the GTM net
- ★ FEC + LAG = Multipath

Deterministic Data Delivery

- Delivery CMs within an upper bound latency
- WR implements VLAN and QoS
- CMs Fast Forward = Prio 7th + Broadcast
- WR cut-through switching
- ✓ Delivery of Acc CMs 500 us
- ★ Delivery of non-CMs



Robust Timing Delivery

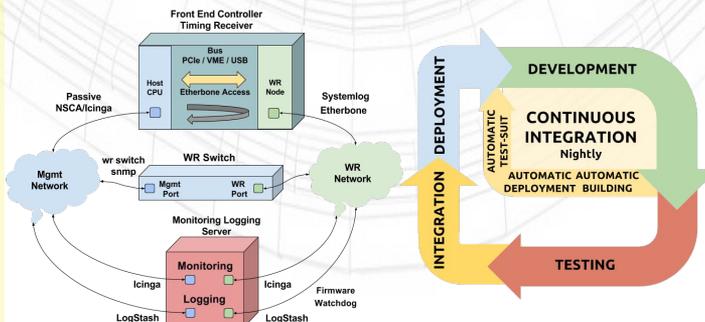
- Synchronization of FeCs
- Steady timing delivery to more than 2000 nodes
- ✓ 1 ns accuracy 15 ps jitter
- ✓ Stable mid-size WR net in production
- ★ Seamless synchronization in event of SPOF

GTM Reliability

- Resilient and Deterministic data delivery
- Robust and resilient Synchronization

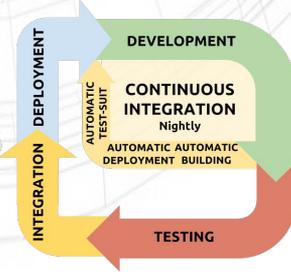
Monitoring & Logging

- Maintain reliability during operation of the GTM
- React to failures
- Offline analysis of failures and performance
- ✓ Monitoring: Observe the status and events of the WR net
- ✓ Logging: Record status of the net Trigger alarms



Continuous Integration

- Complex system in constant evolution
- Share collaborative development
- Limited manpower
- ✓ Automatic building, deployment, testing and feedback
- ✓ Constant check of the reliability & compatibility



C. Prados
A. Hahn
A. Suresh
J. Bai

GSI
Helmholtzzentrum für
Schwerionenforschung

ALBA
ICALEPCS2017