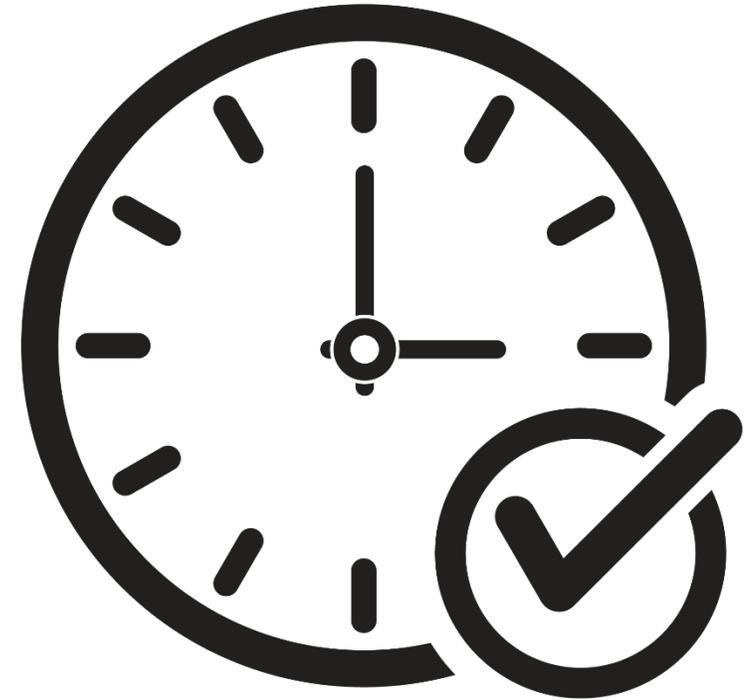
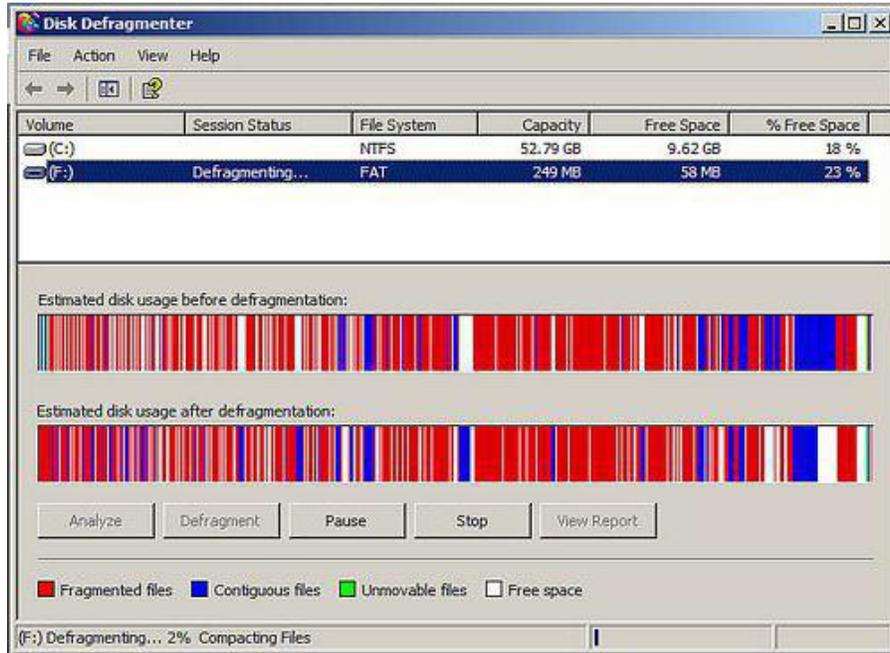


SOSA and the Ethernet Pipe Dream

Nigel Forrester
Director of Strategy

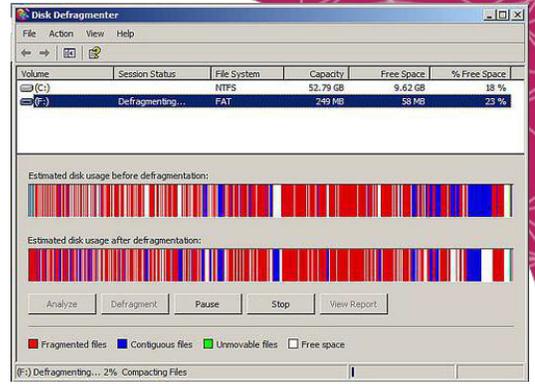
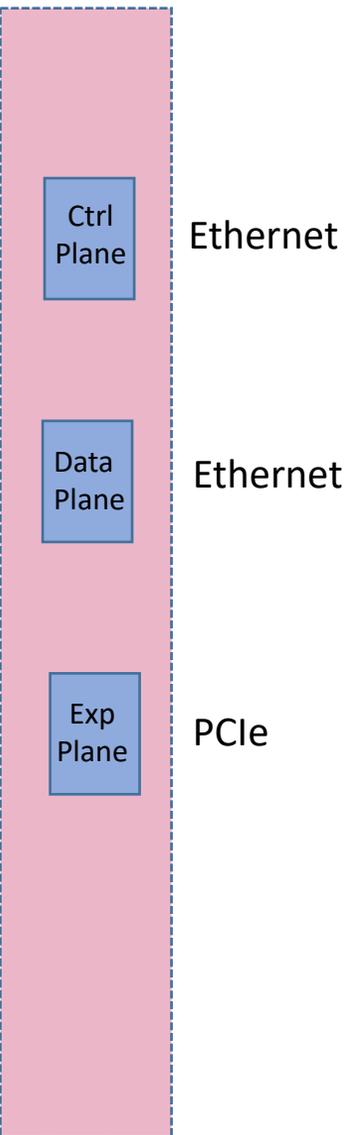
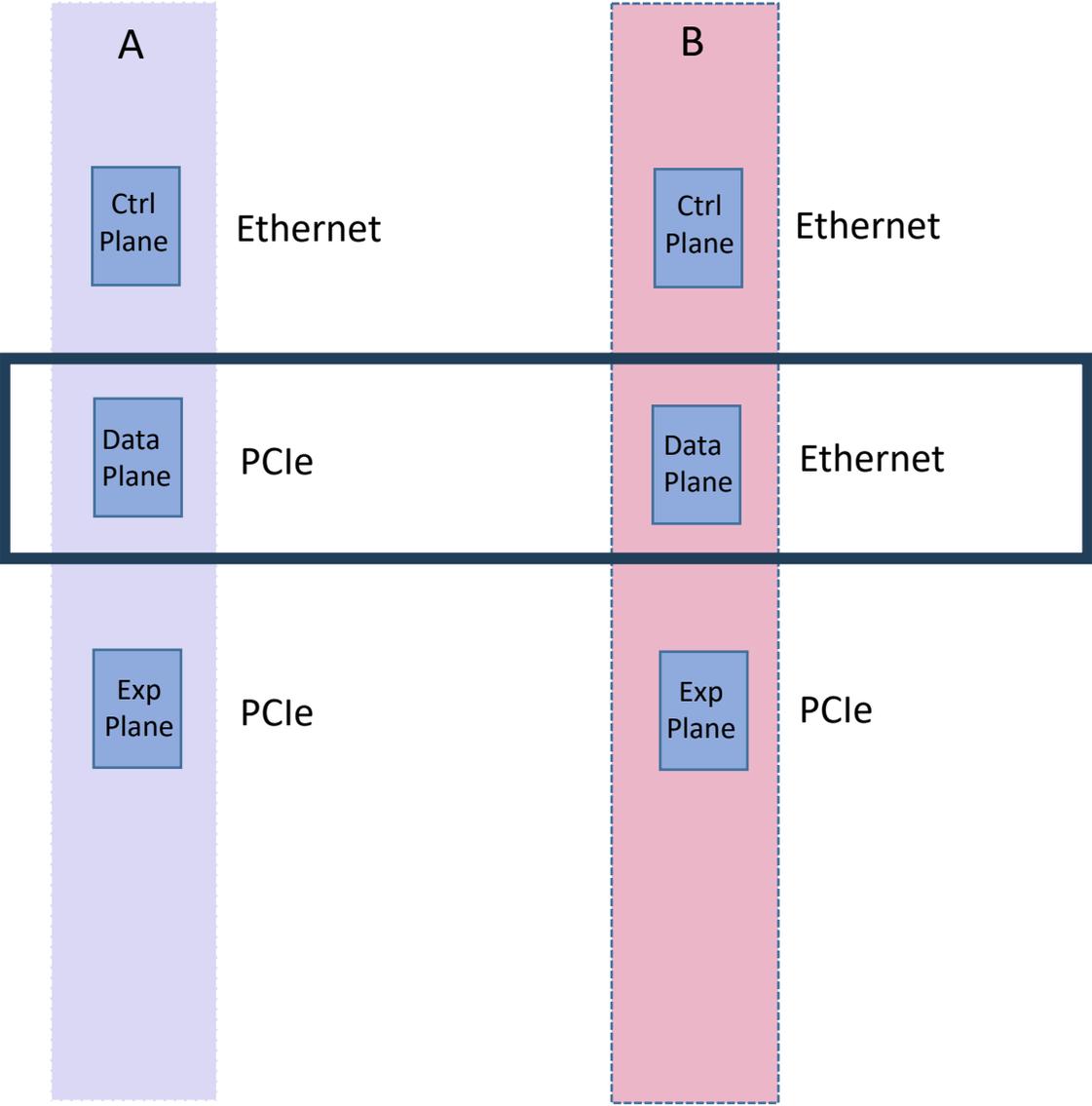
The importance of Ethernet



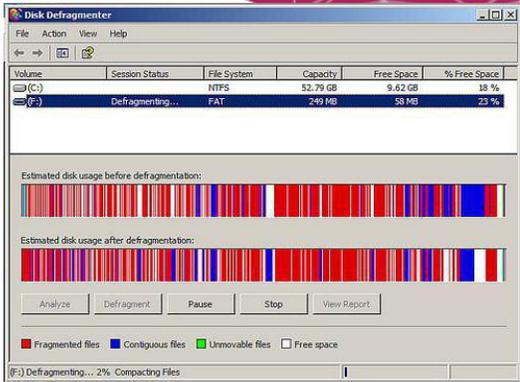
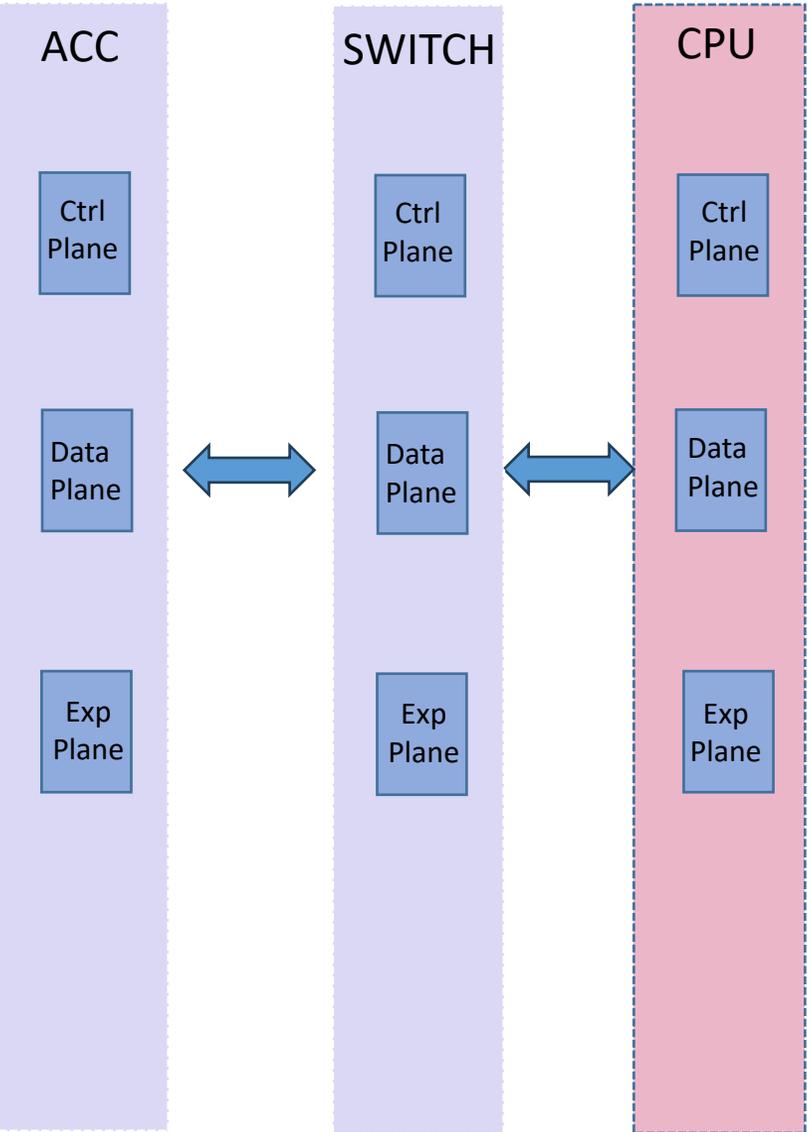
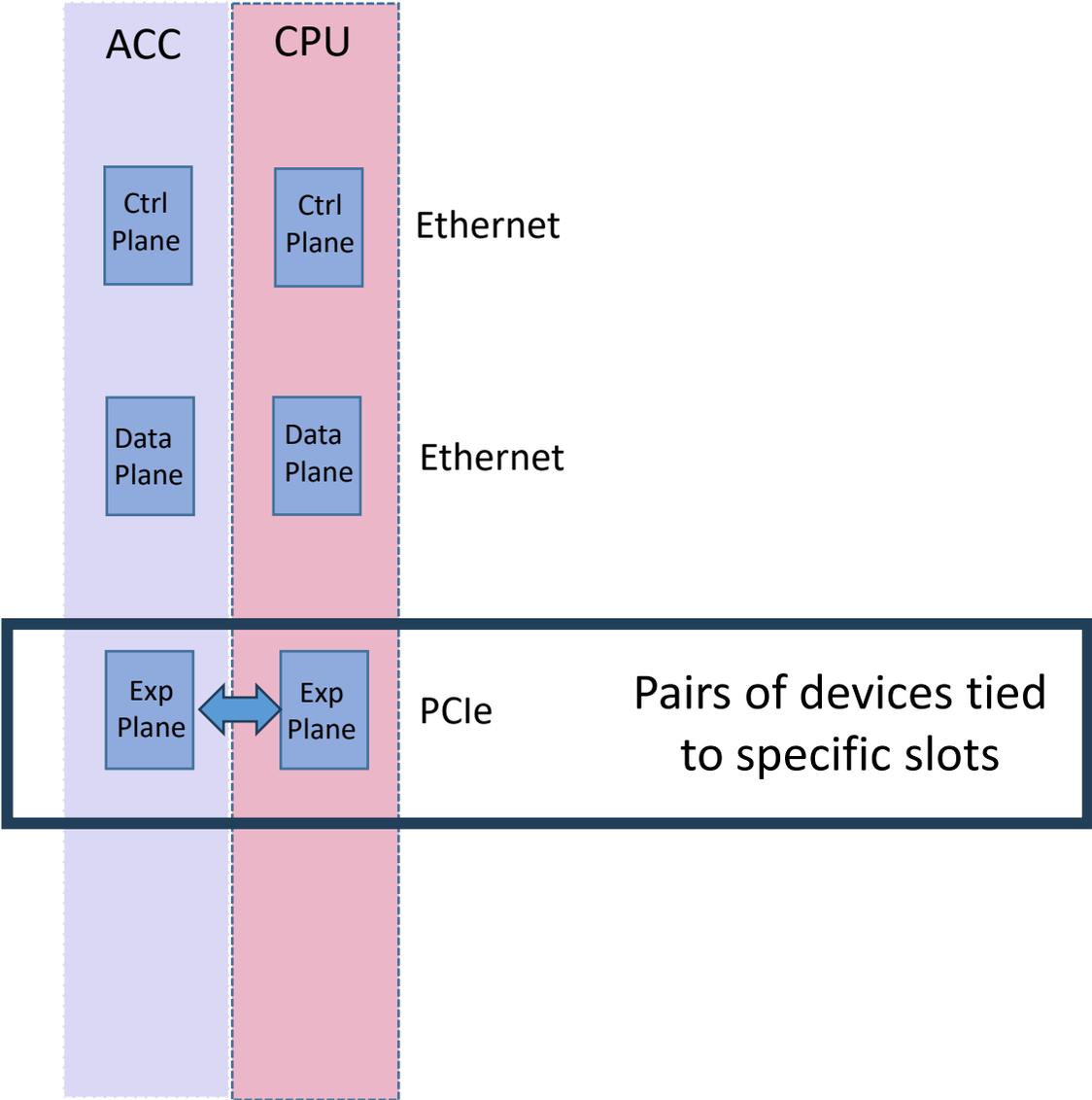
**Future
Proof**

REAL TIME

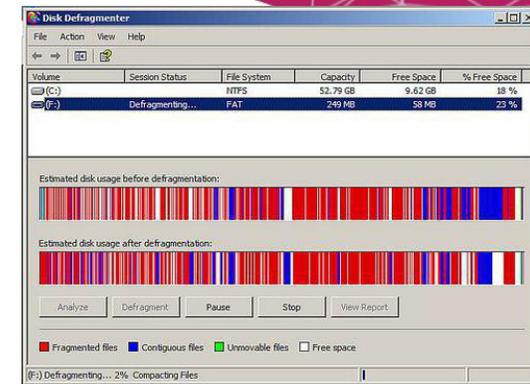
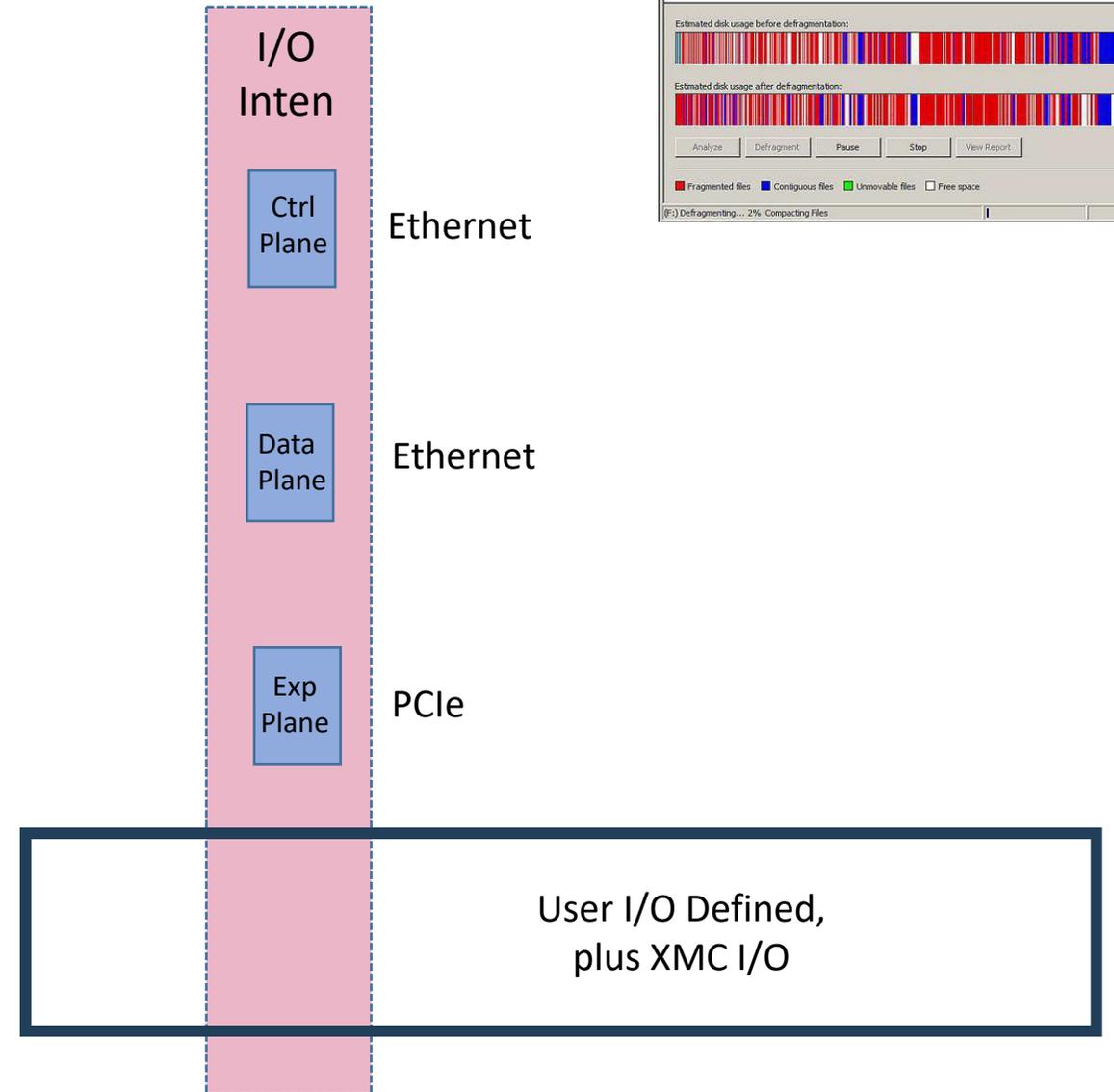
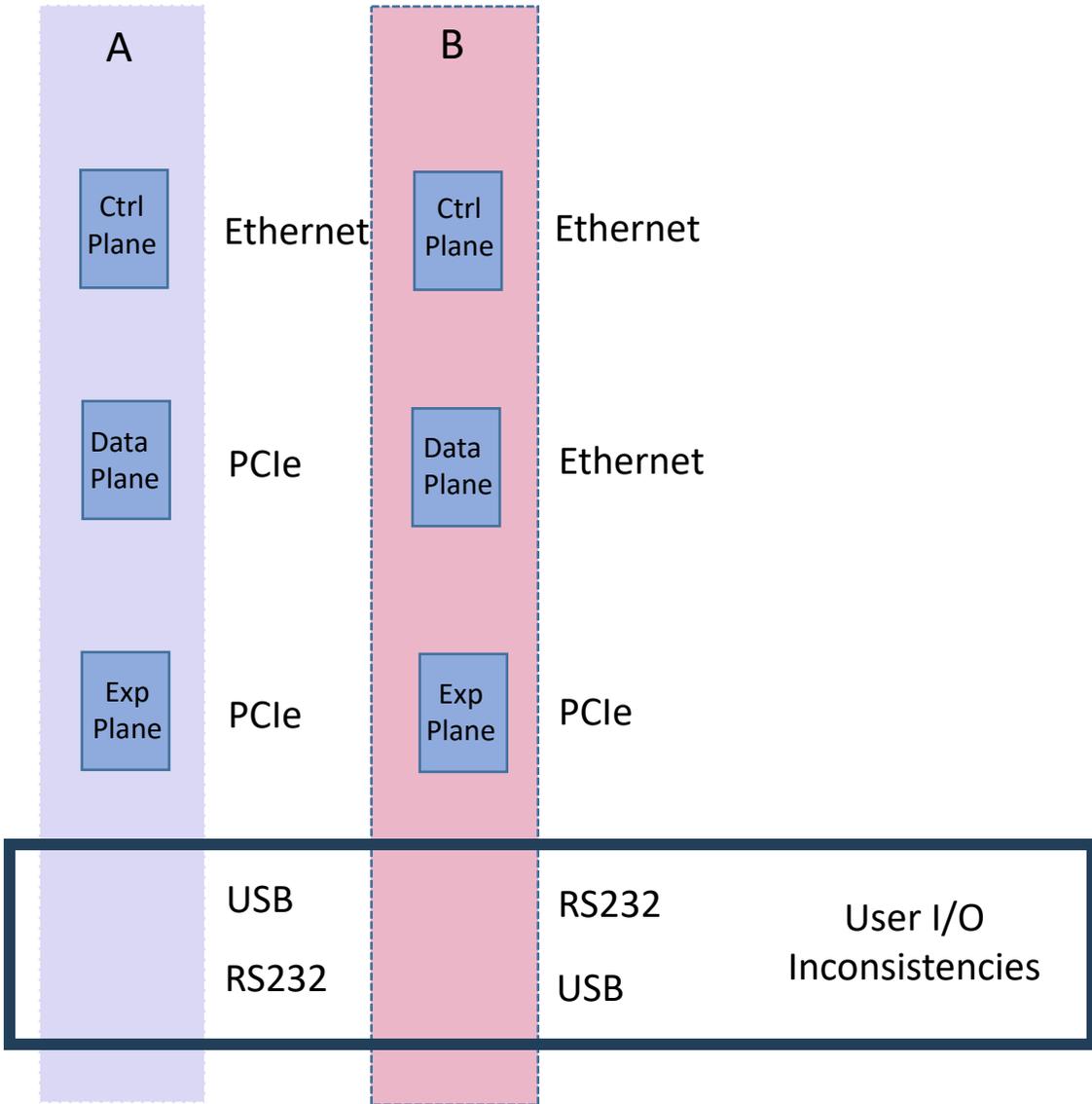
Data Plane Defragmentation



Defragmentation and Independence



Defragmentation User I/O



Defragmentation Summary

- 3U VPX before 2020:
 - 25 Designs
 - 112 Variants
- 3U VPX Aligned to SOSA:
 - 13 Designs
 - 36 Variants

The screenshot shows the Windows Disk Defragmenter utility window. The title bar reads "Disk Defragmenter". The menu bar includes "File", "Action", "View", and "Help". Below the menu bar is a toolbar with navigation icons. A table displays disk information:

Volume	Session Status	File System	Capacity	Free Space	% Free Space
(C:)		NTFS	52.79 GB	9.62 GB	18 %
(F:)	Defragmenting...	FAT	249 MB	58 MB	23 %

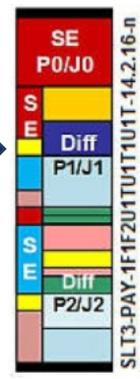
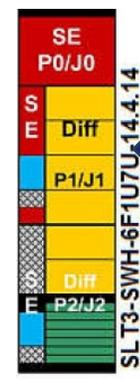
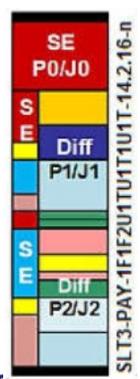
Below the table, there are two bar charts illustrating disk usage. The first chart, "Estimated disk usage before defragmentation:", shows a highly fragmented disk with many small, scattered blocks of red (fragmented files) and blue (contiguous files). The second chart, "Estimated disk usage after defragmentation:", shows the same disk with significantly fewer and more contiguous blocks, indicating improved disk efficiency. Below the charts are five buttons: "Analyze", "Defragment", "Pause", "Stop", and "View Report". A legend at the bottom identifies the colors: red for "Fragmented files", blue for "Contiguous files", green for "Unmovable files", and white for "Free space". The status bar at the bottom indicates "(F:) Defragmenting... 2% Compacting Files".

Ethernet Test Setup



Future Proof

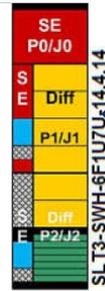
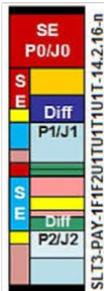
- Completed by using a pair of SOSA Aligned processor cards linked by a 100G Ethernet Switch
- Each card was running Ubuntu 22.04.1 (kernel version 5.15.0-43) and the MTU was set to 9000
- iPerf3 used to measure the maximum available bandwidth



Ethernet Benchmarks

Future Proof

- Running iPerf3 on both the server and client:
 - The total bit rate achieved was 94.3Gbps
 - After installing the Linux preempt_rt Real Time kernel, the bit rate was 92.6Gbps
- Using RDMA/ROCE
 - We achieved 88.2Gbps



Future Proof?

- Always a Pipe Dream
- 100/200/400G Ethernet
- PCIe Gen 5 & Gen 6

- Easy to transition payloads
- Difficult to upgrade backplanes



**Future
Proof**

Looking Beyond Ethernet Bandwidth Performance Metrics

- Ethernet is the de facto control and data fabric
- SOSA Aligned processors have no ‘user I/O’ making it more challenging to implement legacy real time serial protocols such as ARINC 429, CANBus and MIL-STD-1553
- Traditional Ethernet fabric has gaps around “determinism” and “reliability”
- Time Sensitive Networking (TSN) separates out the real-time traffic from other less critical systems traffic to provide a viable converged Ethernet solution



REAL TIME

Time Sensitive Networking (TSN) – the Basics

- TSN is a collection of IEEE Standards providing real-time behavior in systems utilizing Ethernet by Time Synchronization, Traffic Shaping and Scheduling, Reliability and Resource management
- TSN grew out of the IEEE 802.1 standard working groups on Audio Video Bridging (AVB) to make sure that independent networks streams for audio and video data arrive at the correct times to ensure synchronization



REAL TIME

Time Sensitive Networking Profiles

- TSN uses a profiles approach that defines:
 - Features
 - Configurations
 - Protocols
- Some profiles are well defined, while others are still works in progress
- For example, work is currently underway by SAE and IEEE on the Aerospace profiles (P802.1DP), which are being defined in SAE AS6675 Working Group as IEEE 802.1DP; these will focus on security, high availability and reliability, maintainability, and bounded latency for deterministic networks that range in Design Assurance Levels (DALs)



TSN Profiles and Grouping

Time-Sensitive Networking (TSN) Profiles (Selection and Use of TSN tools)

Audio Video Bridging
[802.1BA]

Fronthaul
[802.1CM/de]

Industrial Automation
[IEC/IEEE 60802]

Automotive In-Vehicle
[P802.1DG]

Service Provider
[P802.1DF]

Aerospace
[P802.1DP]

TSN Components

(Tools of the TSN toolbox)

Time synchronization:
Timing and Synchronization [802.1AS-2020]
(a profile of IEEE 1588)
Hot Standby [P802.1ASdm]
YANG [P802.1ASdn]

Synchronization

High availability / Ultra reliability:

Frame Replication and Elimination [802.1CB]
Path Control and Reservation [802.1Qca]
Per-Stream Filtering and Policing [802.1Qci]
Reliability for Time Sync [802.1AS-2020]

Reliability

Dedicated resources & API:

Stream Reservation Protocol [802.1Qat]
Link-local Registration Protocol [802.1CS]
TSN Configuration [802.1Qcc]
Foundational Bridge YANG [802.1Qcp]
YANG for CFM [P802.1Qcx]
YANG for LLDP [P802.1ABcu]
YANG for 802.1Qbv/Qbu/Qci [P802.1Qcw]
YANG & MIB for FRER [P802.1CBcv]
Extended Stream Identification [P802.1CBdb]
Resource Allocation Protocol [P802.1Qdd]
TSN Configuration Enhancements [P802.1Qdj]
LLDPv2 for Multiframe Data Units [P802.1ABdh]
Multicast and Local Address Assignment [P802.1CQ]

Latency

Resource Management

Bounded low latency:
Credit Based Shaper [802.1Qav]
Frame Preemption [802.1Qbu & 802.3br]
Scheduled Traffic [802.1Qbv]
Cyclic Queuing and Forwarding [802.1Qch]
Asynchronous Traffic Shaping [802.1Qcr]
QoS Provisions [P802.1DC]

Zero congestion loss =
Bounded latency

Note: A 'P' in front of an ID indicates an ongoing Project.

February 3, 2021

individual contribution on IEEE 802.1 TSN profiles

3



REAL TIME

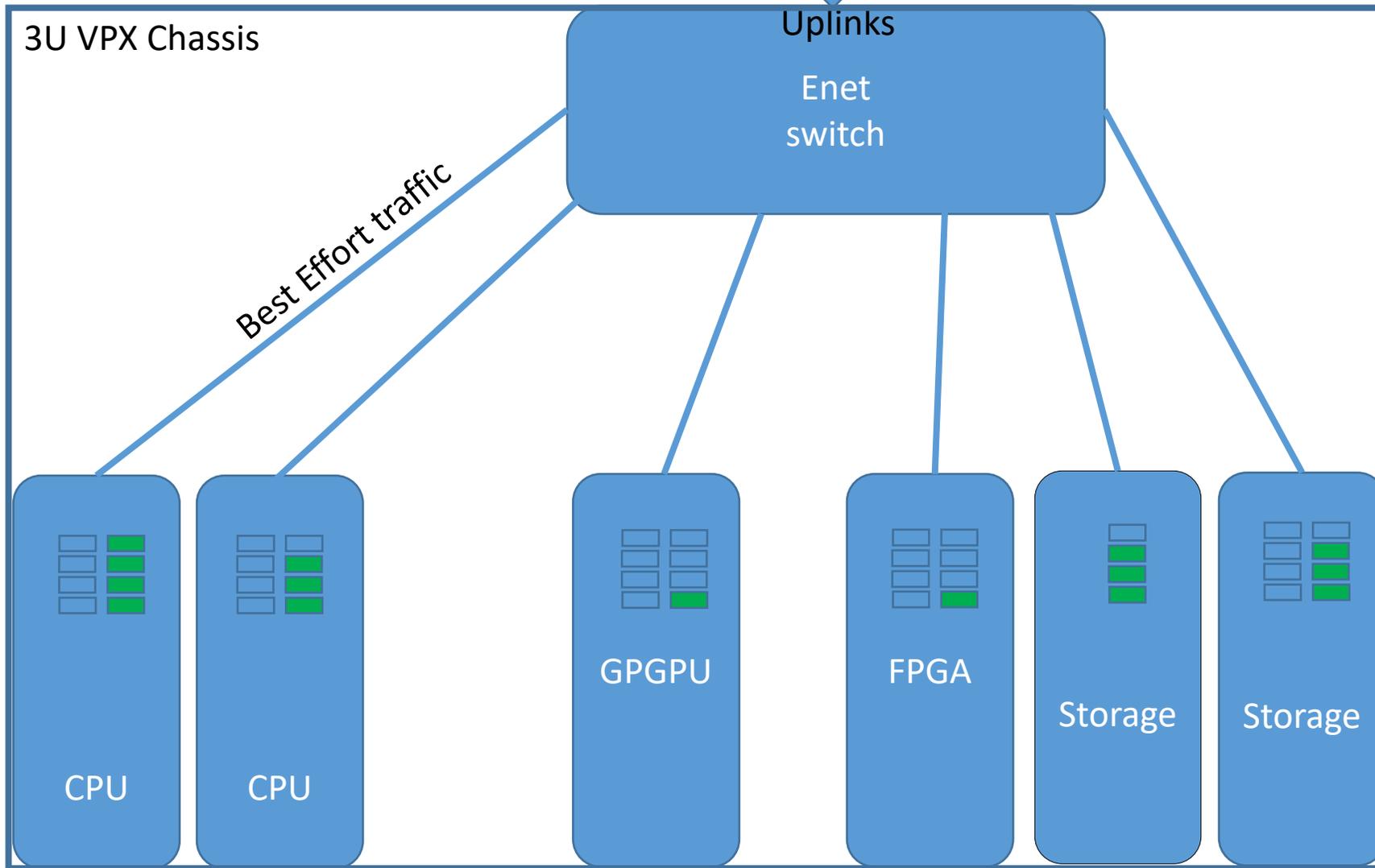
Time Sensitive Networking (TSN)

- Time Synchronization
 - IEEE 802.1AS gPTP
- Traffic Shaping
 - IEEE 802.1Qbv – Time aware Shaper (TAS)
 - IEEE 802.1Qav – Credit Based Shaper (CBS)
- High Availability
 - IEEE 802.1CB – Frame Redundancy and Elimination for Reliability (FRER)
- Configuration of the network
 - IEEE802.1Qcc - Centralized Network Configuration(CNC)
- Traffic Types
 - Hard Real-Time (i.e. Control)
 - Soft Real-Time (User experience i.e. Video display)
 - Best Effort (General traffic)



REAL TIME

Ethernet Systems Perspective

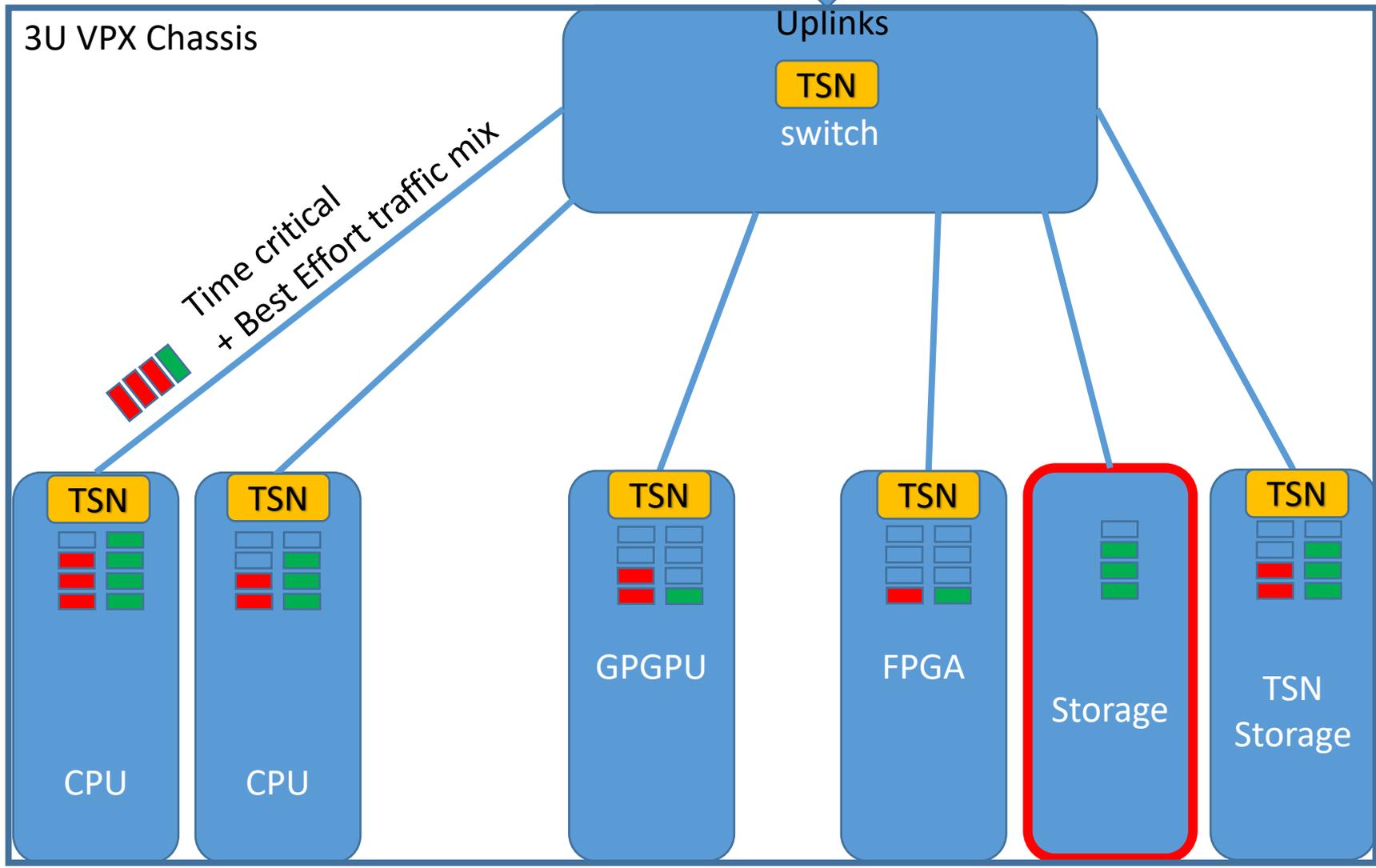


REAL TIME

Green = Packets

Common Time Base
across system w/ 802.1AS

Time Sensitive Systems Perspective



REAL TIME

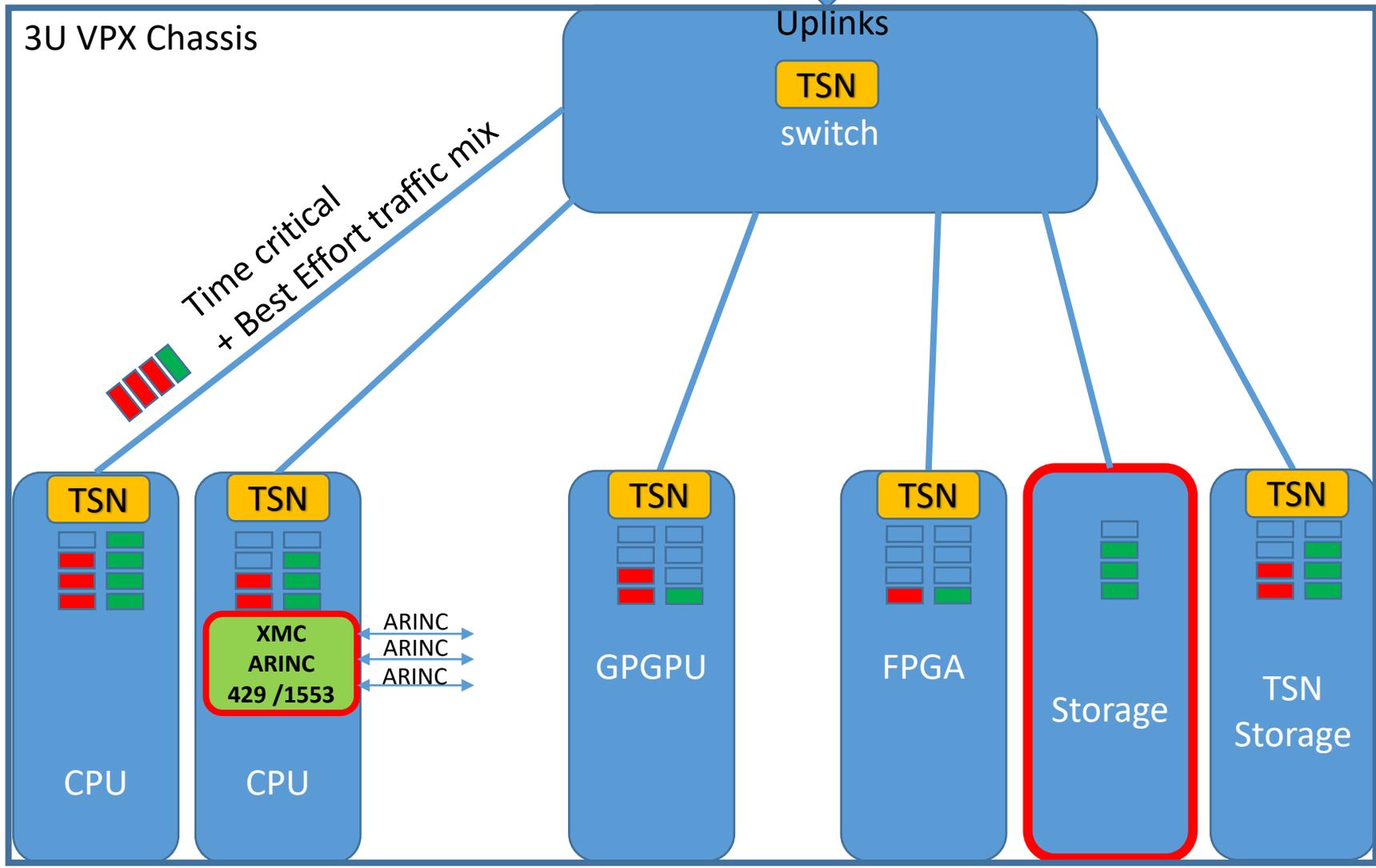
Key



Red = High Priority queue
Green = Low Priority queue

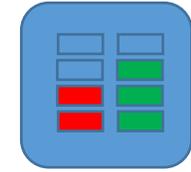
Common Time Base
across system w/ 802.1AS

Time Sensitive Systems Perspective



REAL TIME

Key

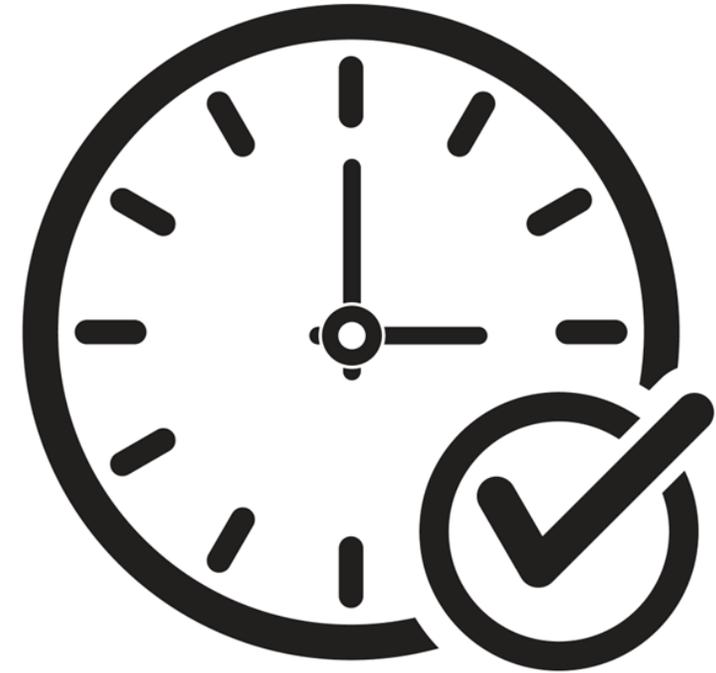


Red = High Priority queue
Green = Low Priority queue

Common Time Base
across system w/ 802.1AS

Real Time Summary

- TSN is driving another change in architectures
- Early days but has significant momentum



REAL TIME

Thank You

Nigel Forrester
Director of Strategy