

Enabling SMPTE ST 2110 in 100% Software-Based IP Video Applications on Standard COTS HW

Maximizing the Scalability / Agility Promise of IP in Live Production workflows



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Summary

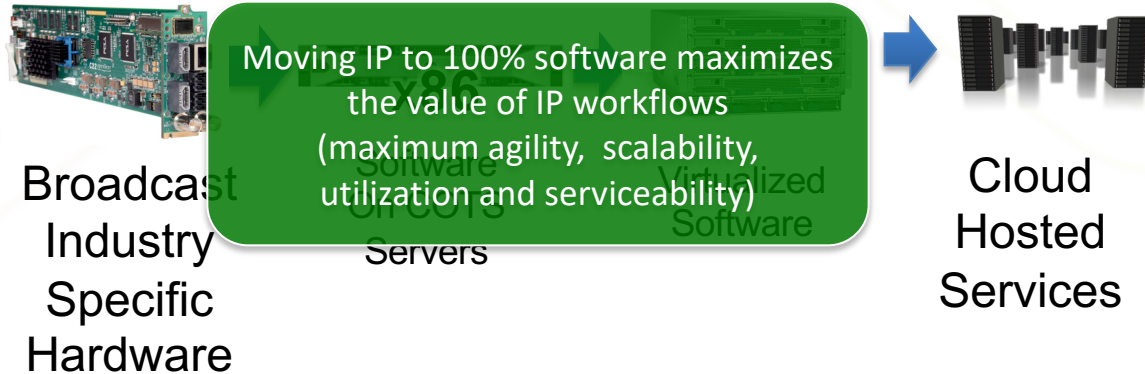
- 1 100% Software based IP ST 2110 (uncompressed) workflows:
Achieving the full potential of IP in Live Production
- 2 Characteristics of ST 2110 and their impact on Live Production workflows on standard COTS HW
- 3 Innovations that enable 2110 to be deployed 100% software on standard COTS HW

Transition to IP only gets you so far...

Replacing SDI Infrastructure with IP



Transition IP to 100% Software



Realtime Video & SW are an “Odd Couple”

Many things impact the ability of a CPU to handle uncompressed video streams

- Many overhead tasks are going on at once, not related to video
- Tasks are asynchronous
- Tasks may use CPU unpredictably
- Tasks may “hog” resources in an untimely manner

Hardware

- Memory bandwidth
- Bus bandwidths
- Network Interface

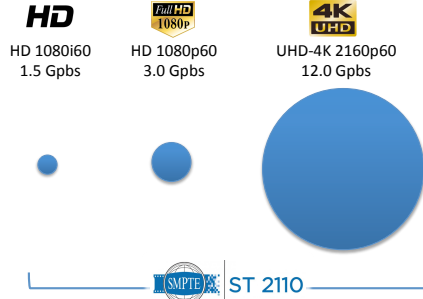
All of these things make it difficult to build critical **realtime** applications.

Deep customization of the OS is required to meet the needs of uncompressed video



SMPTE ST 2110 on 100% software on COTS

SMPTE 2110 Characteristic 1: Huge Bandwidth

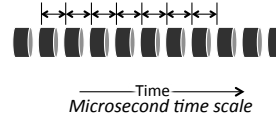


SMPTE 2110 Characteristic 2: Tight Packet Pacing

SMPTE ST 2110 Video Flow



Very Tight and Consistent Packet Pacing



Live Production Demands Very Low Latency



100% Software Running on COTS Computer Servers

COTS Glass Ceiling is being Shattered

Today's COTS server-class CPUs and supporting hardware are able to do uncompressed video

- Raw bandwidth, memory, timeliness is sufficient
- As time passes, more processing and IO can be accommodated

There is always a ceiling to how much can get done

- This is a function of code design – better code = more functionality

How much can be done is a pure function of the virtuosity and mastery with which the code is written. Requires deep understanding of HW design and SW design.



Challenges: Software Kernel Limitations

The Kernel is designed for general use cases. Almost everything is asynchronous among activities

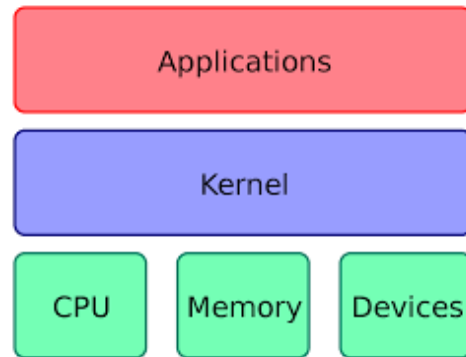
Hardware video solutions use clocks and counters, **highly accurate and predictable**

Software uses buffers and queues combined with scheduling = **Low predictability**

Video needs precise predictability and low latency

Network drivers and stacks provide the network software services

- These are written for utility, not speed
- Since most IT networks are far slower than the CPU, they're not well optimized
- Sub-microsecond services are not available in legacy drivers



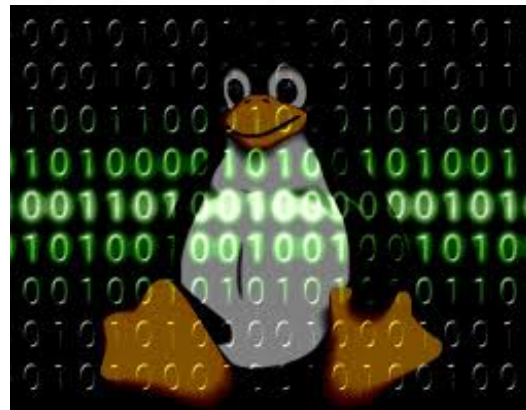
But times are a changing and Linux is helping lead the way

Today the Operating System of choice for COTS video applications is Linux.

Linux is Open-Source, and deeply customizable with no licensing or secrets involved

- *Open-source, broad and deep support in that community*
- *Vast array of available information on all aspects of its design*
- *Rich development toolsets exist and are evolving*
- *Manageable security*

Kernel can be extensively customized and optimized.



Linux CPU Management 101

- Most computer programs reside in “Application Space” memory
- Managed memory on the system that is reserved for applications
- Data is moved to and from the OS kernel’s memory
- The lower-level work is the function of the kernel
- The Kernel is the core code in the OS

Kernel provides:

- Application Program Interfaces (APIs) to it’s low-level services
- Abstracts the hardware from the applications
- File System, Process scheduling / CPU time management
- Enables multiple processes to appear to run simultaneously
User tools (ping, ifconfig, etc.)

Linux is a kernel, it is packaged with other software to make it a full OS.
(Ubuntu, Debian, etc.)



Meet The Orchestra

What if..... We could handle 2110 in SW with latency = 1fps?

The most difficult challenge today for COTS CPUs is the SMPTE ST 2110

- GPUs can't help
- Full video bandwidth needs to be input and output in **realtime**
- The 2110-21 Narrow Profile needs to be met

Achieving this is tough. Achieving it on many **realtime** streams is really tough

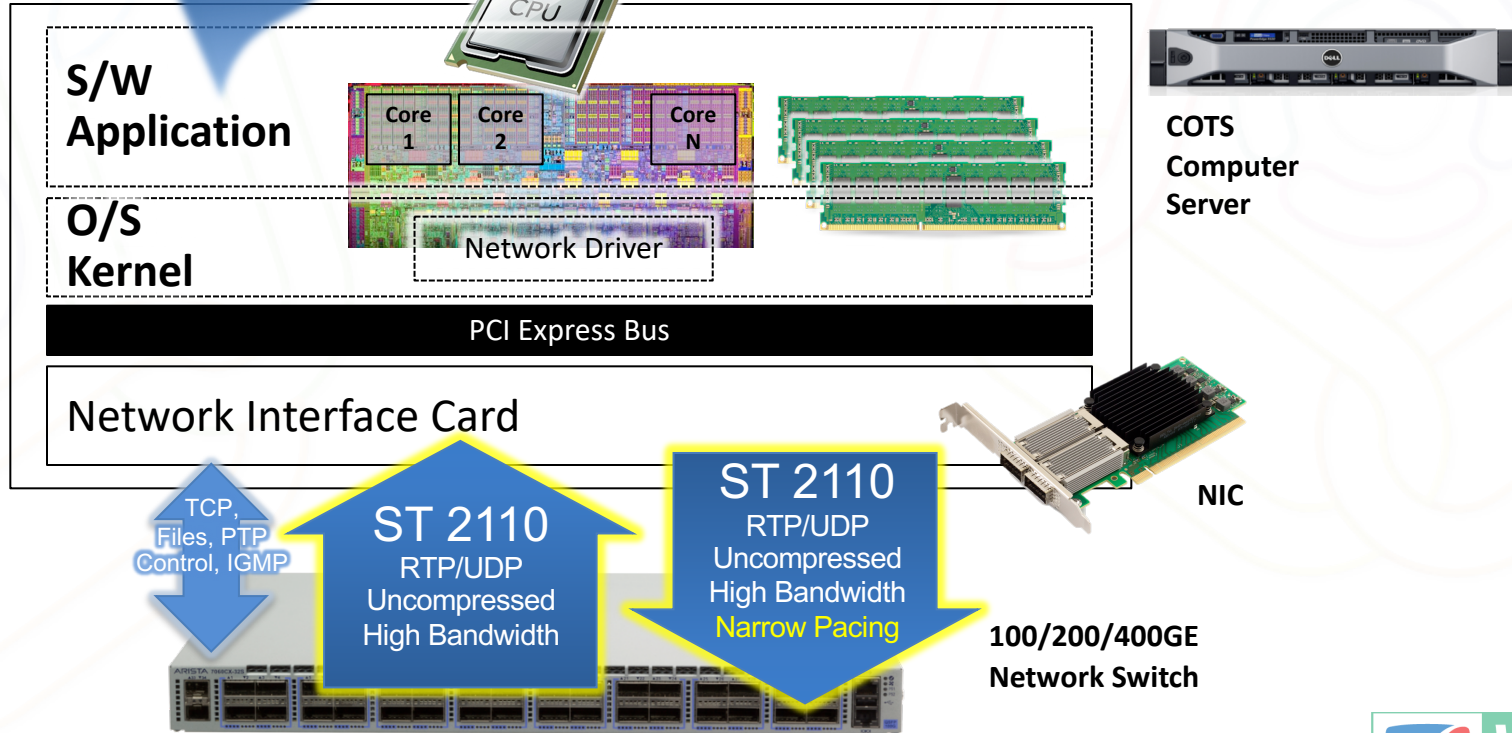
Many things conspire inside the platform and OS that need to be dealt with.

Let's examine a couple of key problems and the solutions that enable large numbers of uncompressed channels to be handled while meeting required timing constraints and leaving time for meaningful applications to be used.

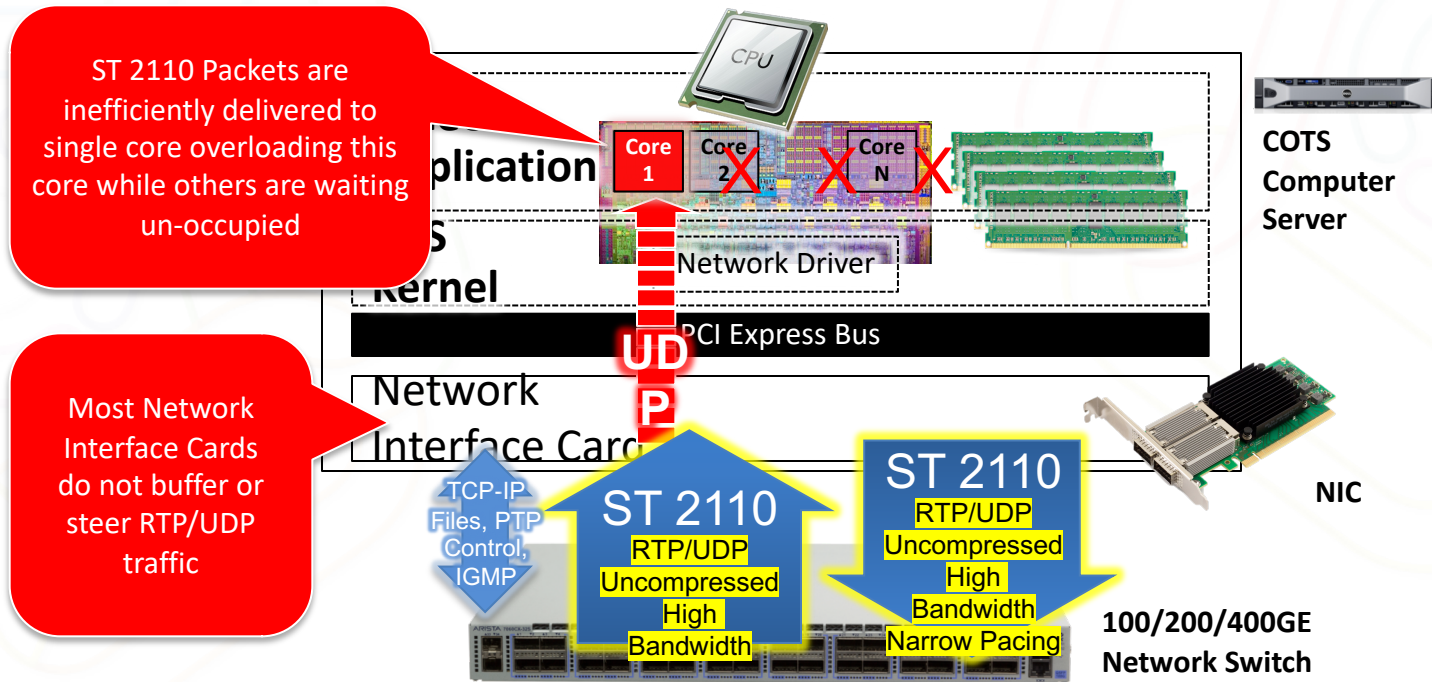


The COTS Hardware and Software Environment

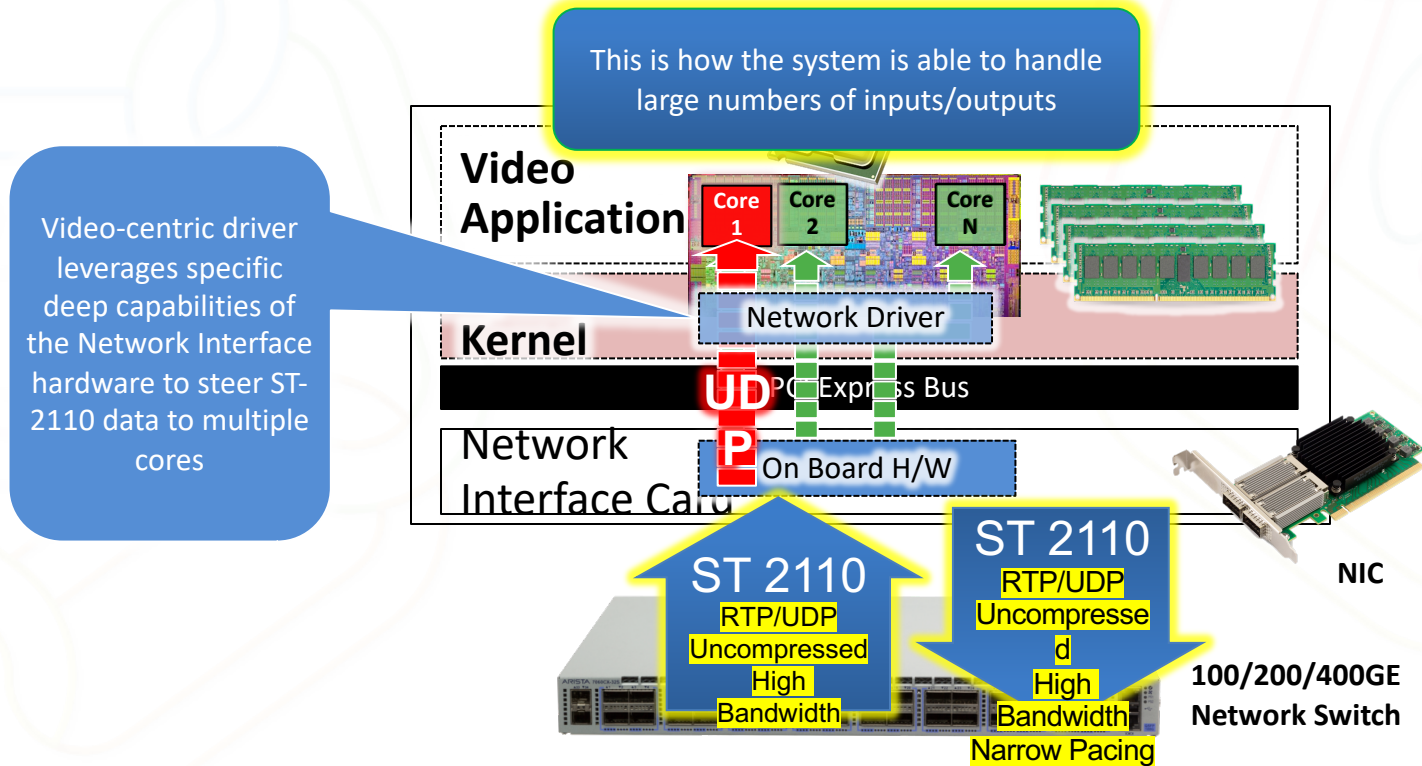
Video S/W Application



Challenge: Lack of Steering of RTP/UDP Packets

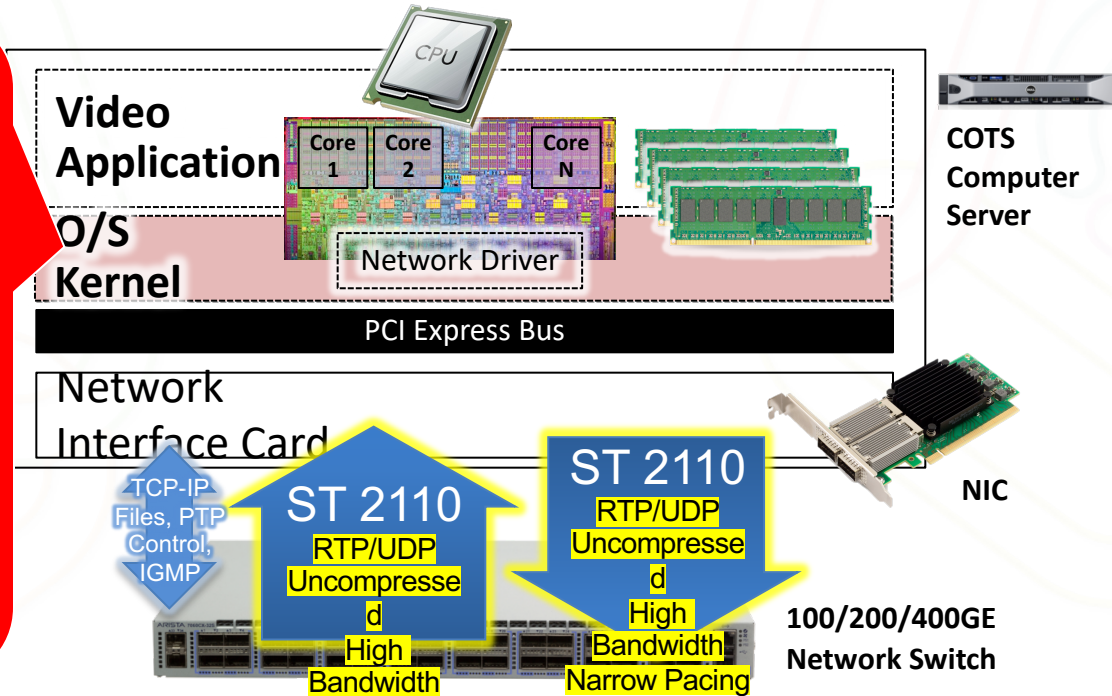
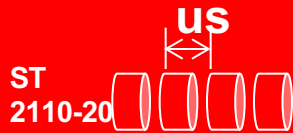


Solution: Custom Driver to Steer Packets



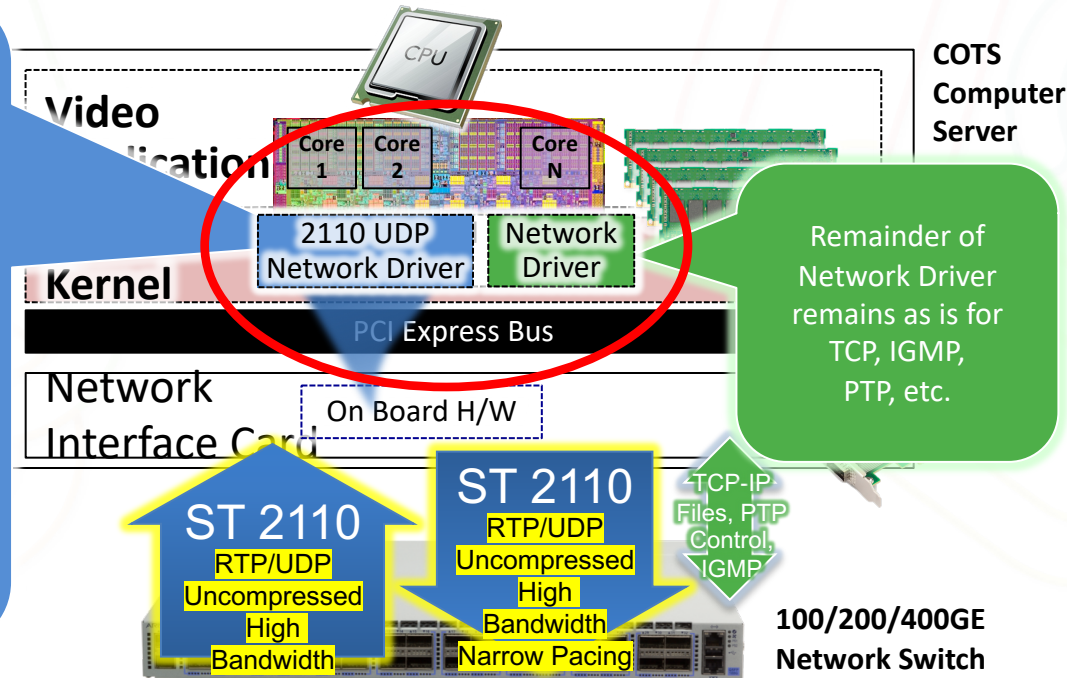
Challenge: The tight timings of ST 2110

O/S Kernel is not designed to support tight timing requirements of ST-2110 video flows, especially sending with the 2110-21 Narrow Profile

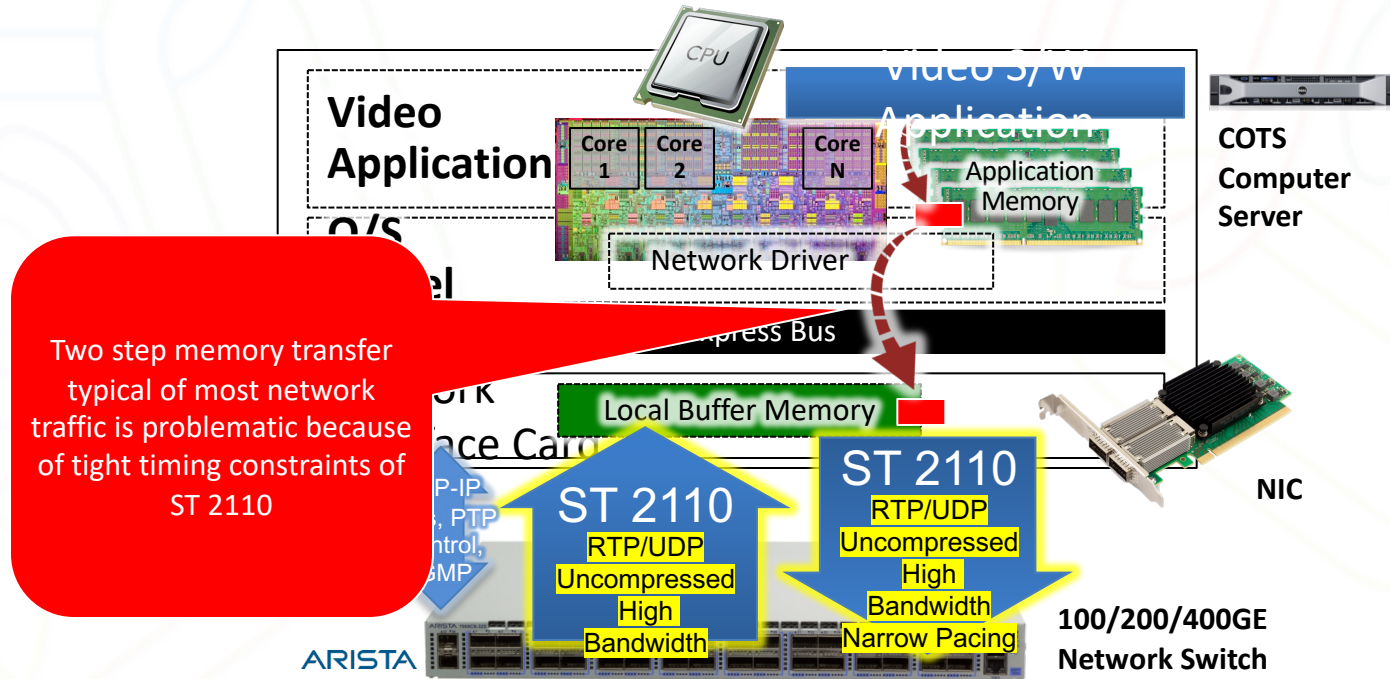


Solution: Write Specialized Network Driver

The answer is to re-write the RTP/UDP portion of the network driver to leverage hardware off-loading on the NIC to meet the timing constraints of SMPTE 2110

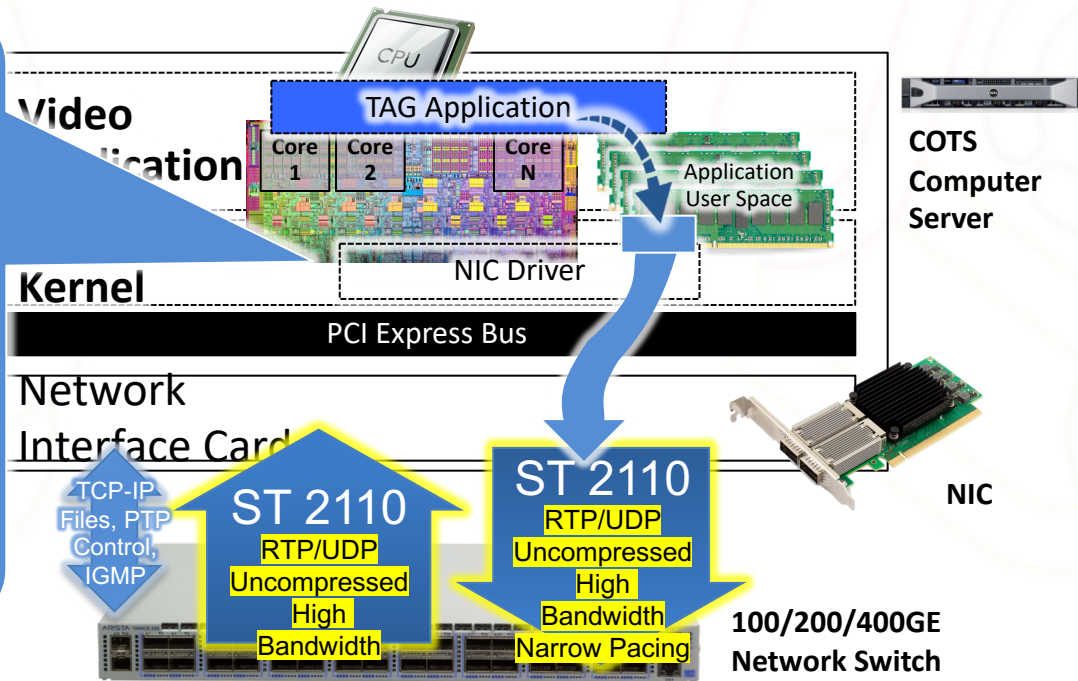


Challenge: Double Memory Copies



Solution: Application Access to NIC Buffers

Clever driver code enables Application to work directly with Network Interface Card's buffers, eliminating the double copy.



Summary

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The full potential of IP is achieved when it is deployed in 100% Software on standard COTS

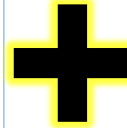
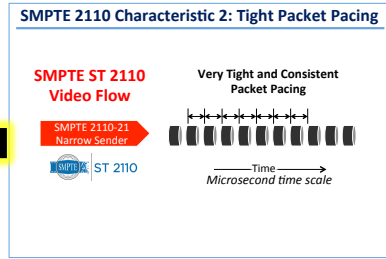
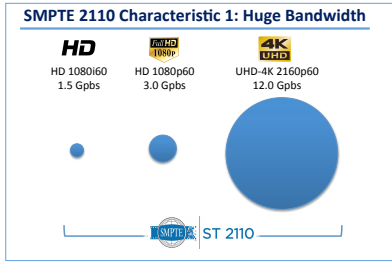
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Overcoming the challenges of 2110 requires deep understanding of COTS hardware design and SW innovation.

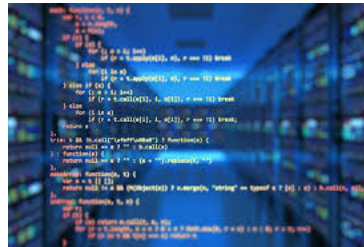
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Live Production Multiviewing is one of the most demanding applications to deploy 100%SW 100%COTS. Now commercially deployed, this should pave the way to accelerate the full value of IP workflows across all realtime applications

100% SW 2110 on COTS



ST 2110





WORLD'S #1 INTEGRATED PROBING, MONITORING, & MULTIVIEWING SOFTWARE SOLUTION

The background of the lower half of the slide is a blue-tinted image of a large video wall. The wall is composed of many smaller screens displaying various video feeds. Some of the visible text on the screens includes "MCM-8000", "DASH", "TAG VVS", "Penalty Box", and a digital clock showing "3:09:02".

THANK YOU
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