

SMPTE ST 2110 FPGA-based NIC for IP Media Workflows

The FPGA-based SMPTE ST 2110 network interface controller (NIC) card provides multi-channel IP video I/O from HD to 4K with zero CPU usage.

Key Applications

- Studio Broadcast / Live Production
- Video Wall displays
- Virtual Production
- Post-Production

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The future of Media and Entertainment

Broadcasters worldwide seek more flexible, agile, and scalable hardware infrastructures to easily adapt to the requirements of today's media consumption cases.

There are two main trends to accomplish these goals: a technological shift towards software-based media processing solutions and an Internet Protocol (IP) network-based infrastructure to share media content with higher flexibility. Software solutions can be easily deployed, modified, updated, and maintained with minimal overhead over standard commercial off-the-shelf (COTS) based hardware. Using IP for media connectivity lets you change the way you conduct live video productions as you can implement distributed workflows, breaking geographical boundaries and restrictions.

IP infrastructure is seen as the foundation for the use of commodity hardware with software-only applications. This will in turn enable virtualization, which is a precondition to migrating systems into on-premises or cloud data centers for resource sharing that will increase efficiency and reduce costs.

While different proprietary IP production solutions have been available for the past years, SMPTE ST 2110 marks the first time an IP standard is designed from the ground up for truly flexible workflows that is widely adopted across the industry. However, there are challenges that need to be addressed to fully leverage the benefits of architectures combining software-based media processing solutions and SMPTE ST 2110 based IP networks.



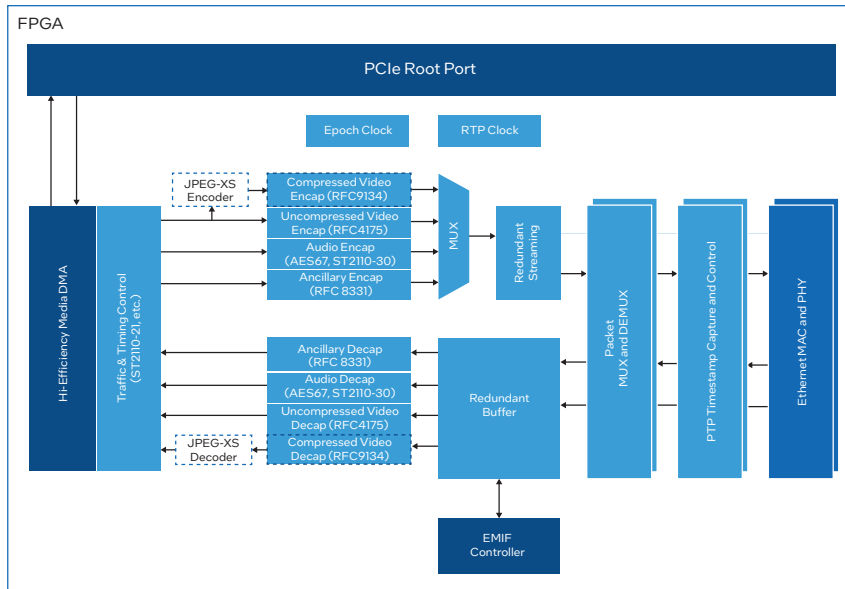


Figure 1. FPGA solution block diagram

Network challenges for real-time media

A typical IP network provides best-effort delivery and uses retry and retransmit mechanisms to compensate for any lossy connectivity. When it comes to real-time transport of live studio feeds, network-based packet losses cannot be tolerated.

To ensure connectivity, properly designed networks are critical and the IP traffic requires specification to interoperate and behave deterministically. The ultimate goal for an IP setup is to achieve 24/7 operations at scale using best-of-breed broadcast equipment while achieving high network utilization.

SMPTE ST 2110 provides the requirements for transporting uncompressed video essence. Its development signals a move towards standards-based IP connectivity that provides industry-wide interoperability for robust and flexible connectivity – with a prerequisite of having the same reliable and deterministic behavior as the Serial Digital Interface (SDI) standard.

In broadcast, SDI has set the bar for being predictable and deterministic. SMPTE ST 2110 was developed as a low-latency and flexible replacement to SDI, but it comes with its own complexities in PC-based platforms:

- The network fabric capacity must not be overwhelmed when transmitting high-bitrate video essence over a network. This is called packet pacing.
- The accurate precision time protocol (PTP) across the different nodes and network fabric is required to reduce jitter, latency, and network buffering requirements.
- Network kernel bypass is needed to reduce unnecessary CPU usage and improve throughput.
- The redundancy scheme, also called hitless protection switching, needs to be managed at the NIC level to optimize CPU usage and to reduce unnecessary PCIe* bandwidth.

Optimizing solutions with SMPTE ST 2110 NIC

A SMPTE ST 2110 -aware NIC is a COTS add-in card providing access to an accelerated media network protocol stack implemented in a built-in FPGA. Using the accelerated network stack, a broadcast software application can send and receive full frame video, audio, and ancillary data to and from the card.

The combination of the full hardware implementation of the SMPTE ST 2110 protocol stack – including PTP timestamping, packet pacing, and hitless protection switching – and a fully featured multichannel Direct Memory Access (DMA) engine allows the media content to be transferred directly to and from the host CPU memory and the SMPTE ST 2110 network card. This is done independent from the OS and with no CPU usage.

Using SMPTE ST 2110-aware NICs, software-based applications can easily process SMPTE ST 2110 flows without compromising system resources or network integrity – all the while providing deterministic, scalable, and repeatable SMPTE ST 2110 environments.

Intel together with Macnica has developed a 100G SmartNIC solution, which will provide a hardware-accelerated alternative to today's mainly software-based SMPTE ST 2110 100 Gb solutions.

Intel® FPGA-based NIC cards combined with Macnica's FPGA intellectual property cores enable more efficient bandwidth usage over 100 Gb networks, providing benefits that include better power efficiency and lower CPU utilization, whilst offering OS independent deterministic behavior and overall lower system latency.

Intel® FPGA SmartNIC N6000-PL Platform

The platform of choice is the Intel® FPGA SmartNIC N6000-PL Platform which features the Intel Agilex® 7 FPGA providing on-board resources for the most demanding video processing workloads.

The platform provides dual-port QSFP28 network interfaces for up to 100 GbE each, a PCIe Gen4 x16 connection with the host server, and up to five independent DDR4 memory banks for local media buffering implementation.

Learn more about the [Intel® FPGA SmartNIC N6000-PL Platform](#).

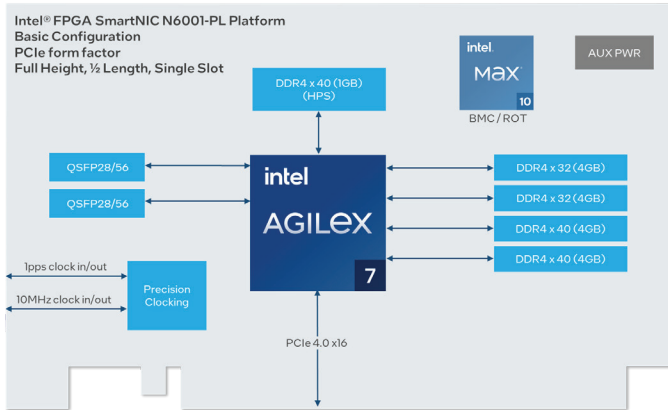


Figure 2. Intel® FPGA SmartNIC N6000-PL Platform block diagram

Macnica Media Over IP Package

Macnica offers an SMPTE ST 2110 compliant FPGA-based solution for broadcasting systems. It consists of SMPTE ST 2110 hardware intellectual property for Intel SoC FPGA implementation, as well as the SMPTE ST 2110 Software Development Kit (SDK) and a collection of reference designs and implementation for SDI-to-IP gateways and NIC solutions.

Learn more about Macnica's [Media Over IP Package](#).



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Macnica Media Streaming SDK

Macnica's 100G SmartNIC solution adds another layer when integrated with the new Macnica Media Streaming (M2S) SDK which debuted at IBC 2022. The M2S SDK enables the implementation of software-based SMPTE ST 2110 systems on general-purpose servers. This provides a gateway solution for broadcast systems that operate "all-IP" workflows, whether deployed on-premises or in the cloud. The M2S SDK can be used with a wide variety of NIC cards, providing users with more flexibility to build products with optimal specifications.

Learn more about the [M2S SDK](#).

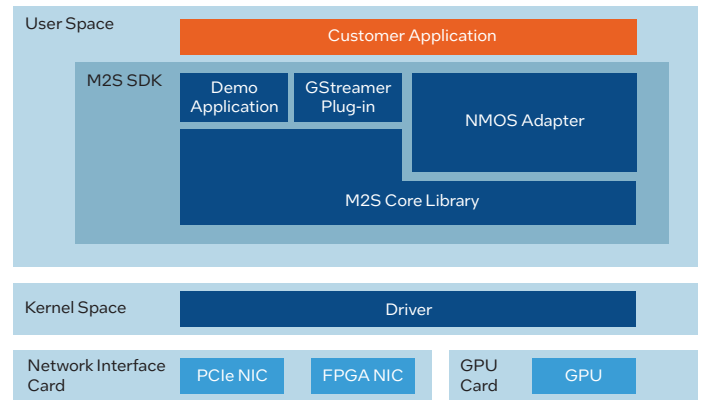


Figure 3. Macnica M2S SDK components

Specifications

- Compliant with SMPTE ST 2110-20, 2110-22, 2110-30, 2110-31, and 2110-40: video, audio, and ancillary essence stream encapsulation/decapsulation
- Seamless reconstruction in hardware of SMPTE ST 2022-7 redundant streams (Class C)
- SMPTE ST 2110-21 compliant hardware packet pacing at line rate (up to 100 Gbps) (Type N)
- Up to 8x 4k60 streams, up to 16x 1080p60 streams (any combination < 100 Gbps)
- Integrated hardware PTP for SMPTE ST 2059-2
- NMOS integration for management orchestration (i.e. NMOS IS-04 and IS-05)
- V4L2-compatible GStreamer plugin