

Create Redundant Networks with TSN 802.1CB

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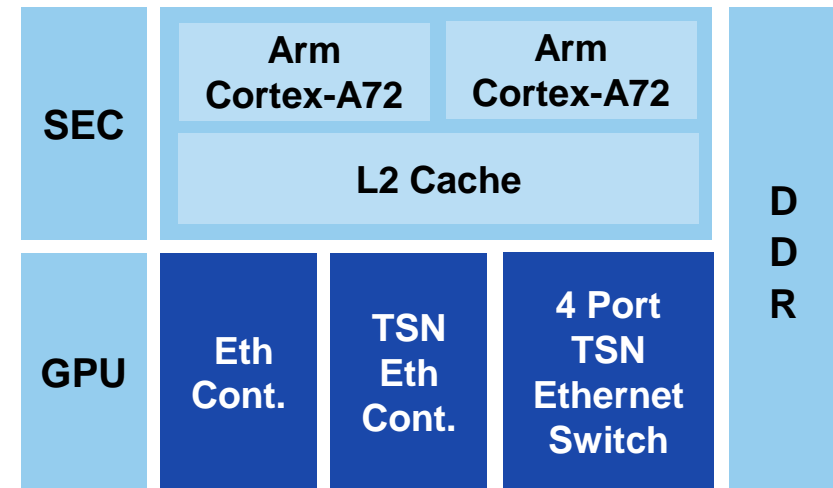
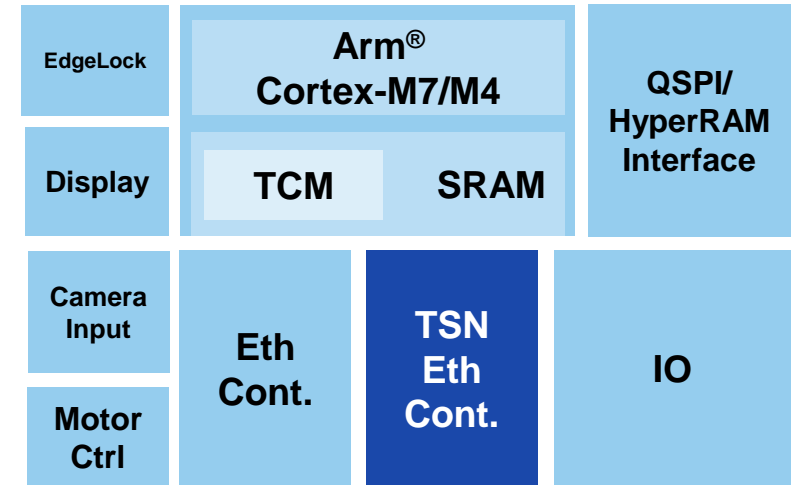
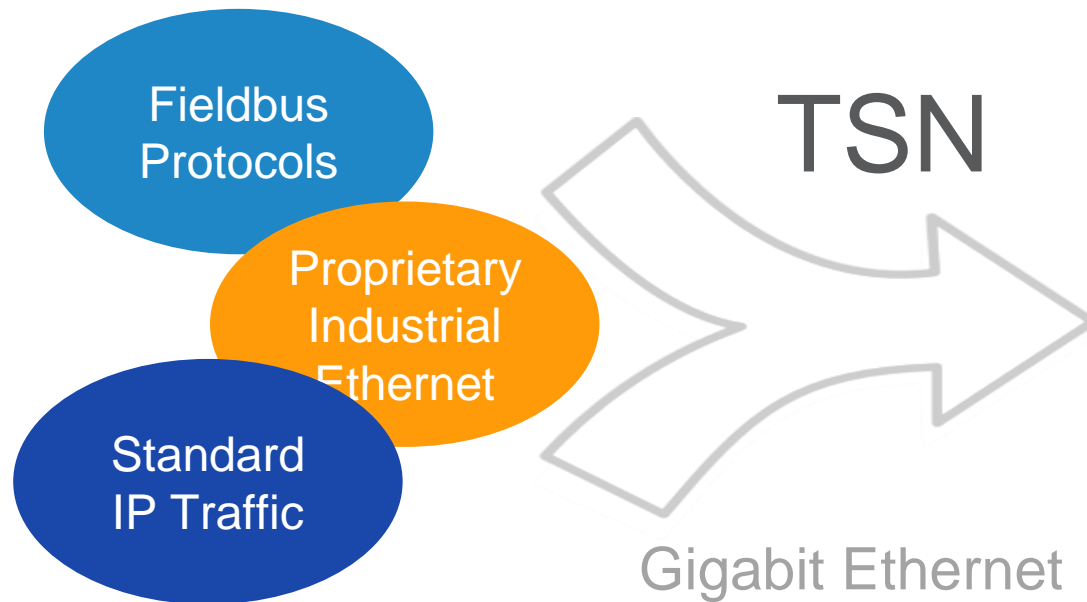
EXTERNAL

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EMBEDDED TIME-SENSITIVE NETWORKING (TSN)

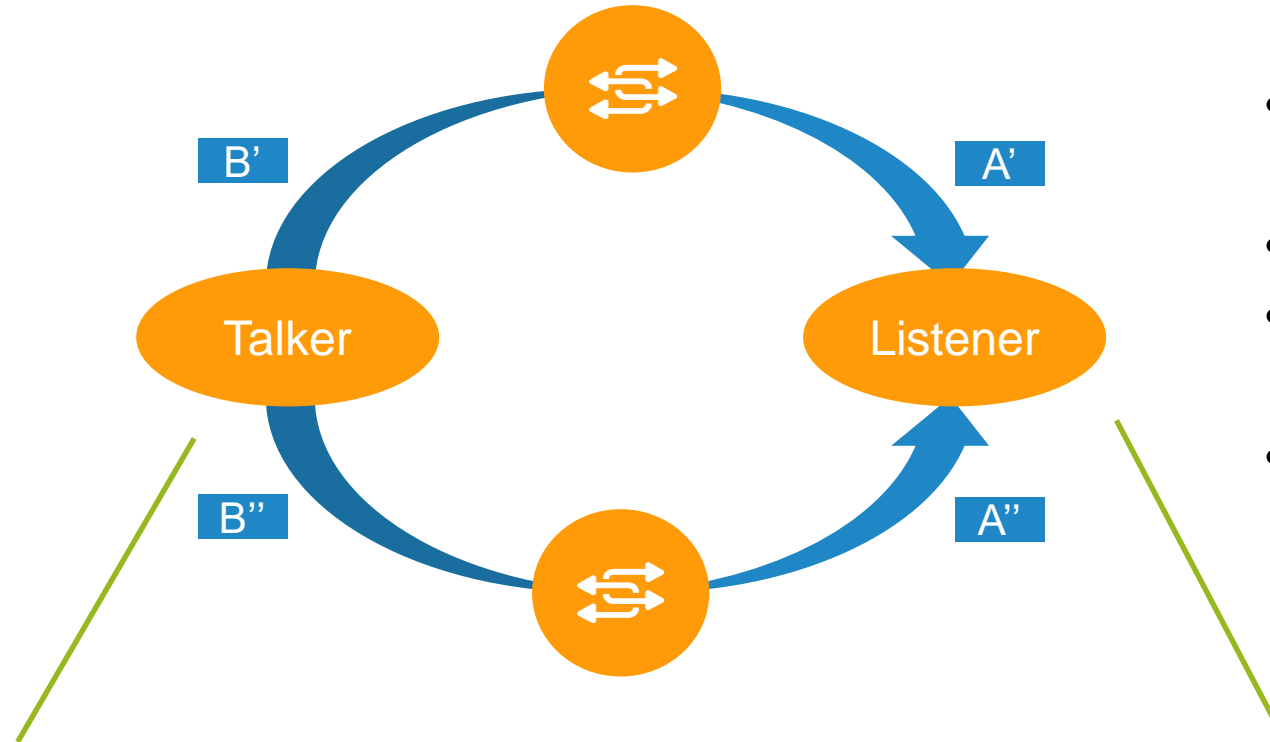
- Converge OT and IT traffic in a single network
- Determinist Ethernet at gigabit speeds
- Reduce network delays, improve robustness
- Embedded in multi-processor and crossover MCUs



TSN STANDARDS FOR INDUSTRY

Standard	Description
802.1Qbv	Scheduled Traffic
802.1Qav	Forwarding and Queuing Enhancements
802.1Qbu, 802.3BR	Frame Preemption
802.1CB	Frame Replication and Elimination for Reliability
802.1Qci	Per-stream filtering and policing
802.1AS	Timing and synchronization for Time-Sensitive Applications

802.1CB – FRAME REPLICATION AND ELIMINATION FOR RELIABILITY

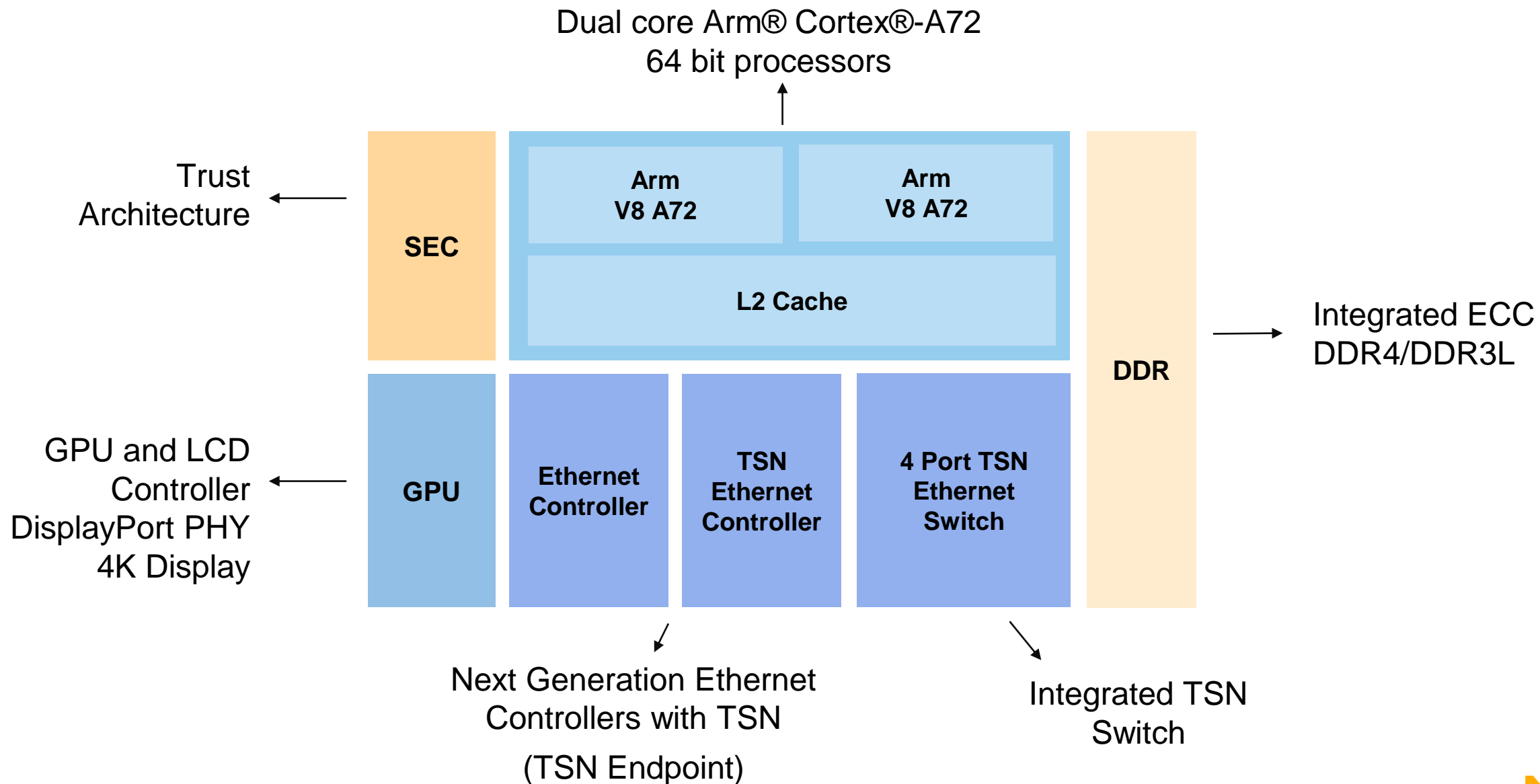


- TSN hardware performs replication/elimination
- Zero time failover if 1 path fails
- No need for upper level retry mechanisms
- Simpler code base with reliability

Talker replicates Ethernet frames and sends over multiple paths to Listener

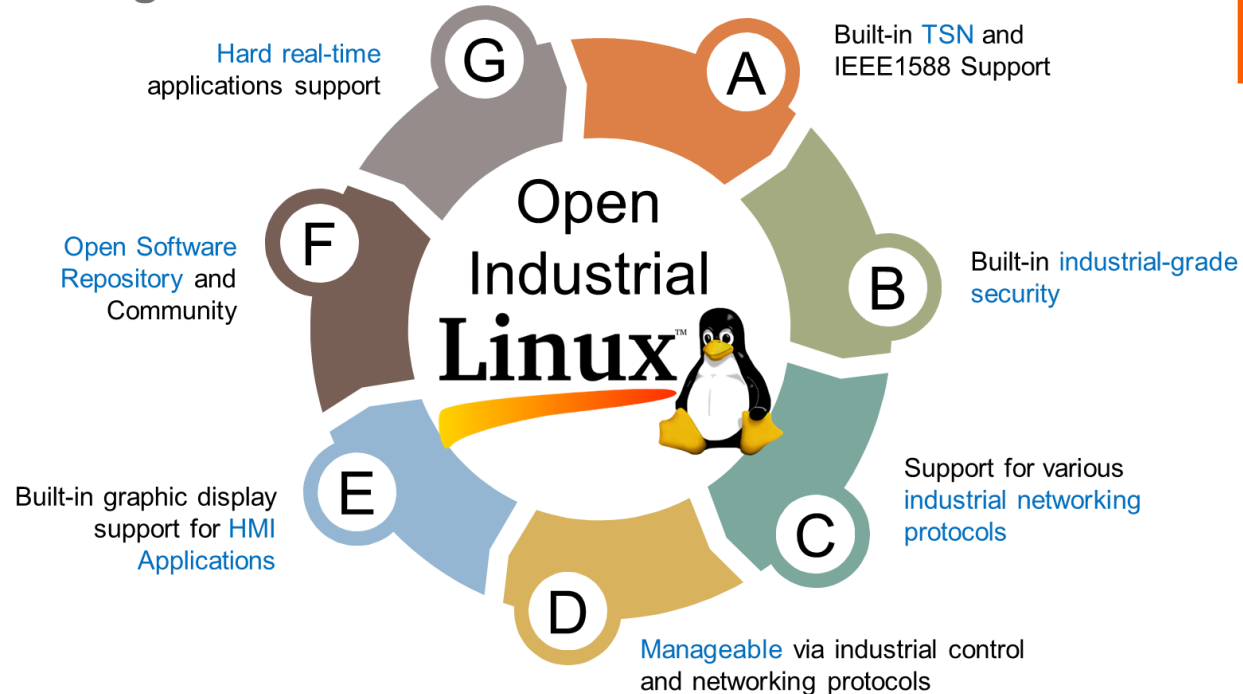
- Listener provides first Ethernet frame that arrives to application
- Listener removes duplicates

LAYERSCAPE LS1028A – INDUSTRY READY



OPENIL OPEN INDUSTRIAL LINUX

OpenIL.org



LS1028A

- Deterministic Computing
Xenomai Linux
Bare Metal Framework
- Open Source support for TSN
- Open source support for timing synchronization (PTP, gPTP)

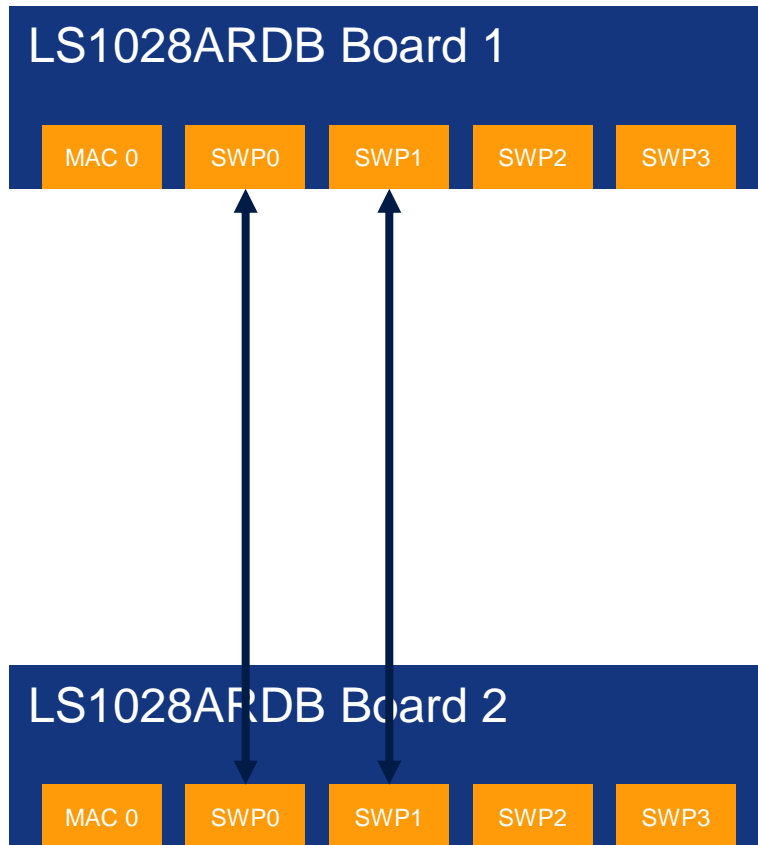
IEEE 802.1CB - STREAM IDENTIFICATION

- Clause 6 of 802.1CB defines 4 stream identification functions:

Stream identification function	Examines	Overwrites
Null	DMAC, VLAN ID	None
Source MAC and VLAN	SMAC, VLAN ID	None
Active Destination MAC and VLAN	DMAC, VLAN ID	DMAC, VLAN ID, VLAN PCP
IP	DMAC, VLAN ID, IP SRC, IP DST, DSCP, IP Next Proto, Source Port, Destination Port	None

- The LS1028A switch supports the Null Stream Identification.
 - This means that based on the MAC table (FDB rules), the switch may perform a lookup and associate {DMAC, VLAN} pairs with a Seamless Stream ID (SSID).

IEEE 802.1CB - USAGE EXAMPLE



- Use 802.1CB to create redundant streams between 2 LS1028A devices
- Instant failover if one of the links fails
- Use Cases:
 - Wireless links
 - (microwave, point-to-point)
 - Critical control and data paths
 - (automotive, data center, industrial)

TRAFFIC GENERATION

- `tsntool cbstreamidset -device swp0 -nullstreamid -nulldmac <receive_board eno2 macaddr> --nullvid <vid1> --streamhandle <ssid> --index <ssid> --enable`
- `tsntool cbgen -device swp0 -index <ssid> --iport_mask 0x10 -split_mask 0x03 -seq_length 16 -seq_num 0`

Identify stream to replicate (Using null stream ID)
Specify rules to split traffic

TRAFFIC TERMINATION

- `tsntool cbstreamidset -device swp4 -nullstreamid -nulldmac <receive_board eno2 macaddr> --nullvid <vid1> --streamhandle <ssid>`
- `tsntool cbrec -device swp0 -index <ssid> -seq_length 16 -his_len 31 -rtag_pop_en`

NXP has scripts to perform switch configuration and vlan Ethernet device.

Identify stream to join (Using null stream ID)
Specify rules to perform sequence recovery

LS1028A 802.1CB DEMONSTRATION

version 19.09.0

LS1028ARDB TSN 802.1CB

MASTER SLAVE

Start Demo Stop Demo

802.1CB Frame Replication and Elimination 906 MBPS

BandWidth (in Mbps)

Time

Iperf Traffic (TSN-Board)

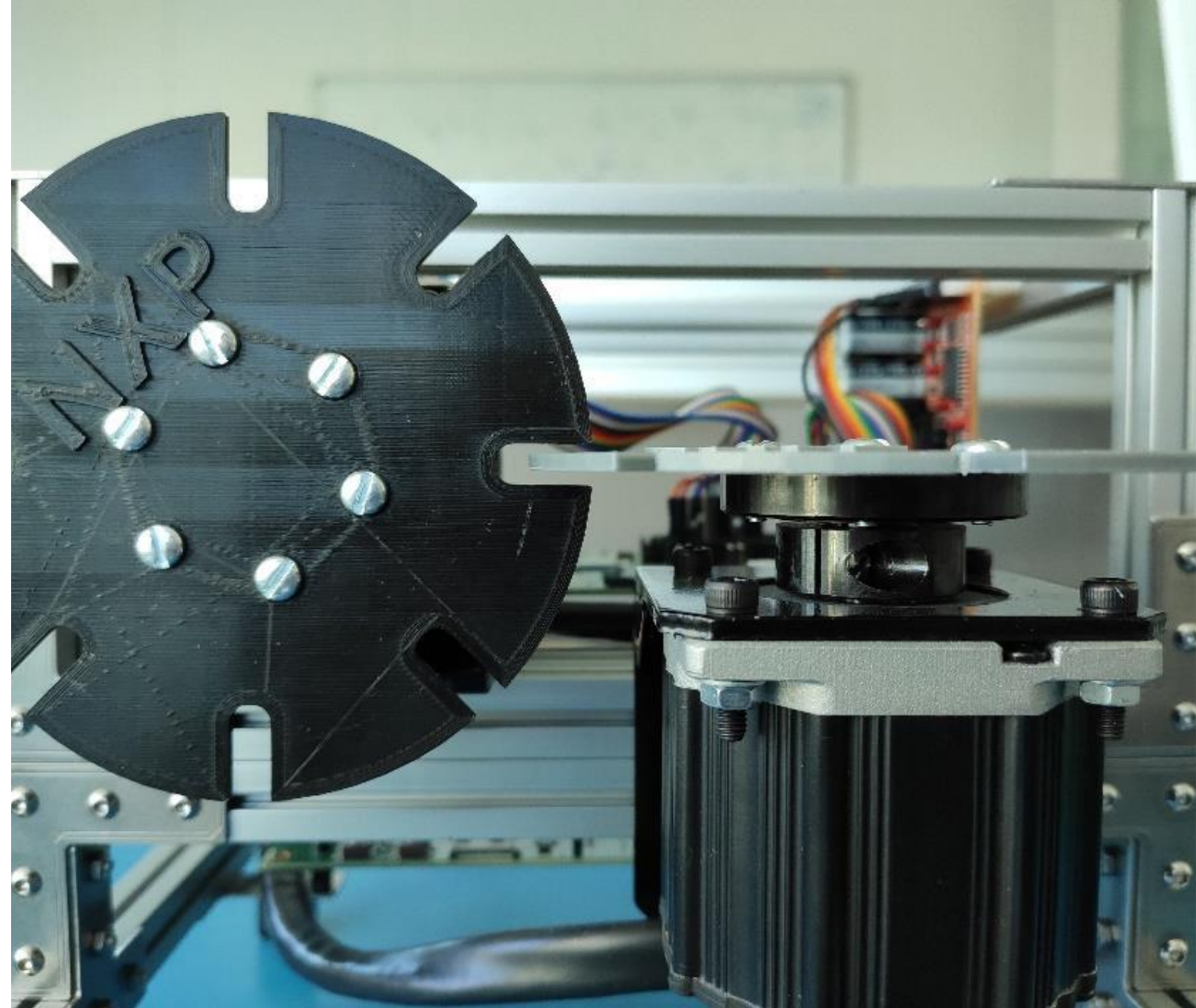
Start Stream Stop Stream

on Mar 23, 06:20 PM

BENEFITS FOR FRAME REPLICATION AND ELIMINATION

- Instant failover for redundant communication paths
- Available on NXP LS1028A
- Open source software support

TSN AT NXP



ADDITIONAL RESOURCES

Product Pages

- LS1028A <https://www.nxp.com/LS1028A>
- LS1028ARDB (Reference Design Board) <https://www.nxp.com/LS1028ARDB>
- Layerscape SDK <https://www.nxp.com/LSDK>



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