



Yocto Project*-based Board Support Package for 11th Gen Intel® Core™ Processors (Formerly Known as Tiger Lake UP3) on IoT Platforms (Kernel 5.10)

Release Notes

April 2024

Maintenance Release 8 (MR8)



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Revision History

Date	Revision	Description
April 2024	3.1	<ul style="list-style-type: none"> Updated info in Section 3.2.5, 3.4.5 & 3.5.2 Intel® TCC Tools is no longer supported
May 2023	3.0	MR8 Release <ul style="list-style-type: none"> Intel® oneVPL replaced Intel® Media SDK which has been EOL Added support Intel® Ethernet Controller I226
December 2022	2.0	MR7 Release <ul style="list-style-type: none"> Added Everest i2s based codec support Added TI DP83867 Ethernet Phy support Added support for 8K60 via DP1.4 to HDMI2.1 LSPCON with Source Control Mode Reinstate Intel® TCC Tools support
July 2022	1.0	MR6 Release <ul style="list-style-type: none"> Added Senary HD codec support Removed Intel® TCC Tools support

1.0 Introduction

This document provides release information, notes, and reference for the Yocto Project*-based board support package (BSP). For instructions on how to build the Yocto Project-based image, refer to the *Yocto Project*-based Board Support Package for the 11th Gen Intel® Core™ Processors (Code Name: Tiger Lake UP3) Get Started Guide* ([Document number: 635120](#)).

Notes: The version of the Yocto Project*-based build system and the corresponding open-source software components that are suggested for use with the BSP are only for reference purposes. If you decide to use Yocto Project*, it is your responsibility to integrate the latest functional and/or security updates when they are available from the open-source community

1.1 Terminology

Table 1. Terminology

Term	Description
AIC	Add-in Card
BKC	Best-Known Configuration
BSP	Board Support Package
DCL	Dear Customer Letter
DG	Developer's Guide
GPIO	General-Purpose Input/Output
gPTP	Generalized Precision Time Protocol
HEVC*	High Efficiency Video Coding
ID	Identity
Intel® AMT	Intel® Active Management Technology
Intel® PTT	Intel® Platform Trust Technology
Intel® TCC	Intel® Time Coordinated Computing
I ² C*	Inter-Integrated Circuit
MSI	Message Signaled Interrupts

Term	Description
NVMe*	NVM Express*
PCIe*	Peripheral Component Interconnect Express
PTP	Precision Time Protocol
PXE	Preboot Execution Environment
RDC	Intel Resource & Documentation Center website
RVP	Reference Validation Platform
SATA*	Serial ATA
SDK	Software Development Kit
SMBus	System Management Bus
SoC	System on Chip
SPI	Serial Peripheral Interface
TCP	Transmission Control Protocol
TGPIO	Time-Aware GPIO
TPM	Trusted Platform Module
TSN	Time-Sensitive Networking
TSO	TCP Segmentation Offload
UART	Universal Asynchronous Receiver/Transmitter
USB*	Universal Serial Bus
VAAPI	Video Acceleration API

1.2 Intended Audience

This document is for users of the Yocto Project*-based BSP for the 11th Gen Intel® Core™ processors.

1.3 Customer Support

Contact your Intel representative for support or submit an issue to [Intel® Premier Support](#).

1.4 Reference Documents

Table 2. Reference Documents

Document	Document No./Location
11th Gen Intel® Core™ Processors Real-Time Tuning Guide	640980
Tiger Lake – UP3 for IoT Platforms – Message of the Week	614057
How-to Video: Setting Up Build Environment in the Host System for Yocto Project*	608732
Intel Atom® and Intel® Core™ Processor Build Environment Setup for Yocto Project*	334828
Ethernet Time-Sensitive Networking for Elkhart Lake/Tiger Lake UP3 - Getting Started Guide	616446
Wireless Connectivity Product for Yocto Project* User Guide	617199
Tiger Lake UP3 Platform Reference Validation Platform (RVP) User Guide	612924
Generate Key for Secure Boot with the Yocto Project*-based Image and Bootloader/UEFI BIOS	633630
Intel® In-Band Manageability Framework x86 .1	630741
Yocto Project*-based Board Support Package for 11th Gen Intel® Core™ Processors (Formerly Known as Tiger Lake UP3) Get Started Guide	635120
6th Generation Image Processing Unit for 11th Gen Intel® Core™ Processors (Tiger Lake-UP3) User Guide	646639

Note: To download or search for a specific document, type the document number on the search bar on the Intel website.

2.0 Best-Known Configuration

This section shows the hardware and software compatible configuration for this release.

2.1 Hardware

- 11th Gen Intel® Core™ Processors Platform
- Add-in Card: Intel® Wireless-AC 9260, Intel® Wireless-AC 9560 and Intel® Wi-Fi 6E AX210 Module (for Wi-Fi* technology and Bluetooth® technology)
- Fibocom* LTE Module (M.2) - L860-GL* (Contact Fibocom directly for module information and support)
- Network Interface Card with Intel® Ethernet Controller I225 series

2.2 Software

1. Yocto Project*-based BSP. Refer to the *Yocto Project*-based Board Support Package for the 11th Gen Intel® Core™ Processors (Code Name: Tiger Lake UP3) Get Started Guide* ([Document number: 635120](#)) to download the BSP.
 - LTS Kernel version: v5.10.168 LTS
 - LTS Real-time Kernel version: v5.10.168-rt83
 - Yocto Project* version: v4.0 LTS (Kirkstone)

Note: This kernel source is maintained in GitHub, and it is not the same source as kernel.org.

2. UEFI Reference BIOS: [Document number: 614395](#)
3. Proprietary package: `yocto_project_mr8_release.zip` ([Document number: 759479](#)). The package includes the following files:
 - `meta-intel-cellular.tar.gz`
 - `meta-intel-wireless.tar.gz`

Instructions for integrating the layers are in Section 3 of the *Yocto Project*-based Board Support Package for 11th Gen Intel® Core™ Processors (Code Name: Tiger Lake UP3) Get Started Guide*

4. Audio Firmware i2s via DSP - `audio_fw_mr8.zip` ([Document number: 759479](#))
For further details, refer to Section 5.2 of the *Yocto Project*-based Board Support Package for 11th Gen Intel® Core™ Processors (Code Name: Tiger Lake UP3) Get Started Guide*

5. Intel® Converged Security and Management Engine (Intel® CSME): ([Document number: 776169](#))
6. In-band Manageability Framework ([Document number:768985](#))
7. Intel® oneVPL (<https://github.com/oneapi-src/oneVPL-intel-gpu>)
8. Diagnostic ACM ([Document number: 630368](#))
9. 6th Generation Image Processing Unit RPM Packages: tgl-up3_ipu6_mr8.zip ([Document number: 759479](#))
Instructions for integrating the layers are in Section 3 of the *Yocto Project*-based Board Support Package for 11th Gen Intel® Core™ Processors (Code Name: Tiger Lake UP3) Get Started Guide*

2.3 What's New in This Release

For bug fixes, refer to the respective Fixed Issues sections for details. For firmware or IFWI-related bug fixes, refer to the related IFWI BKC release notes.

3.0 Component Release Notes

3.1 BSP, I/O, Power Management and Security

3.1.1 Introduction

This section contains general release information for BSP, I/O, Power Management and Security.

3.1.2 New Features

N/A

3.1.3 Product Features

Table 3. List of BSP, I/O, Power Management and Security Features

Features	Summary	Availability
I/O	USB 2.0/3.1 Gen2/3.2 Gen2 – Host Mode	Yes
	USB 2.0/3.1 Gen 1/3.2 Gen1 – Device Mode	Yes ²
	USB Type-C Host Mode	Yes
	DMA controller	Yes
	Thermal	Yes
	HPET Driver	Yes
	Storage - SATA	Yes
	Storage - NVMe	Yes
	PCIe Gen 3	Yes
	PCIe Gen 4	Yes
	LPSS HUART	Yes
	LPSS SPI	Yes
	LPSS I2C	Yes
	LPSS PWM	No
	SMBUS	Yes
	RTC	Yes
	GPIO	Yes
	Time-Aware GPIO	Yes

Features	Summary	Availability
Power Management	Hibernation	Yes
	Sleep State	Yes
	S0ix	Yes(1)
Security	PTT/TPM	Yes
PXE Boot	Supports PHY – Marvell* Alaska* M 88E1512 and Marvel* Alaska* M88E2110; MaxLinear* GPY115, GPY211 and GPY215 Ethernet Network Connections. (Supported Interface: SGMII for PCH GbE port)	Yes

NOTES:

1. On selected SKUs, refer to the *Dear Customer Letter* (DCL) for more information.
2. Refer to *USB Device Mode Sighting Alert* ([Document number: 634465](#)) for more information.

3.1.4 Known Issues

Table 4. List of I/O and Power Management Issues

Issue ID	Description
N/A	N/A

3.1.5 Fixed Issues

Table 5. Fixed Issues for I/O and Power Management Issues

Issue ID	Description
15010631037	[TGL-UP3] IBECC Error Injection not triggering MCE error on i3
15011297970	[TGL-UP3] Firmware update cannot support oemkey revocation

3.1.6 Workaround

Table 6. Workaround for I/O and Power Management Issues

Issue ID	Workaround
1507842596	Segmentation fault is running the existing version of powertop. Workaround: Installing the latest powertop v2.11 from https://01.org/powertop .

3.1.7 Limitations/Observations

The tpm2-tools in the Yocto Project*-based BSP is an open-source tool to compute the values of PCRs from the event log. However, the tool is not designed to interpret the event data which is required when the Boot Guard is enabled, it always initializes PCR[0] = 0.

When Boot Guard is enabled, the tool needs to be modified to look for the event EV_NO_ACTION and interpret the event data to determine if it is "StartupLocality", if yes, extract the value of locality and use it to initialize PCR[0].

3.2 Graphics, Display and Media

3.2.1 Introduction

This section contains general release information for graphics, display and media for the 11th Gen Intel® Core™ Processors.

3.2.2 New Features

N/A

3.2.3 Product Features

Table 7. List of DisplayPort Features

Features	Summary	Availability
eDP	Supports eDP1.4 with backward compatibility	Yes
	Panel Self Refresh (PSR1/PSR2)	Yes
	Panel Fitting/Scaling	Yes
	Maximum Resolution: 3840x2160@60Hz	Yes
	Dual eDP	No
HDMI	Supports up to HDMI2.0 (Integrated)	Yes
	Supports for HDMI2.1 via PCON Maximum Resolution: 7680x4320 @60Hz	Yes
	Hotplug support	Yes
	Supports up to HDCP2.2	Yes
	Display Audio Support	Yes
DisplayPort	Display Audio Support	Yes

Features	Summary	Availability
	1 Pipe 1 Port Maximum Resolution: 3840x2160 @60Hz 2 Pipe 2 Port Maximum Resolution: 7680x4320 @30Hz/60Hz	Yes
	2 Pipe 1 Port Maximum Resolution: 7680x4320 @60Hz	No
	Hotplug support	Yes
	Supports up to HDCP2.2	Yes
	Display Audio Support	Yes
Type C	1 Pipe 1 Port Maximum Resolution: 3840x2160 @60Hz *2 Pipe 2 Port Maximum Resolution: 7680x4320 @30Hz/60Hz	Yes
	Type C to DP display	Yes
	Type C to HDMI display	Yes
	Hotplug Support	No
MIPI DSI	Supported on platform	No

Table 8. List of Display Features

Features	Summary	Availability
Display	Display Plane with NV12 Support	Yes
	4 Independent Display	Yes
	HDR (High Dynamic Range) 10bit	Yes
	Display HW Rotation	Yes
	MPO (Multi Plane Overlay)	Yes
	MST (Multi Stream Transport)	Yes
	BT2020 (Rec 2020) for UHDTV	Yes
	Backlight Control	Yes
	DSB (Display State Buffer)	No
	Collage Mode Display	No
	Intel® Rapid Memory Power Management (CxSR)	No
	Intel® Display Refresh Rate Switching Technology (Intel® DRRS)	No
	Intel® Smart 2D Display Technology (Intel® S2DDT)	No
	Connected Standby (S0ix)	Yes
	S3/S4 suspend / resume cycles	Yes
	Horizontal mirroring (H Flips)	Yes
	Type-C/DP 8K@30/60Hz (2 pipe 2 port)	Yes

Table 9. List of Graphics PM

Features	Summary	Availability
Graphics Power Management	GUC RC6	Yes
	Intel® Turbo Boost Technology	Yes
	Preemption	No
	Dynamic Frame Per Second (DFPS)	No

Table 10. List of 3D Features

Features	Summary	Availability
3D	EGL version up to 1.5	Yes
	OpenGL* API (Core Profile) up to version 4.6	Yes
	OpenGL* API (Compatibility Profile) up to version 4.6	Yes
	OpenGL* shading language (GLSL) up to version 4.6	Yes
	OpenGLES* API up to version 3.20	Yes
	OpenGLES* shading language up to version 3.20	Yes
	OpenGLES* Legacy API up to v1.1	Yes
	Weston*/Wayland* compositor Hardware Render	Yes
	Wayland* with HDR Support	Yes
	Wayland* with NV12 presentation	Yes
	Xorg* DDX DRI2 Support	No
	Xorg* DDX Driver support	Yes
	Xorg* DDX DRI3 Support	Yes
	Vulkan* API v1.1	Yes
	Antialiasing mode (16x MSAA)	Yes
	Anisotropic Filtering (up to 16x angle-independent AF)	No

Table 11. List of Media Features

Features	Component	Summary	Availability
Media	Decode	JPEG	Yes
		AVC	Yes
		HEVC 8-bit, 10-bit (420, 422, 444)	Yes
		HEVC 12-bit (420, 422, 444)	Yes
		HEVC Screen Coding Extension (SCC)	Yes
		MPEG2	Yes
		VC1	Yes

Features	Component	Summary	Availability
		VP8	No
		VP9 8-bit (420,444)	Yes
		VP9 10-bit (420,444)	Yes
		VP9 12-bit (420, 444))	Yes
	Encode	JPEG	Yes
		AVC VME & VDEnc	Yes
		MPEG2 1080p	Yes
		VP8	No
		HEVC 8-bit, 10-bit VME (420)	Yes
		HEVC 8-bit, 10-bit VDEnc (420)	Yes
		HEVC 8-bit, 10-bit VME (422)	Yes
		HEVC 8-bit, 10-bit VDEnc (444)	Yes
		VP9 8-bit, 10-bit (420)	Yes
		VP9 8-bit, 10-bit (444)	Yes
		VP9 8-bit, 10-bit (422)	No
		HEVC Screen Coding Extension (SCC) Encode	Yes
	Transcode	Decode + Encode + VP	Yes
	Video Processing	Composition IEF	No
		Composition Color Space Conversion (CSC)	Yes
		Composition Blending	Yes
		Composition ProAmp	Yes
		Composition Scaling	Yes
		Composition BOBDI	No
		Rotation/Mirror	Yes
		IECP (Image Enhancement and Color Pipe)	No
		Denoise	Yes
		Deinterlace	Yes
		Frame rate Conversion	No
		Media Memory Compression (MMC)	No
	Tone Mapping	HDR10	Yes

NOTE: Tone mapping is only from HDR to SDR.

Table 12. List of 8K Display Features

Features	Summary	Availability
Display	Supports 8K60 via DP1.4 to HDMI2.1 LSPCON with Autonomous Mode	Yes ⁽¹⁾
	Supports 8K60 via DP1.4 to HDMI2.1 LSPCON with Source Control Mode	Yes
	Supports 8K60 via HDMI2.1 with 2 Pipe 1 Port	Yes
	Hotplug for DP1.4 to HDMI2.1 LSPCON	Yes
	Rotation	Yes
	S3 & S4 Exit	Yes

NOTE:

1. Supported Display: Chromtel* CH7218

Table 13. 3D Features for 8K Display

Features	Summary	Availability
3D	OpenGL	Yes
	OpenGLES	Yes
	Xorg (X11) Compositor	Yes
	Weston Compositor	Yes

Table 14. Media Features for 8K Display

Features	Component	Summary	Availability
Media	Decode	HEVC 8-bit, 10-bit (420)	Yes
		VP9 8-bit, 10-bit (420)	Yes
Media	Playback	Xorg (X11) Compositor	Yes ⁽¹⁾
		Console Mode	Yes

NOTE:

1. Minimum requirement: Intel® Core™ i7 Processor with LPDDR4x

3.2.4 Known Issues

Table 15. List of Graphics, Media and Display Features

Issue ID	Description
15011197707	[Yocto][TGL-U][GFX][Kernel 5.10] Background observed on IceWM not in center Remark: Will not be fixed as this is a third party issue

3.2.5 Fixed Issues

Table 16. List of Fixed Issues for Graphics, Media and Display Features

Issue ID	Description
22015628095	[TGL-U][IPU6][HDMI in]kernel NULL pointer dereference in buffer_list_get
15013336622	TGL-U/TGL-H - Dual display boot not working in Yocto Workaround: Refer to WA posted in Intel Github. https://github.com/intel/linux-intel-quilt/blob/5.10/yocto/patches/0001-drm-i915-Fixes-the-Dual-Bootup-Issue.drm

3.2.6 Limitations

1. Decode:
 - Video DMA Buffer Sharing (dma-buf) is not available for HEVC 10/12-bit (422,444) & VP9 10/12-bit (444) due to 3D Graphics pixel type limitation
2. Encode:
 - VP9 8-bit, 10-bit (444) encode available on GST_MSDK only
 - HEVC 12-bit (420) VME encode only available with GST-MSDK and GST_VAAPI
 - HEVC 12-bit (422,444) VME encode not supported by iHD media-driver

3.3 Intel® oneAPI Video Processing Library (oneVPL)

3.3.1 Introduction

Intel® oneAPI Video Processing Library (oneVPL) is a programming interface for video decoding, encoding, and processing to build portable media pipelines on CPUs, GPUs, and other accelerators. The oneVPL API is used to develop quality, performant video applications that can leverage Intel® hardware accelerators. It provides device discovery and selection in media centric and video analytics workloads, and API primitives for zero-copy buffer sharing.

Intel® oneVPL is backward compatible with Intel® Media SDK and cross-architecture compatible to ensure optimal execution on current and next generation hardware without source code changes.

Intel® oneVPL is an open specification API, relevant documentation, release limitation and features, refer to [GitHub: intel/vpl-gpu-rt](https://github.com/intel/vpl-gpu-rt)

3.4 Audio

3.4.1 Introduction

This section contains general release information for audio on the 11th Gen Intel® Core™ processor. Refer to the Appendix chapter in the *Yocto Project*-based BSP Get Started Guide* ([Document number: 635120](#)) for information on how to enable audio. You will need `audio_fw_<release>.zip` ([Section 2.2](#)) to enable i2s Audio via DSP.

3.4.2 New Features

N/A

3.4.3 Product Features

Table 17 List of Audio Features

Features	Summary	Availability
Legacy HD Audio (with Codec ALC 711)	48kHz, Stereo capture through ALC711 onboard audio codec	Yes
	48kHz, Stereo playback through ALC711 onboard audio codec	Yes
i2s audio via DSP (codec ALC1308)	48kHz, Stereo playback	Yes
DMIC via DSP	Capture through DMIC external card	Yes

Features	Summary	Availability
HD Audio via DSP (Codec ALC711)	Playback and Record	Not POR
USB Audio	USB Recording	Yes
	USB Playback	Yes
Senary HD Audio codec	48kHz stereo playback and capture through External connected Senary Codec	Yes
Everest i2s based Audio codec	48kHz stereo playback and capture through External connected Everest Codec	Yes

3.4.4 Known Issues

Table 18. List of Known Issues for Audio

Issue ID	Description
N/A	N/A

3.4.5 Fixed Issues

Table 19. List of Fixed Issues for Audio

Issue ID	Description
15012450252	[TGL-U][Yocto][Audio][ES8326] No Audio Input from Audio Recording

3.5 Real Time

PREREQUISITE:

- Features described in this chapter will work ONLY with Industrial processor SKU. Refer to the *11th Gen Intel® Core™ Processors (Tiger Lake) for IoT Platforms - Gold Deck* ([Document number: 615561](#)), for more information on processor type.

3.5.1 Time-Sensitive Networking

3.5.1.1 Introduction

The 11th Gen Intel® Core™ processors provide 1 GbE port (integrated Ethernet controller) with TSN capabilities.

NOTES:

- The 11th Gen Intel® Core™ Processors board contains an RJ45 port that is connected to the Intel® Ethernet Connection I219, which has no TSN capabilities.
- An external PHY is required to use the integrated Ethernet controller with TSN capabilities.

The TSN Reference Software is a set of applications and scripts that use different Ethernet-TSN features to show the advantages of Ethernet-TSN in specific areas while educating users on specific APIs and conditions that are required. Refer to the *Ethernet Time-Sensitive Networking on Linux* Getting Started Guide* ([Document number: 616446](#)) for further information.

Security Advisory Note:

The TSN reference software provided by Intel contains a Ring 3 (userspace) TC configuration application that is used to configure TSN technology parameters. The reference TC configuration application does not provide authentication for the configuration.

3.5.1.2 New Features

Added support for Intel® Ethernet Controller I226

3.5.1.3 Product Features

Table 20. List of Supported PHY or NIC

Features	Description	Availability	TSN
PCIe based Ethernet Adapter	Intel® Ethernet Controller I225/I226	Yes	Yes
PHY	Marvell* Alaska* M 88E1512 PHY – 10/100/1000 Mbps	Yes	Yes
	Marvell* Alaska* M 88E2110 PHY – 10/100/1000/2500 Mbps	Yes	Yes
	MaxLinear* GPY211 Ethernet Network Connection - Single-port 2.5GbED PHY	Yes	Yes
	MaxLinear* GPY215 Ethernet Network Connection - Single-port 1GbE PHY for industrial applications	Yes	Yes
	MaxLinear* GPY115 Ethernet Network Connection - Single-port 1GbE PHY for industrial applications	Yes	Yes
	Texas Instruments (TI)* DP83867 Ethernet Network Connection – Single-port 1GBE PHY	Yes	Yes

NOTE: Get the latest PHY firmware from PHY provider.

Table 21. List of Features for Ethernet/TSN

Domain	Features	Description	Marvell*/ MaxLinear* PHY Texas Instrument (TI)* PHY	Intel® Ethernet Controller I225/I226
Ethernet	MAC Core	MAC speed – 10/100/1000/2500 Mbps (Refer respective product datasheet on supported maximum speed)	Yes	Yes

Domain	Features	Description	Marvell*/ MaxLinear* PHY Texas Instrument (TI)* PHY	Intel® Ethernet Controller I225/I226
		Full Duplex in multi-queue mode for all speeds	Yes	Yes
		Full/Half Duplex in single-queue mode for 10/100 Mbps only	Yes	Yes
		Autonegotiation support	Yes	Yes
		User-configurable MTU size (9K Jumbo Support)	Yes	Yes
		Configurable multi-queue support	Yes 6 RX & 4 TX Queues	Yes 4 RX & 4 TX Queues
		Configurable RX and TX DMA ring size	Yes	Yes
		Multiple RX and TX DMA interrupt support – Message Signaled Interrupt (MSI)	Yes	Yes
		Interrupt Coalescing/Moderation	Yes	Yes
	Receive Hardware Offloading	MAC Address Filtering – Perfect/Hash/Promiscuous	Yes	Yes
		Programmable Flexible Receive Packet Parser/Filter	Yes	Yes
		VLAN Filtering based VLAN ID	Yes	Yes

Domain	Features	Description	Marvell*/ MaxLinear* PHY Texas Instrument (TI)* PHY	Intel® Ethernet Controller I225/I226
		VLAN Header Stripping	Yes	Yes
		Rx Frame Steering based VLAN priority	Yes	No
	TCP/IP Hardware Offloading	TCP Segmentation Offload (TSO)	Yes	Yes
		Checksum Offload Engine (COE) – IP, ICMP and TCP/UDP	Yes	Yes
	Power Management	IEEE 802.3az Energy- Efficient Ethernet (EEE)	Yes (not supported for 2.5Gbps) No for TI*Phy	Yes
		Legacy PM (Sx) with D0/D3	Yes	Yes
		Low Power Mode (S0iX) with D0/D3	Not POR	Yes
		Wake-on-LAN support – Advanced Power Management (APM)	No (Not supported by HW)	Yes
		Wake-on-LAN via Magic Packet support	No (Not supported by HW)	Yes ⁽⁴⁾

Domain	Features	Description	Marvell*/ MaxLinear* PHY Texas Instrument (TI)* PHY	Intel® Ethernet Controller I225/I226
	Express Data Path (XDP)	AF_XDP socket interface with Zero-Copy Mode	Yes	Yes
		Packet HW timestamping support via AF_XDP socket	Yes	Yes (Zero Copy Mode only)
		Packet Transmit Time support via AF_XDP socket	Yes	Yes
TSN	Time Synchronization	IEEE 802.1AS-2011 gPTP and IEEE 1588	Yes ⁽¹⁾	Yes ⁽¹⁾
		Flexible Pulse-Per- Second (PPS) output	Yes	Yes
		PTP clock timestamping triggered by external input pin (AUX_TS)	Yes	Yes
		Cross timestamping (offset between system clock and PTP clock)	Yes	Yes
	Traffic Shaping	IEEE 802.1Qav – Credit Based Shaper	Yes	Yes
		IEEE 802.1Qbv – Enhanced Scheduled Traffic	Yes	Yes
		IEEE 802.1Qbu & IEEE 802.3br – Frame Preemption	Yes ⁽⁵⁾	Yes
		Time-Based Scheduling (Per-packet transmit time setting)	Yes	Yes (No for XDP- TBS)

Domain	Features	Description	Marvell*/ MaxLinear* PHY Texas Instrument (TI)* PHY	Intel® Ethernet Controller I225/I226
TSN Reference Software	Sample Application	Time Synchronization Quality Measurement sample application	Yes	Yes
		Socket level Talker & Listener sample application	Yes	Yes
		OPC-UA level Publish- Subscriber over TSN sample application	Yes	Yes
		OPC-UA level Remote IO & Controller sample application	Single TSN Stream	Not POR
			Multiple TSN Traffic Streams	Not POR
			Mixed Criticality Traffic Streams	Not POR

NOTES:

1. If you have questions on the newer version of IEEE 802.1AS spec, contact your Intel representative.
2. Wake-on-LAN is available only if the PHY is supported. Refer to the PHY datasheet for more information. After the system waking up via Wake-on-LAN, the Ethernet connection can be checked using the ethtool. For Intel® Ethernet Controller i225, rework on TGL-U3 RVP is required for the feature.
3. IEEE 802.1Qbu and IEEE 802.3br (Frame Preemption) are available only if the PHY is supported. Refer to PHY datasheet for more information.

3.5.1.3.1 Usage Constraints

The driver pauses any transmission and reception during the transition period between AF_XDP Zero-Copy and AF_PACKET modes. For some applications such as PTP4L, a timeout or disconnection may occur during this period. After a short time, all regular traffic will resume as normal and PTP4L will re-establish connection.

When the driver is in AF_XDP Zero-Copy mode, it uses a lean code base to deliver bounded low-latency transmission and reception of packets. Because of that, users should avoid removing the driver or use it with power management features (such as suspend/resume) while the driver is in AF_XDP Zero-Copy mode.

3.5.1.4 Known Issues

Table 22. List of Known Issue for supported Ethernet Controller or PHY listed in [3.5.1.2](#)

Issue ID	Description
15011284339	[Yocto][MR6][TGL-U][TSN][5.10Kernel][GPY215]QavDissector unable to get frame length in 1Gbps Remark: Will not be fixed as low impact and this happens only under specific configurations.

Table 23. List of Known Issues for General Drivers and TSN Reference Software

Issue ID	Description
N/A	N/A

3.5.1.5 Fixed Issues

Table 24. List of Fixed Issues for Ethernet/TSN

Issue ID	Title
15010775499	[Yocto][TGL-U][TSN][5.10 Kernel][MARVEL][GPY] Unable to Advertise with 2.5Gbps speed

3.5.1.6 Workaround

Table 25. List of Workaround for Ethernet/TSN

Issue ID	Workaround
N/A	N/A

3.5.1.7 Limitations/ Observations

1. According to IEEE 802.3 Annex 127A, it is permissible for a compliant 1000BASE-XPCS (including 2.5 Gbps) transmit process to truncate the first byte of a preamble to align the start of packet on the EVEN boundary. Elkhart Lake mGBE is compliant with this clause. Some test equipment may not detect preamble truncation. Check with the equipment's vendor if you see error in packet format.
2. As shown in the table in the *Ethernet Time-Sensitive Networking on Linux* Getting Started Guide* ([Document number: 616446](#)), Section 2.4.1:
 - Sub-microsecond time-sync quality is achievable for the current Intel released TSN solution (MAC and PHY) upon TX & RX latency tuning.
 - For 100 Mbps to 2.5 Gbps speed, the variation of the Time Error is within 2-digitnanoseconds.
 - Time Error is important to describe the quality of time-synchronization achieved through IEEE802.1AS technology. Refer to 802.1AS Recovered Clock Quality Testing for more information.
3. Make sure "VT-d" is enabled in the BIOS menu for the Ethernet driver to work.
4. Intel® Ethernet Controller I225 will be reset by igc driver each time TSN Mode is configured. This is due to scheduling packets based on time capability depends on BASET registers, which can only be written once per power cycle. Refer to the *Ethernet Time-Sensitive Networking on Linux* Getting Started Guide* ([Document number: 616446](#)) for further information.
5. 0.4% rounding error is expected for QBV running on 100 Mps link speed. Large delay will be observed when transmitting large frame. Refer to the *GbE-TSN for Intel Atom® x6000E Series Processors, Intel® Pentium® and Celeron® N and J Series Processors Programmers Reference Manual* ([Document number: 619777](#)) for 0.4% rounding down error details.
6. Intel® Ethernet Controller I225 is validated with firmware v1.89
7. Intel® Ethernet Controller I226 is validated with firmware v2.17
8. Intel has identified an incompatibility issue on the SGMII link between the processor's GbE MAC and the supported third party PHYs identified in [Table 20](#) in this document, which causes Frame Preemption (FPE) to fail. Intel has verified that the PCS (Physical Coding Sublayer) module inside the processor's three Gigabit Ethernet (GbE) controllers is correctly encoding/decoding IEEE802.1Qbu/IEEE802.3br Merge Packets. Intel suggests that if you encounter this incompatibility issue, contact your third party PHY vendor for confirmation of TSN compatibility in its PHY.

3.5.2 Intel® Time Coordinated Computing (Intel® TCC)

3.5.2.1 Introduction

Intel® Time Coordinated Computing (Intel® TCC) is a set of processor features and corresponding software that augment the compute performance of Intel processors with ability to address the stringent temporal requirements of real-time applications. The key value is improved temporal performance for latency-sensitive applications when they are running alongside non-time-constrained applications on the same system. For more details, refer to [Real-Time Computing at the Edge](#).

3.6 Bluetooth® Technology, Cellular, and Wi-Fi*

3.6.1 Introduction

This section contains general release information for Bluetooth® technology, Cellular, and Wi-Fi* on the 11th Gen Intel® Core™ processors. For more information, refer to the *Wireless Connectivity User Guide* ([Document number: 617199](#)).

Refer to the *Yocto Project*-based BSP Get Started Guide* ([Document number: 635120](#)), Section 3, on how to integrate Bluetooth technology, Cellular, and Wi-Fi technology. You will need *meta-intel-wireless.tar.gz* and *meta-intel-cellular.tar.gz* from [Section 2.2](#).

3.6.2 New Features

N/A

3.6.3 Product Features

Table 26. Feature List for Bluetooth® Technology, Cellular, and Wi-Fi*

Features	Description	Availability
Bluetooth Technology	LE Low Duty Cycle Directed Advertising	Yes
	LE Dual Mode Topology (Controller)	Yes
	LE Link Layer Ping Mechanism	Yes
	LE Link Layer Topology	Yes
	BT 4.1 Feature Requirements	Yes
	LE Data Packet Length Extension	Yes
	2 Mbps LE	Yes
	Limited High Duty Cycle Non-Connectable Advertising	Yes
	LE Long Range	Yes
	SW RF-Kill or D3hot	Yes
	Bluetooth® Specification Version 4.1 Compliance (Not including optional features)	Yes
	Concurrent BLE connections (7 LE Links)	Yes
	BR/EDR Multiple Connections	Yes
	BLE and BR/EDR dual-mode operation, multiple connections	Yes
	BR/EDR - Scatternet (Multirole)	Yes
	AVDTP Protocol 1.2	Yes
	RFCOMM 1.1 Protocol	Yes
	BNEP Protocol	Yes
	MCAP Protocol	Yes
	Host software support to use SBC codec in BT controller	Yes
	SBC Encoding at Host Processor	Yes
	LE Dual Mode Topology Feature	Yes
	LE Low Duty Cycle Directed Advertising Feature	Yes
	32-bit UUIDs for LE Feature	Yes
	Common Profile and Service Error Codes	Yes
	Implement ESR 5/6/7 erratas	Yes
	Fast Advertising Interval	Yes
	Link Layer Topology Feature	Yes
	LE Ping Feature	Yes
	BR/EDR Secure Connections Feature	Yes
	LE Privacy 1.1	Yes
	LE Privacy 1.2 - Extended Scanner Filter Policies	Yes

Features	Description	Availability
	LE Secure Connection	Yes
	LE Privacy 1.2 - Link Layer Privacy	Yes
	LE Data Packet Length Extension	Yes
	Supports ESR 8 erratas	Yes
	ATT Protocol over BR/EDR	Yes
	SMP Protocol	Yes
	GATT Server	Yes
	ATT Protocol over LE	Yes
	L2CAP Protocol	Yes
	LE Peripheral GAP Role	Yes
	GAP Device Type (BR/EDR/LE)	Yes
	LE Central GAP Role	Yes
	Frequency Manager for BT	Yes
	PAN 1.0 - NAP Role	Yes
	A2DP 1.2 - Source Role	Yes
	GOEP 1.1 - Client Role	Yes
	OPP 1.1 - Push Server Role	Yes
	SDAP Profile	Yes
	HID 1.0 - Host Role	Yes
	GOEP 1.1 - Server Role	Yes
	HSP 1.2 - Audio Gateway Role	Yes
	FMP 1.0 - Find Me Target Role	Yes
	LE Security Pairing Methods	Yes
	BR/EDR Secure Simple Pairing	Yes
	BT Controller Secure Boot	Yes
	Host Driver support for Secure FW Download	Yes
	BTDBG BT Firmware Tracing through HCI	Yes
	BTDBG HCI Tracing	Yes
	WLAN-BT Coex.	Yes
Cellular	LTE FD: Band 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 21, 25, 26, 28, 29, 30, 32, 66	Yes
	LTE TDD: B38/39/40/41/42	Yes
	UMTS: Band 1, 2, 4, 5, 8	Yes
	Modem recovery control from non-responsive states	Yes
	Detection of modem boot failure	Yes

Features	Description	Availability
	Modem Silent Reset	Yes
	PDP context authentication	Yes
	Cellular Default Data connection	Yes
	Initial PDN connection as Cellular Default Data connection	Yes
	First SIM insertion (after power-on without SIM)	Yes
	SIM - Status Query	Yes
	SIM - Set/Get PIN Lock	Yes
	PUK code entry support	Yes
	SMS: Decoding National Language Alphabet Tables	Yes
	SMS MT - supports Character set UCS-2	Yes
	Receiving a Long SMS (Concatenated SMS)	Yes
	Sending SMS over LTE NAS	Yes
	Network Selection & Status	Yes
	SMS Class 0, 1, 2, 3	Yes
	Receiving SMS over LTE NAS	Yes
	Automatic Data Network Attach (GERAN/UTRAN)	Yes
	Internal SIM Access in Flight Mode	Yes
	End-user SIM access in flight mode	Yes
	The UE exit from flight mode without asking for PIN Code	Yes
	IPv4 Cellular data connection	Yes
	Data Roaming	Yes
	Flight mode	Yes
	Modem Power Up Sequence	Yes
	IPv6 Cellular data connection	Yes
	Dual Stack Cellular data connection (IPv4v6)	Yes
	Generic Internet IAP Provisioning	Yes
	DNS servers retrieval - via PCO/NAS	Yes
	Sending a Long SMS (Concatenated SMS)	Yes
	SMS: Receiving More Message to Send (MMS)	Yes
	IPv6 address allocation - Opaque Interface Identifiers for SLAAC (RFC7217)	Yes
	IPv6 addresses allocation - Stateless address autoconfiguration (SLAAC) for 3GPP	Yes
	Wi-Fi / Cellular data coexistence: default route	Yes
	Address Auto Configuration	Yes
	Parallel IPv4/IPv6 Support on Parallel PDP Contexts	Yes

Features	Description	Availability
	Modern Standby	Yes
	Wi-Fi stack needs to also support non real time coexistence between LTE-wifi-BT	Yes
	DSSA support with 2 SIM cards	Yes
	SIM hot swap	Yes
	SMS over LTE	Yes
	MMS for 3G and LTE	Yes
	ETWS/CMAS (Emergency notifications)	Yes
	SIM Application toolkit	Yes
	Handover from 3G to LTE and vice versa	Yes
Wi-Fi	802.11d - Worldwide Compliance with Regulations For use of Wireless Signal Spectrum.	Yes
	802.11n - 40MHz Channels (Channel Bonding)	Yes
	Wake on WLAN (WoWLAN)	Yes
	Wi-Fi Direct - 5GHz 802.11n support - 40MHz channel	Yes
	Wi-Fi Direct - WFA Power Saving features	Yes
	Wi-Fi Direct - 2.4GHz 802.11g support	Yes
	Wi-Fi Direct - 5GHz 11ac support	Yes
	Platform shall behave as P2P Client for P2P File Sharing.	Yes
	Wi-Fi Direct - WFA mandatory features	Yes
	Platform shall behave as Group Owner for P2P File sharing	Yes
	Wi-Fi Direct - 802.11ac support	Yes
	Wi-Fi Direct - 5GHz 802.11a support	Yes
	Wi-Fi Direct - P2P Multi Client support for P2P Group Owner	Yes
	Wi-Fi Direct - 2.4GHz 11bgn support	Yes
	Wi-Fi Direct - P2P Service Discovery	Yes
	802.11ac - AP Mode	Yes
	Tethering - Routing USB <-> WLAN	Yes
	DHCPv6 client for IPv6 network over WLAN	Yes
	IPv6 Static Address over WLAN	Yes
	connect to hidden SSID AP	Yes
	AP+STA Multirole Single Channel 5GHz	Yes
	802.11ac - Very High Throughput	Yes
	STA+P2P Multirole Single Channel 2.4GHz	Yes
	Flight Mode ON---- Wi-Fi enabling	Yes
	STA+P2P Multirole Single Channel 5GHz	Yes

Features	Description	Availability
	AP+STA Multirole Single Channel 2.4GHz	Yes
	EAP-TTLS/MSCHAP2 – Authentication	Yes
	WPS (Wi-Fi Protected Setup) - PIN method	Yes
	WEP - Wi-Fi Security	Yes
	WPS (Wi-Fi Protected Setup) - Push Button Configuration	Yes
	EAP-TLS – Authentication	Yes
	PEAP – Authentication	Yes
	WPA2 PMF - STA privacy/forging protection	Yes
	connect to AP - enter static IP	Yes
	Proxy Settings in Wireless Networks Advanced Menu	Yes
	WLAN ON - OFF from UI (via rfkill)	Yes

3.6.4 Known Issues

Table 27. List of Known Issues for Bluetooth® Technology, Cellular, and Wi-Fi*

Issue ID	Description
N/A	N/A

3.6.5 Fixed Issues

Table 28. List of Fixed Issue for Bluetooth® Technology, Cellular, and Wi-Fi*

Issue ID	Description
N/A	N/A

3.7 Intel® In-Band Manageability Framework

3.7.1 Introduction

Intel® In-Band Manageability Framework is software running on edge IoT devices, which enables its users, owners, and maintainers to perform critical device management operations over-the-air updates remotely. It also facilitates the publishing of telemetry and critical events, and logs from the edge IoT device to the cloud, enabling the device owner to take corrective actions if, and when necessary. The framework is designed to be modular and flexible, ensuring scalability of the solution across a preferred cloud service provider (for example, Azure* IoT Central, Telit* deviceWISE*, and ThingsBoard*).

Download the latest release package for Intel® In-Band Manageability Framework ([Document number: 768985](#)) from RDC. Refer to the *Intel® In-Band Manageability Framework Release Notes*, [Document number: 630741](#) for more details.

3.8 Active Management Technology (AMT)

3.8.1 Introduction

Active Management Technology (AMT) is a manageability feature of the Intel vPro® Platform available on selected Intel processors. It uses out-of-band connection that operates independent of the OS and provides persistent connectivity to fix a wider range of system issues. The Intel® Management Engine Interface (MEI) driver is the OS interface to the Intel AMT device. The Intel Local Manageability Service (LMS) driver enables local applications running on Intel® AMT to use common SOAP and WS-Management functionality that is available to remote application.

11th Gen Intel® Core™ Processor AMT feature is supported by Intel® Converged Security and Management Engine (Intel® CSME) Firmware 15.0.

Refer to [Document number: 630548](#) for the latest 11th Gen Intel® Core™ Processor and Intel® Converged Security and Management Engine (Intel® CSME) Firmware 15.0 Release Notes.

3.9 6th Generation Image Processing Unit

3.9.1 Introduction

IPU6 is Intel's 6th generation solution for Imaging Processing Unit, which offers advanced imaging capabilities. It is integrated into the 11th Gen Intel® Core™ Processors (Tiger Lake-UP3). The IPU6 camera system consists of ISP (Image Signal Processor), camera power and control logic, MIPI CSI-2 interface, and camera software driver.

Refer to the *6th Generation Image Processing Unit for 11th Gen Intel® Core™ Processors (Tiger Lake-UP3) User Guide* ([Document number: 646639](#)) for the latest release information and steps to enable the IPU6 system. You will need *tgl-up3_ipu6_<release>.zip* from [Section 2.2](#). Refer to the *Yocto Project*-based BSP Get Started Guide* ([Document number: 635120](#)), Section 3, on how to integrate IPU6 firmware.

§

4.0 *Where to Find Documents and Release Packages*

Get the documents of this release notes from the [Resource & Documentation Center](#) website by logging into your RDC account, and then searching for the corresponding document number.

§

Appendix A Component Version Change List

Component	MR7	MR8
Linux* kernel	5.10.145	5.10.168
TSN Reference Software	0.8.25	0.9.5
ice-fw	1.9.11	n/a
intel-compute-runtime	22.38.24278	22.49.25018.24
intel-graphics-compiler	1.0.12149.1	1.0.12812.24
Intel® In-band Manageability	3.0.13	3.0.14
wireshark	3.4.12	3.4.12
lms	2226.0.0.0	2226.0.0.0
oneVPL	2022.2.2	2023.1.1
libmfx	22.5.4	n/a
dbus	1.14.0	1.14.0
dlt-daemon	2.18.8	2.18.8
e2fsprogs	1.46.5	1.46.5
gnupg	2.3.4	2.3.7
itt	3.23.0	3.23.0
libigdgmm	22.2.0	22.3.3
libva	2.13.0	n/a
iavf	4.3.19	4.8.2
ice-module	1.9.11	1.11.14
mtd	2.1.4	2.1.4
open-model-zoo	2022.2.0	2022.2.0
OpenVINO™ Toolkit	2022.2.0	2022.3.0