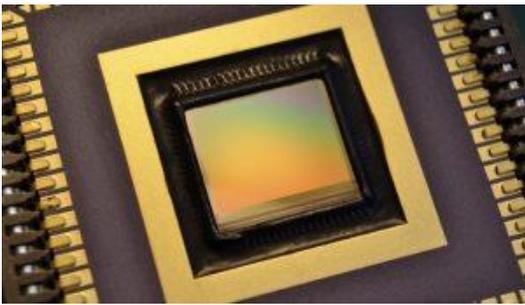# Bit-MIPI CSI-2 - FAQ

BitSim's very compact Camera Interface IP

What is MIPI CSI-2?

A widely adopted, simple, high-speed protocol primarily intended for point-to-point image and video transmission between **embedded** cameras **sensors** and host devices.

Why should I use it?

If you want to have the ability to easily change the sensor in your product, with a standardized interface, you should use MIPI CSI-2.

What are the advantages?

- High performance (can handle up to 4k for example) Low power consumption (since it started in the mobile industry 10 years ago, power consumption has always been a priority
- Low emission (EMI)
- Low-cost camera sensors, manufactured in large quantities for the mobile industry

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Where can I use it?

- Imaging
- Vision
- Surveillance
- Biometric security
- VR/AR

Business areas where it is used today?

- Mobile
- Consumer
- Automotive*
- Medtech
- Industrial
- IoT

What kind of sensors are available today using the MIPI CSI-2 interface?

- Traditional RGB-sensors (CMOS-sensor or daylight sensor)
- Radar and ToF
- Probably even IR-sensors in the near future. The largest commercial IR-sensor today, is using 1024x768 pixels (XGA).

BitSim has been a part of the Board of Feathers (BoF) group that the MIPI Alliance has launched. Together with OEMs, suppliers and other industry experts, it defines and collects industry input to enhance existing or develop new interface specifications for automotive applications.

How does the future look like for MIPI CSI-2?

The MIPI organization has over 300 members today, and the specification evolves to adapt to the future for applications like drones, AR/VR and automotive (ADAS).

MIPI Manufacturer ID [MSB LSB]

02h ADh   BitSim AB
BitSim is part of the MIPI Alliance.

Note:

Note that neither the cable nor the connector is specified in the standard. An advantage of this is that you can choose from many different types and vendors. One limitation when prototyping, using a ready-made camera module, it can be less flexible due to fewer possible choices.

Recent versions of MIPI CSI-2

The last few years, there has been many upgrades on the spec to be able to handle automotive requirements, especially in the ADAS area, so RAW 14, 16 and 20 support are added. But also features like phase detection auto focus (PDAF), and single frame HDR. Today, up to 12 bits are available, for example the IMX290 from Sony that BitSim has used. Also, sensors from OmniVison and On Semi has 12-bits. 8 and 10-bit sensors are still the most common.

What parts of the OSI model covers MIPI CSI-2?

CSI-2 with the PHY-interface handles layer 1,2 and 3 (Physical, Transport and Application) in the OSI model.

Why are there several PHY-layers?

D-PHY was released 2005, but the most popular one, the v1.1 was released 2011 and it delivers up to 1.5 Gb/s per lane, with up to four lanes are used. For a typical system, it uses one signalling pairs for the clock and up to four pairs of data, altogether 10 pins.

- M-PHY was released 2011, with up to 5.8 Gb/s per lane, and it is a full-duplex design.

- C-PHY was released 2014. 180Mb/s – 5.7 Gb/s per lane, were a C-PHY lane has three (3) pins with an embedded clock.

- A-PHY, a coming version with many new features, like extended range (up to 15 m), up to 16 Gbps (first release), a generic data link layer that supports many different protocols (MIPI/non-MIPI), scalable, high EMC immunity etc.

- Most widely used, is still the D-PHY. There are only a few cameras today that supports the C-PHY, and they can also handle the D-PHY.
  M-PHY is not used for cameras, more for server applications like HDD and chip-to-chip connections etc.

CCS, a new initiative by the MIPI organization

Have you tried to set up and use a MIPI CSI-2 sensor from scratch? It may contain 100s of registers that must be set at the right value and in the correct order. The specs aren't always up-to-date, so this is a cumbersome work! Trying to get the configuration part more streamlined, meaning simpler, the MIPI organisation has released a first specification of the CCS, Camera Command Set:

https://mipi.org/specifications/camera-command-set

It allows and enables rapid integration, both implementing and controlling of basic image sensor functionalities without device-specific drivers. MIPI CCS also specifies mandatory and optional test modes.

More information about the Bit-MIPI CSI-2 IP from BitSim

The future of the IP?

By purchasing IP with the source code option (readable RTL), you get full control now and in the future.

Is the IP proven?

Yes, both the Rx- and Tx-part has already been used by our customers.

How many FPGA pins are needed?

- For FPGAs without embedded D-PHY support, that is most of the FPGAs today, 4 per lane is needed. That means for a clock lane and one data lane, 8 pins are needed.
- For FPGAs with embedded D-PHY support, like UltraScale+, 2 per lane is needed. That means for a clock lane and one data lane, 4 pins are needed.

The needed FPGA size?

- Our IP is very compact, only around 500 for a 1-lane version. And 1 000 FFs/LUTs **(when configured for 4 data lanes/8 bit).**
- With the help of VHDL generics, you can configure no of lanes

Extra features

Several debug features have been implemented, to make it easier to integrate the IP correctly.

What FPGAs can I use?

The latest families from Xilinx, Intel (Altera), Microsemi and Lattice. Depending on which FPGA-type was chosen, a D-PHY voltage adaption outside the FPGA may be needed. Please, contact us for further information.

How is the IP delivered?

Normally, the IP is delivered directly by e-mail to the customer.

- Encrypted or readable Source code

- User Guide

- Design- and Simulation environment and setup (test bench, scripts etc).

Is it possible to have other functions in the FPGA?

Yes, depending on the size of the FPGA, much more functionality can be included besides MIPI CSI-2. Example of such functionality is image enhancements.

We're not so familiar with FPGAs?

Many engineers at BitSim has been developing for FPGAs since the end of the 80s.

BitSim has been offering IPs for over ten years now. If you need assistance, we could help you both with FPGA and PCB designs.

Can I try before buy?

Yes, we have different FPGA platforms from different venfors.

Is some kind of SW needed?

An I2C interface is needed to configure the MIPI CSI-2 interface.

This can be achieved from the main processor (external or internal) with an embedded I2C-controller.

For a soft processor, it can easily be added.
Or it could also be handled in the programmable part of the FPGA.

How is support handled by BitSim?

Up to 8 hours of support is included, depending on license type.

For general questions, please contact us at: **info@bitsim.com**