Osmocom icE1usb data sheet

sysmocom
systems for mobile communications GmbH

Introducing icE1usb

The **icE1usb** is a dual-port E1 adapter with a USB interface. It can be used to attach to circuit-switched primary-rate E1 circuits used in traditional/legacy telecom environments.

Today, E1 circuits can primarily be found in the context of cellular networks; whether to carry **A-bis** back-haul, **Gb over Frame Relay**, **A over TDM** interfaces or any classic **circuit SS7** signaling.

Those few other E1 adapters available on the market are typically PCI / PCIe cards, which constrains their usage to larger servers with the appropriate slots. Contrary to that, **icE1usb** connects via USB to the computer, allowing for use cases like

- E1 attached to a Laptop computer

- E1 attached to embedded Single Board Computers like for example Beagleboard, Raspberry Pi, Intel NUC or any other platform with a USB host controller.

E1 Clock / GPS-DO

E1 circuits not only carry symmetric full-duplex 2.048 Mbps data, but also a precise clock reference. Traditionally, this clock reference was provided by the public wide-area PDH/ISDN network.

As classic PDH/ISDN wide-area networks are less frequently deployed today, one important topic is the question of clock source. Many devices, including cellular base stations require a precise E1 clock as they use it as a reference for its internal clocks, which in turn drive the frequency synthesizers of the radio transmitters/receivers.

The Osmocom **icE1usb** solves this problem in a novel way: By integrating a GPS Disciplined Oscillator (GPS-DO) right in the E1 adapter.

Use of the GPS-DO is entirely optional. If your use case features a different E1 clock source, or it is happy with the precision of a normal crystal oscillator, you can use **icE1usb** without the GPS-DO functionality.

Open Source Hardware (OSHW)

The **icE1usb** is 100% Open Source Hardware (OSHW). This includes

- mechanical cad files

- schematics, circuit board layout, bill of materials

- Verilog/HDL sources for the gateware

- C source code for the firmware running on the PicoRV32 softcore in the FPGA

- C source code for the (Linux) drivers on the host computer

Having the entire design as OSHW ensures future availability. At a time where most silicon E1 framers are already long end-of-life, open source hardware is a future-proof alternative.

Software Interface / Drivers

The Osmocom **icE1usb** does not require any kernel driver, but instead uses a userspace daemon (osmo-e1d), which in turn utilizes libusb in order to get access to the USB bus of the host computer.

osmo-e1d is fully integrated with libosmo-abis,

Integration with other drivers/software is not provided at this point, but it is relatively straight-forward due to the simplicity of the E1 protocol implemented over USB: The isochronous USB transfers basically consist of octet-aligned 32-byte E1 frames. sysmocom can provide R&D and software integration services, if needed.

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Mechanical / Electrical Specification

Dimensions of Device	90 x 63 x 30 mm (length excluding SMA connector)
Power Supply	USB bus powered
E1 interface	balanced E1 on RJ45 connector; one for each E1 circuit
long-haul / short-haul	tested with short-haul only at this point!
Antenna connector of GPS-DO	SMA jack, female; provides DC phantom supply voltage to antenna
USB	USB 2.0 full-speed on USB-C connector
Serial Console (for Development)	Osmocom style 2.5mm stereo jack with UART at 3.3V level
Future Extensions	internal header for extension board; extra RJ45 socket

Software / Logical Specification

USB Protocol/Interface	• non-standard protocol using E1 frames in isochronous transfers • USB-DFU as per "Device Firmware Upgrade 1.1" by USB-IF
Linux driver	https://git.osmocom.org/osmo-e1d/
hardware/gateware/firmware git	https://git.osmocom.org/osmo-e1-hardware/
Microprocessor softcore	https://github.com/cliffordwolf/picorv32
E1 Framer softcore	https://github.com/no2fpga/no2e1.git
USB device softcore	https://github.com/no2fpga/no2usb.git
wiki / bug tracker	https://osmocom.org/projects/e1-t1-adapter/wiki/ICE40_E1_USB_interface
Schematics in PDF format	https://git.osmocom.org/osmo-e1-hardware/plain/hardware/icE1usb/r1.0/icE1usb.pdf

Block Diagram
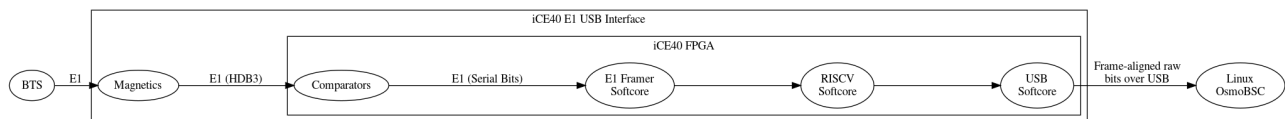
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