Outline of Flatbed in Open Rack V2.0
Support for 12V IT Payloads in 48V Power Distribution Racks
What is Flatbed?

A **toolbox** of components to provide standardized *“shim” interfaces* between Off-The-Shelf Server Motherboards and deployed higher-level rack infrastructure (OpenRack Version 2.0)

- Sheetmetal tray options (aka the “sled”)
  - Various widths and server motherboard mounting hole locations
  - Shielded or open-top tray design
- Power supply with 12V or ATX outputs
- Fans, heatsinks, ducting, with associated mechanical brackets
- Miscellaneous adapters and breakouts between Motherboard and other HW
  - PCIe riser cards
  - Air temperature sensors
  - Other (TBD)
What Is a “Typical” Flatbed Implementation?
Motivations for Flatbed

- Flatbed provides an incremental migration path from 12V to 48V racks using existing, proven 12V IT payloads
- Fast implementation of a broader range of payloads in OpenRack Version 2.0
- OpenBMC & re-usable HW adapters ease SW re-use by focusing on bridging between open, standard interfaces.
Examples of Diverse Payload Support Capability

- **Re-use:**
  - PCBAs (Tractor, Risers)
  - Fans, Sensors
  - Most BMC FW & SW

- **Customize by Payload:**
  - Brackets
  - Fairings

- **Possible Re-use or Custom:**
  - Cables
  - Heatsinks
Overview of Flatbed Proposed Specification: What is Covered?

- **Tray/Sled Mechanical**
  - Maximum Dimensions
  - Thermal Considerations

- **Tractor PCBA**
  - Power Conversion (Hotswap, DC/DCs, Monitoring)
  - Control/Monitoring Path, including Thermal Control (Fans, Sensors)
  - Interface to Motherboard for Control & Status

- **Server Motherboard Minimum Requirements**
Highlights: Flatbed Mechanical Details

Features to enhance rapid prototyping, configurability

- **Standardized tray designs**
  - Fans, power entry, Tractor PCBA typically hard located
  - Flexible electrical cable routing & attachment features
  - Airflow fairings: fast 3-D printed prototype to low-cost production path

- **Heatsinks**
  - Standardized CPU attachments at the socket and chip retention interface
    - Traditional heatsinks: Design can tradeoff BOM cost vs. height vs. tray level fan power
    - Heatpipe or evaporator based designs: Design can customize interconnections & radiators
Highlights: Thermal Control

- Front to Back airflow (architectural requirement)
- Multiple zone control with support for independent sensors, fans
  - Tractor PCBA implementation supports up to twelve independent fans (PWM, tach)
  - Tractor PCBA implementation supports up to four remote I2C air temperature sensors
  - Main thermal control loop is implemented on BMC with Tractor PCBA functioning as an aggregated fan/sensor controller
- Custom heatsinks and fairings may be used if required
- Thermal implementation
  - Varies by payload; managed by custom or OTS heatsinks + fans
Minimum Required Features:
Server Payloads - Mechanical Requirements

● Maximum mechanical dimensions
  ○ Width: up to 19.5”
  ○ Depth for “co-planar” tray layouts:
    ■ Up to 15.9” depth for shallow ORv2 option (30” Rack depth)
    ■ Up to 21.4” depth for deep ORv2 option
  ○ Height agnostic

● Front-to-rear airflow direction (DIMMs, PCIe slots, heatsink fins)

● CPU socket and retention mechanism match vendor reference designs
  ○ Standardized heatsink interface details

● “Most” PCIe slots located at front (those used for NIC and other external I/O)
Minimum Required Features:
Server Payloads - Electrical Requirements

- PCIe slots
  - PCIe RSVD pin usage generally fits under “soft” requirements.
- 100Base-TX compatible RJ45 connector routed to BMC for NC-SI
- At least one “clean” SMBus accessible on a header for Tractor PCBA interface
  - Clean = empty address space. Existing I2C EEPROMs, expanders, and cascaded muxes on the Payload are particularly difficult to work around.
- BMC that can boot Linux, support OpenBMC
  - Upgrade via software
- Power input must be **12V + 12V_STBY or ATX/EPS12V**
- FCC Part 15, subpart B (radiated emissions)
  - Additional compliance TBD
Highlights: Tractor PCBA

- 48V power input, fusing, and hotswap
- Supply outputs to payload: 12V or ATX/EPS12V
- Fan control + connectors
- Miscellaneous digital communications & breakouts between Motherboard and other HW, through the PCBA comms block
  - PSU enable and powergood (ATX PSU standard signals)
  - SMBus (main communication link)
  - Other (optional, TBD, GPIOs)
Tractor-ATX
Up to ~1000W
Power Option

- Target width 7.5” with a 9.5” fallback
- ATX/EPS12V power outputs
- Stuffing options in light gray.
Tractor-12V Power Option, Large Servers and Appliances

- Target width ~18”
- Modular and scalable
- Can depopulate 5V/3.3V Buck DC/DCs and sequencer used in Tractor-ATX

IT tray conn. 25A/50A

Cable to Tractor PCBA

48V Hotswap 25A/50A fault trip

1x1 IBC 12V_STBY @ <3A

3.3V_STBY @ <1A Buck DC/DC (for Tractor logic)

¼ Brick IBC, 650W 12V_A @ <50A Paralleled operation

¼ Brick IBC, 650W 12V_A @ <50A Paralleled operation
Tractor PCBA Control and Communications

I2C <-> GPIOs & Interrupt Aggregation Function
(two * TCA9555 or equiv.)

I2C Mux Function
(PCA9548 or equiv.)

I2C EEPROM
(24C04)

Tractor PCBA Resources

Expansion Function Connector

Off-Tractor Resources

Thermal Sensor Connectors

Expansion Function Connector

Payload secondary PWR
IBCs, DC/DCs, monitors
(powered by bulk 12V)

48V primary PWR
hotswap, power monitors

Fan Control

Sequencer

But switch isolation is required for resources crossing power domains or connectors

I2C galvanic isolator

SCL/SDA

PS_ON#
PWR_OK

ALERT#

( clock stretching permitted )

RESET#

I2C device address
LTC4316

I2C_XOR_SEL[3:0]
Flatbed Software: Management and OpenBMC

- OpenBMC support for Tractor to be upstreamed for easy integration with existing and future OCP servers
- Single I2C interface for BMC-to-Tractor Control/Status
  - Any BMC or uC has access to the same Tractor/Flatbed resources
  - Different Flatbed+Payload variants can execute similar BMC code
    - Fewer dependencies on free BMC GPIOs or server connector I/O (fans, sensors)
- Tractor can support a uC in the “I2C device address xlate” block implementation
  - Supports payloads with special requirements or without BMCs
  - Local Tractor uC option can unload monitoring tasks from motherboard BMC
    - High sample rate monitoring or control loops
    - Interrupt aggregation
Discussion: What Do YOU Need From Flatbed?

- **Sheetmetal tray options (aka the “sled”)**
  - Widths: 8”? 10”? 19”? Other?
  - ~10” width (microATX)
  - ~19” width (OpenCompute or other multi-socket servers)

- **Power supply with 12V or ATX outputs?**

- **Thermal solution reference designs (heatsinks, fairings, fans, sensors)?**

- **Miscellaneous adapters and breakouts between Motherboard and other HW**
  - Particular PCIe riser cards? Special sideband requirements? USB?
  - Air temperature sensors? TPMs? Others?

- **Particular logical mappings for Tractor PCBA control/status bus branches?**
  - Power domains: 48V (primary, may use isolators), Standby, Main/Bulk
  - uC implementations with multiple polling masters for fast, deterministic power sampling?