Facebook Serviceability Design Principles

A Guide for Facebook Vendors

This document is a guideline we use to evaluate candidate equipment designs. It describes the operational characteristics that we expect to see in the hardware designs deployed in our data centers.

facebook

As demonstrated by the Open Compute Project (www.opencompute.org), Facebook believes that serviceability is a key facet of efficiency. Because of Facebook's scale, we require the equipment deployed in our data center to be highly serviceable and manageable.

This document is a guideline we use to evaluate candidate equipment designs. It describes the operational characteristics that we expect to see in the hardware designs deployed in our data centers.

The Guiding Principle

A single data center technician must be able to completely service 90% of the top service items within 3 minutes without tools. The service items with the highest anticipated failure volumes should be serviceable by a single technician within 1 minute after opening a system.

Simplicity is the solution. We are driving towards a common data center language expressed by the same color-coding of elements, the same toolsets, the same simple LED functions, and interface consistency.

There are five design principles:

1) Safety
2) Accessibility
3) Diagnostics
4) Manageability
5) Documentation

Principle 1: Safety

A single data center technician is mechanically safeguarded from injury when moving and servicing equipment.

To protect against electrical, mechanical, thermal and repetitive stress hazards, we require safe equipment. Consider each of the following questions when designing equipment for Facebook.

Electrical

- Are there exposed surfaces that carry a dangerous level of current?
- Are there surfaces that can have their insulating covering damaged during operations?
- Is it possible to touch anything with hand tools or fingers that would cause an electric shock?

Mechanical

- Does any individual field-replaceable unit (FRU) weigh more than 18 kg?
- Does removing any component present a risk of cuts or abrasion?
- For racked equipment, is there a tipping risk?

NOTE: When a server is fully extended using a telescoping rail, it should not be so heavy that the weight of the extended server or storage shelf could cause the cabinet to tip.

Thermal

- Does any exposed surface exceed 44°C?
- Is the airflow within the system sufficient to prevent thermal damage to components?
- Is the airflow within the system sufficient to ensure optimal performance?

Repetitive Stress

Are there any contact points that will cause fatigue or stress if manipulated repeatedly over an eight-hour period?

Principle 2: Accessibility

Technicians can replace 90% of the top service items (by volume, by component) in three minutes or less without tools. Technicians can replace all service items in less than 15 minutes.

We define "Replacement" as removing a system from the rack, opening the system, identifying and swapping the failed item, closing the system, and replacing the system back into the rack.

Questions to ask

- Can all of the repair actions be completed in the cold aisle? Or does system identification or removal require moving back and forth from the cold aisle to the hot aisle?
- Is access to system components toolless?
- Does anything obstruct components of the system, such as cabling, rack mounting or chassis enclosures?
- What obstructs an individual component from removal and replacement?
- Are there small parts that can be dropped or lost during a repair?
- Are most (or all) cable ties or guides multiuse and toolless?

Common language

Screws, if used, will have Phillips heads only. If possible, each system should only use one screw size.

Principle 3: Diagnostics

Health and status information for all machines in the fleet must be available via a network interface within 15 minutes (maximum). When in front of system, health and status of 90% of the top service items must be available within 30 seconds (maximum).

Any tools needed to access diagnostic information should weigh less than 2.26 kg and not have any external dependencies, such as power, or lighting.

Fault data must be accurately reported, visible locally and remotely, and available after any reboot. The diagnostic tool cannot lose data.

Questions to ask

- How is a failed system identified in the rack?
- Can a technician remotely activate an indicator for a faulty system or component?
- Can all physical fault indicators be read from the front of the system?
- Are internal components clearly labeled? Does the labeling match the identifier provided by the diagnostic utilities?

Common language

For physical access to a system, access to a console via a serial interface is required. VGA requires a monitor that violates both Facebook's weight criteria and its no external dependencies criteria.

Use of the Facebook debug card is the preferred diagnostic interface.

Principle 4: Manageability

Systems and components must be manageable remotely. Systems must have network power control regardless of the presence of an operating system. All customizable configurations (RAID settings, BIOS, firmware, etc.) must be modifiable over the network.

In addition, all components that retain data after being powered off must have a data erase procedure that will destroy 100% of data even if the device is not operable.

Questions to ask

- Can I power on, power off and reboot a system over the network?
- Can I read and set customizable configurations (RAID settings, BIOS, firmware, etc.) over the network?

Common language

Use of industry standard, open source tools for management. Some examples of acceptable management tools include Intelligent Platform Management Interface (IPMI), Data Center Manageability Interface (DCMI), and Integrated Lights-Out (iLO).

Additional management tools necessary for peripherals including RAID controllers, NIC cards, and flash storage must be Linux compatible and have the necessary source code to be compiled for our environment.

Transaction logging, error logging and reporting must conform to standard Linux practices and allow for optional machine parsed output using a widely recognized standard. JSON is an example of a standard acceptable to Facebook.

Principle 5: Documentation

Simple documentation, in a format that is accessible to the data center technician, for standard repair operations must be available. All system error codes must be documented.

Questions to ask

- Are there directions or diagrams that explain how to access all major system components?
- Is there a diagram identifying major system components?
- Are expansion slots and external ports enumerated and described?
- Are components labeled with IDs that match the diagnostic codes assigned to the components?

Evaluation

Hardware Design

All hardware designs must be as simple as possible without sacrificing any of the previously mentioned principles.

Questions to ask

- How many parts to meet the functional requirements?
- How many field replaceable parts?
- How many steps to action each part replacement?

Quality

Facebook will not accept equipment of low design or build quality

Questions to ask

- Does the quality of the finish, allow for sharp edges, jagged flanges, etc.?
- What is the potential for technicians to injure themselves during part replacement?
- What is the potential for part damage during operation or repair?

Common Language

All connections must indicate correct installation. Connections must also be keyed to ensure the proper orientation.

Component Identification and Labeling

All components must be clearly labeled or identified in some manner.

Questions to ask

- Are all field replaceable parts clearly identified?
- Are safe handling points identified?
- Are all the cables labeled?

Accessibility

Repair process

The removal and installation process for each part should be unobstructed by chassis, cables, or other objects. Part removal and installation process should be obvious. If not obvious the system should have clear indicators of the removal and installation process. I.E. if the motherboard has to be moved to the rear before lifting up, there should be some indicator of this directional move.

Cabling

Route internal cabling so it does not obstruct part removal or installation.

Internal cable lengths should be long enough to be routed adequately to prevent obstruction without stressing the connection points, but short enough to eliminate the need for slack management.

Internal cabling should not be routed through other components.

External I/O connections should be designed to facilitate cable management within the cabinet, allowing for easy routing to the side oriented vertical cable management without obstructing any service access to the server or server removal from the cabinet.

Connectors should be designed with removal and installation considered.

Component Placement

Field replaceable parts should be located with service and replacement in mind, so they are easily accessed within the server without removing additional parts.

FB uses a hot/cold aisle design in the data center with containment. Servers should be designed for cold aisle access and service, reducing or eliminating the need for the technician to access the hot side of the server.

All high volume parts should be accessed from the cold aisle.

All I/O access to the server should be on the cold aisle.

Any components requiring service from the hot aisle should be designed for quick and tool-less service.

Reduce or eliminate screws or any fastener requiring tools. I.E. on the main board use slots and standoffs with one screw or a single mechanical lock instead of multiple screws.

Use only one size and type of screw, preferably #2 Phillips, in the server.

Reduce or limit to one type and size of screw.

Questions to Ask

- Does the design make use of captive screws where possible?
- Does the chassis design allow for safe handling?
- Are there grip points or handling features?
- For equipment over 18 kg, can the system be serviced without removing from the cabinet? For example, using telescoping rails sufficiently engineered for safe handling.

Specifications and Documentation

Questions to ask

- Have you provided have clear and adequate design specifications to Facebook?
- Has a full BOM been provided?

Service and Repair

Questions to Ask

- Has a service manual or guide been provided?
- Do the service instructions include all field replaceable parts?
- Do the service instructions include all necessary steps to correctly action all part replacements?

Evaluation process

Our evaluation begins with a visual inspection of the system. During this inspection we will look at the form factor and the quality of the tooling.

Using the BOM, and any provided assembly or service documentation, the system will be disassembled and reassembled. Each line item from the BOM will be reviewed, and all field replaceable parts will be rated for serviceability. The criteria for the rating will include part identification, the number of steps necessary to remove and replace the part, potential for damage to the specific part or adjacent parts during the removal and replacement process, the potential for technicians to injure themselves during all aspects of system servicing, the quality of the service instructions, labeling of components and cabling, and the complexity of the overall system.