Mobile Compute Cluster – Hardware Specification Sheet

Mobile Compute Cluster

Hardware Specification Sheet

Stripped-Phone Node Rack (20-Board Reference Configuration)

Research Engineering Lab – 2025-04-25

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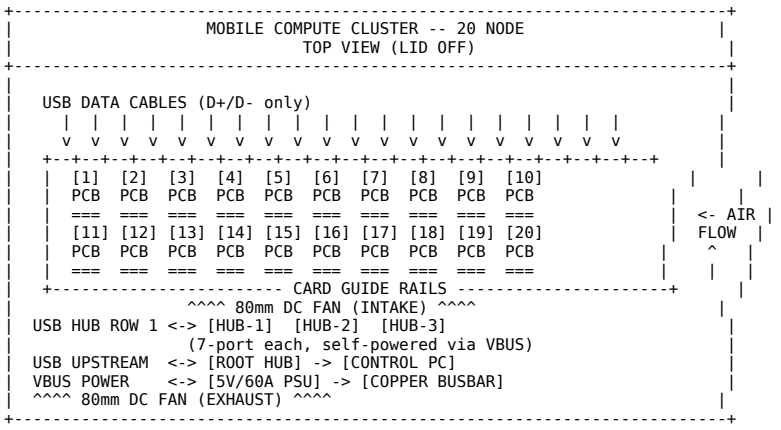
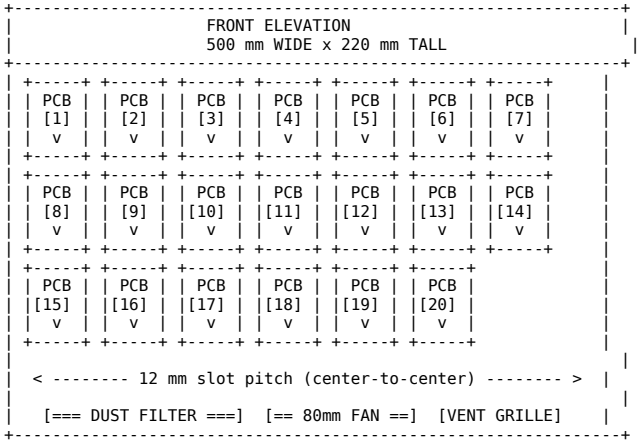
1. System Overview

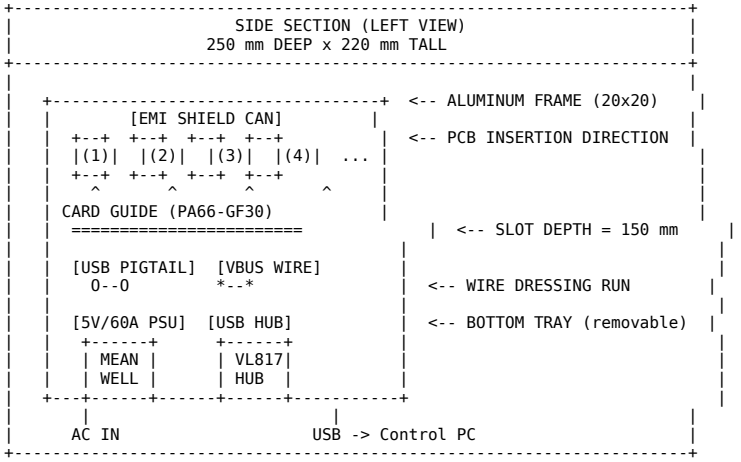
The diagram below shows the complete 20-node compute cluster built from stripped consumer smartphone PCBs mounted in a custom chassis with shared power and data infrastructure.



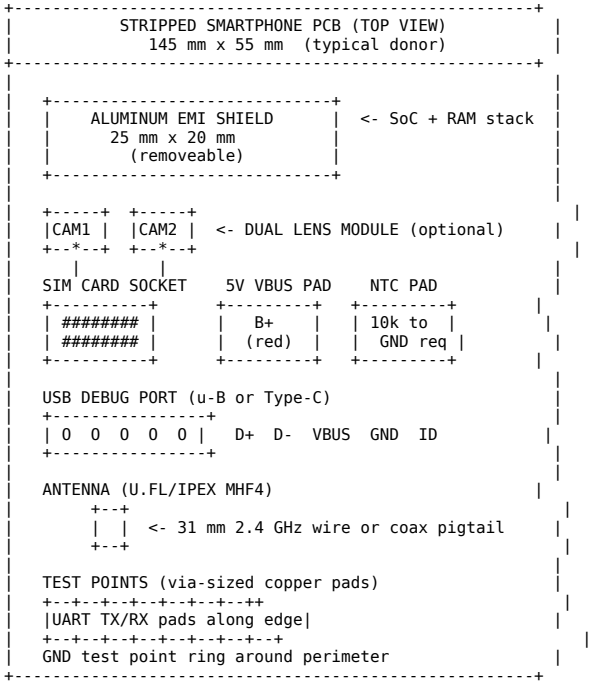
2. Chassis Drawing – Front Elevation



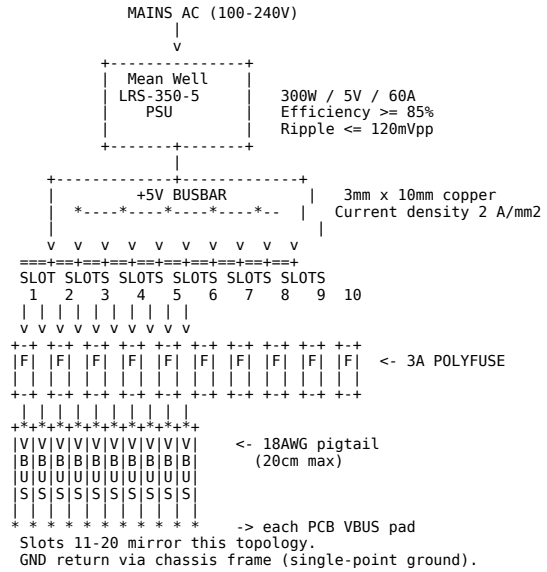
3. Chassis Drawing – Side Section



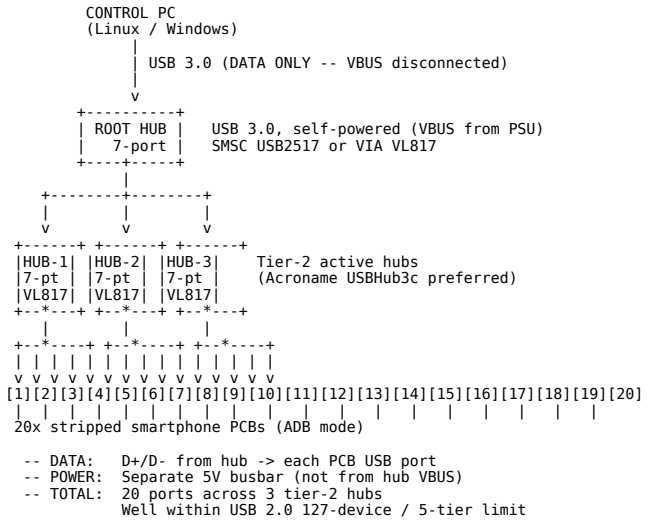
4. Node PCB Layout – Detail View



5. Power Distribution Diagram

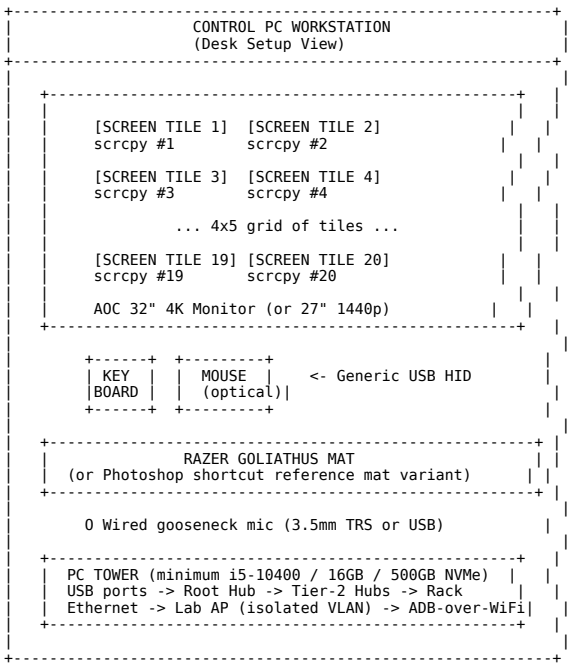


6. USB Data Topology

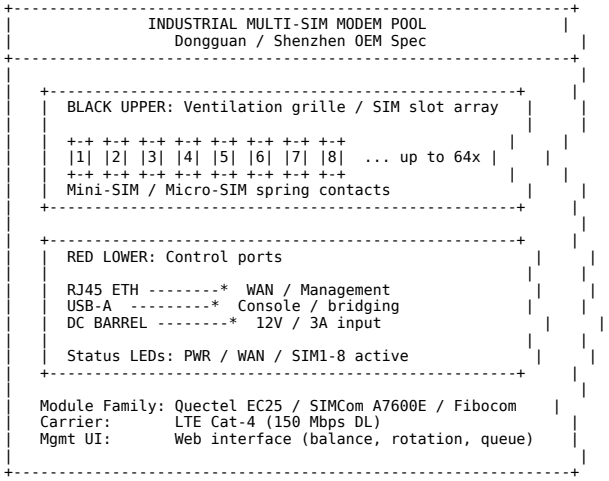



```
  -- DATA:   D+/D- from hub -> each PCB USB port
  -- POWER:  Separate 5V busbar (not from hub VBUS)
  -- TOTAL:  20 ports across 3 tier-2 hubs
             Well within USB 2.0 127-device / 5-tier limit
```

7. Control PC Workstation



8. Cellular / SIM Aggregation Gear



9. Bill of Materials (BOM)

Part	Qty	Unit Cost	Sourcing Notes
Stripped smartphone PCB	20	USD 10	Xiaomi Redmi 6A / ZTE Blade surplus
Aluminum extrusion 20x20mm	4	USD 8	MakerBeam / 8020.net / local
Laser-cut acrylic card guides	22	USD 2	3mm PA66 or acrylic dividers
Mean Well LRS-350-5 PSU	1	USD 25	5V / 60A / 300W, DIN rail
Copper busbar (3x10x300mm)	1	USD 5	C11000 copper, hardware store
20AWG silicone wire (10m roll)	2	USD 6	Red + black, 300V rated
USB pigtail assemblies (20cm)	20	USD 0.50	Micro-B or Type-C; data-only cut
7-port USB 3.0 hub (VL817)	3	USD 25	Anker, Sabrent, or industrial
80mm DC fan (ball bearing)	2	USD 8	Noctua NF-A8 or Delta; 3000 RPM
Dust filter (200x200mm)	2	USD 3	50 PPI polyurethane
M3 hardware kit	1	USD 10	Screws, T-nuts, standoffs
Thermal pad (10x10 mm, 1mm)	20	USD 0.40	6 W/mK conductivity
10k resistor (thermistor bypass)	20	USD 0.05	1/4W, 1% tol
NTC thermistor (10k @ 25degC)	20	USD 0.10	Preferred over resistor bypass
Antenna pigtail (U.FL to SMA)	20	USD 1.50	If using external antennas
Faraday tent (optional)	1	USD 150	RF shielding for legal compliance

Total BOM: **USD 626** (with Faraday tent) / **USD 476** (without)

Cost per functional node: **USD 24-31** (amortizing chassis + PSU + hubs across 20 slots).

10. Key Dimensions Summary

Parameter	Value	Tolerance
Outer chassis (W x D x H)	500 x 250 x 220 mm	+/- 5 mm
PCB slot pitch (centers)	12 mm	+/- 0.5 mm
PCB insertion depth	150 mm	–
PCB thickness range	0.8 - 1.6 mm	–
Fan cutout	80 mm x 80 mm (both sides)	–
PSU cutout	100 x 50 mm (bottom tray)	–
USB hub tray depth	30 mm (side pocket)	–
Max component height per slot	6 mm (camera module retained)	–
Chassis material	6061-T6 aluminum, 1.5 mm wall	–
Total loaded weight	5.5 kg	+/- 0.5 kg

11. Environmental and Power Summary

Parameter	Value
AC input	100-240 VAC, 50/60 Hz, 1.5 A max
DC output	5 V at 60 A / 300 W (peak capacity)
Heat dissipation per node	2-12 W (typical 5 W)
Total rack thermal load	100-240 W active
Required airflow	15 CFM minimum
Operating temp	15-35 degC ambient
Humidity	30-70% RH non-condensing
Noise level	< 35 dBA at 1 m

12. Recommended Software Stack

Layer	Tool	Purpose
OS	Ubuntu 22.04 LTS	Host OS; ADB and scrcpy available via apt
Device orchestration	DeviceFarmer (OpenSTF)	Web UI for remote screen control and ADB shell
Screen mirroring	scrcpy v2.x	Lightweight; 1-3 ms latency over USB
Automation	UI Automator 2 + Python	Programmatic UI interaction across all nodes
Logging	adb logcat	Centralized syslog with filtering via pidcat
CI/CD bridge	Jenkins + Appium Grid	Automated testing across all devices
Network isolation	dnsmasq + hostapd	Isolated WiFi lab network (ADB-over-WiFi)
Firmware backup	dd via rooted adb	Full disk imaging before destructive testing
Security testing	Frida, Objection, Magisk	Instrumentation, SSL bypass, root

13. Failure Modes and Diagnostics

Symptom	Likely Cause	Fix
Board won't boot, no LED	Missing NTC/ID resistor; PMIC brownout	Check VBAT at PMIC input; verify thermistor loop
Boots then reboots in 30 sec	Inadequate PSU (voltage sag under load)	Add bulk capacitance (1000 uF, 6.3 V) near board input
ADB appears then disappears	USB VBUS back-powering hub; ground loop	Use data-only cables; ensure single-point ground
Overheating shutdown	Insufficient airflow; missing heatsink	Verify 45 degC ambient max; add aluminum fin on shield
Cellular not registering	SIM not seated; antenna missing; IMEI blacklisted	Check AT+CREG; verify antenna continuity
Intermittent touch events	NTC line floating; PMIC glitching	Ground unused sensor lines; check dmesg for driver errors

14. Build vs. Buy Matrix

Component	DIY	Commercial	Recommendation
Chassis	USD 40-80	USD 150-400 (Schroff)	DIY for under 20 nodes; buy for rack infrastructure labs
Power	USD 30-50	USD 80-150 (programmable lab PSU)	DIY busbar fine; buy if per-port current telemetry needed
USB hubs	USD 75 (3x consumer)	USD 400-800 (Acroname)	Consumer works for 90% of labs; Acroname for remote power cycle
Device mgmt UI	Free (OpenSTF)	USD 500+/mo (AWS Device Farm)	Self-host OpenSTF for on-prem; cloud only for global diversity
SIM bank	USD 80-200 (OEM)	USD 500-2000 (branded)	OEM adequate for test labs