

Infrastructure Specification: District Hub (DHU)

Role: District Director & Edge Coordinator | Tier: Layer 2 (Field Mesh Manager)

1. Enclosure & Mechanical Engineering

The DHU is designed to act as a localized "Director," requiring a physical build that balances high-compute thermal management with extreme environmental resilience.

- **Housing:** NEMA 4X Rated Oversized Polycarbonate Enclosure (24" x 20" x 10").
 - *Justification:* Unlike metal enclosures, high-impact polycarbonate is RF-transparent, allowing internal diagnostic radios and GPS modules to maintain high-gain locks without externalizing all antennas. The "Oversized" volume is a strategic requirement: it provides the necessary air-gap for the 200Ah Dual-Pack battery system and acts as a massive thermal buffer against the high-altitude solar radiation of the San Luis Valley.
- **Mounting System:** 304 Stainless Steel "Band-It" universal pole mounting brackets. This system allows for non-destructive, high-torque attachment to structures ranging from 4-inch lattice towers to 12-foot diameter concrete silos, rated to withstand 100mph wind gusts.
- **Thermal Management:**
 - **Active Heating:** An integrated 20W internal heater is mapped to the battery management system (BMS). It utilizes the first priority of morning solar harvest to bring the LiFePO4 cells to a safe charging temperature (+5°C) before allowing current to flow into the bank.
 - **Atmospheric Balancing:** Dual passive Gore-Tex vents allow for pressure equalization during rapid barometer shifts (common in alpine storm fronts) while maintaining a hermetic seal against fine alkali dust and moisture.
- **Weight:** ~115 lbs (fully integrated). The weight is concentrated in the lower third of the enclosure to provide a low center of gravity, reducing vibration stress on the mounting brackets during high-wind events.

2. Siting & Structural Deployment Options

In scenarios where existing high-elevation farm infrastructure (silos/elevators) is unavailable, the DHU deployment utilizes standardized "Utility-Grade" structures to maintain the 10km operational radius and Fresnel zone clearance.

A. Preferred Structural Options (Topographical High Points)

1. **Grain Silos & Municipal Water Towers:** The primary targets. These provide immediate height (50ft+) and structural stability. Proximity to silos often offers easier access for maintenance crews.
2. **Utility-Class Timber Poles:** In "Dead Zones" where no structures exist, the Blitz crews deploy 35ft-40ft Class 4 Southern Yellow Pine (or Douglas Fir) poles.
 - *Installation:* Poles are set 6ft-8ft deep with a native-backfill tamper or crushed rock base.
 - *Advantage:* Extremely durable, low maintenance, and visually consistent with existing rural utility lines.
3. **Lightweight Guyed Steel Towers:** For remote ridge lines or bluffs where heavy equipment for pole-setting cannot reach.
 - *Specs:* 30ft-40ft aluminum or galvanized steel triangular lattice (e.g., Rohn 25G type).
 - *Anchoring:* Requires a three-point guy-wire system with 4ft earth anchors. This is the preferred method for high-altitude bluffs where the "Director" needs to look down into the valley floor.

B. Clearance & RF Requirements

- **Height:** Minimum 30ft Above Ground Level (AGL). This is non-negotiable to clear the 60% Fresnel zone over a 10km span, especially when accounting for summer heat-shimmer (refraction) and maturing corn/potato canopies.
- **Fresnel Zone:** Must maintain a clear 360-degree line-of-sight. Any obstruction within the first 60% of the zone (trees, power lines, or pivots) can cause "multipath interference," degrading the "Worksheet" sync between the DHU and the field-level VFAs.

3. Build-Out Costs & Infrastructure Economics

Component	Detailed Itemization	Estimated Cost
Compute	8-Core ARM SoC (High-Efficiency) + 16GB ECC RAM + 128GB Industrial SSD (pSLC)	\$450
Networking	3x 5GHz 120° LTU Sector Antennas + LTE-M/NB-IoT Modem + Shielded LMR-400 Cabling	\$1,200
Power Plant	200W High-Tilt Solar Array + 200Ah Heated LiFePO4 + 30A MPPT Controller	\$1,800

Housing/Mounts	NEMA 4X Polycarbonate Box + GDT Surge Protection + Stainless Mounting Kit	\$750
Alt Structure	Optional: 40ft Utility Pole (Installed) or 30ft Guyed Tower Kit	\$1,200 - \$1,800
Total Hardware	Standard Subtotal (Excl. Structural Upgrades)	~\$4,200

4. Policy & Implementation Implications

The DHU is classified as "Critical Watershed Infrastructure." * **The Digital Ledger Role:** As the "District Director," the DHU holds the 30-day "Blackout Cache." This local data redundancy is the primary defense against legal challenges in Water Court; if the regional internet fails, the DHU continues to record every "Audit Packet," ensuring the farmer's water conservation credits are never lost or questioned.

- **Worksheet Autonomy:** The DHU is the only layer capable of executing "Reflex" logic without a cloud handshake. This localized autonomy means that if a pivot stalls or a pipe bursts, the DHU can trigger a PFA shutdown in milliseconds, preventing catastrophic soil erosion or aquifer over-extraction.