

Case Analysis — Maury High School

Structured cabling, Ethernet equipment, and network security plan with budgets

Summary

Maury High School is served from one main Equipment Room (MDF) and three Telecom Closets (IDFs), placed in four of the small first-floor offices that the project permits (the circled offices). Each closet sits over a vertical riser and serves the rooms stacked directly above and below it on all four occupied levels (basement, first, second, and third floors), so no horizontal cable run exceeds the Category 6A distance limit.

The design provides two RJ45 outlets in every classroom and office (96 outlets across 48 rooms), a 10 Gigabit fiber backbone between the MDF and each IDF, managed Layer-3 PoE switches with 144 access ports (50% above the required 10% port headroom), and a single shared, secured Internet connection behind a firewall that separates staff and student traffic into distinct VLANs/subnets.

Deliverable	Result	Est. materials cost
Part 1 — Structured cabling & passive plant	96 outlets, ~12,000 ft Cat6A, 10G fiber backbone, 4 patch panels	\$4,835
Part 2 — Ethernet equipment	5 managed L3 switches (144 ports), patch cords, racks/UPS	\$6,471
Part 3 — Network security	UniFi firewall/gateway, staff/student VLANs, content filtering	\$379

0. Scale, Assumptions, and Room Count

Determining the scale

The first-floor plan image measures 857 × 461 pixels. Measuring the outermost building walls (the left wing to the right wing), the structure spans about 828 pixels. With the stated building width of 300 ft, the scale is $300 \div 828 = 0.362$ ft per pixel (≈ 2.76 pixels per foot).

Applying that scale, each end wing is roughly 120 ft long (north–south) by 35 ft wide, and the central block is roughly 230 ft wide. Floor-to-floor height for a building of this era is assumed at 14 ft for riser (vertical backbone) calculations. Four levels are treated as occupied: basement, first, second, and third floors.

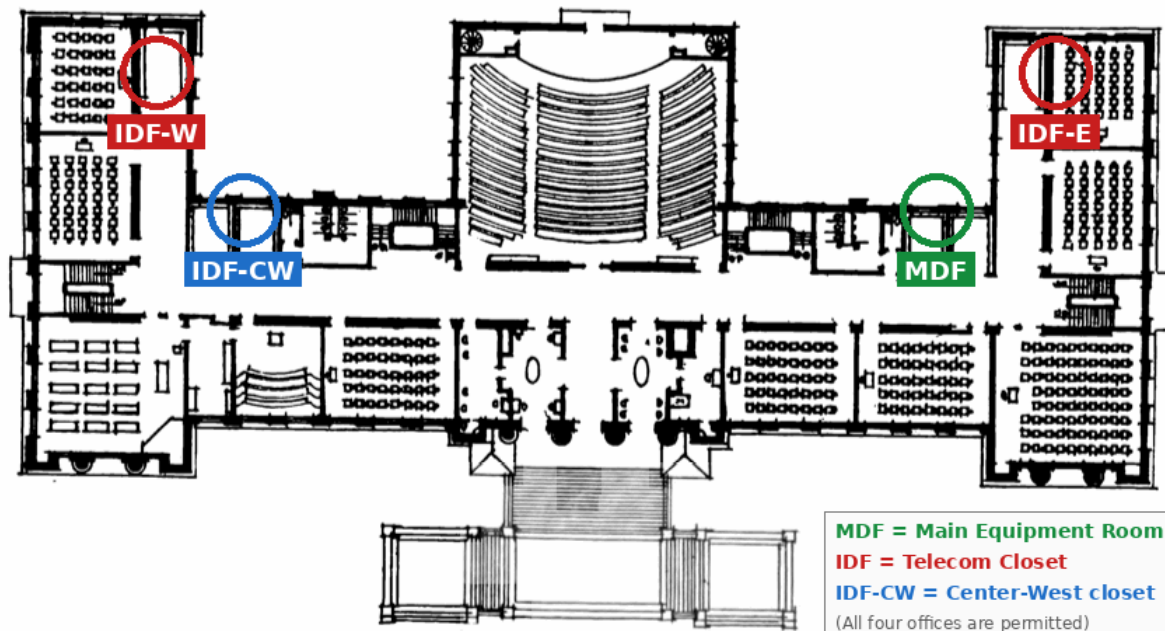
Equipment Room and Telecom Closet placement

All four permitted small offices are on the first floor: one at the top of each end wing and two flanking the central corridor. They are assigned as follows, chosen so that each closet sits near a vertical riser and is centered within the rooms it serves:

- MDF (Main Equipment Room): center-east office. Houses the firewall/gateway, the core/aggregation switch, the ISP demarcation, and the patch panel for the 26 center-east drops.
- IDF-CW: center-west office. Serves the 26 center-west drops on all four floors.
- IDF-W: top of the west wing. Serves the 22 west-wing drops on all four floors.
- IDF-E: top of the east wing. Serves the 22 east-wing drops on all four floors.

First Floor — Equipment Room (MDF) & Telecom Closets (IDF)

Backbone (10G fiber) runs from the MDF up/down the risers to each IDF; IDFs serve all four floors stacked above



Room count (two outlets per classroom/office)

Counting classrooms, offices, labs/shops, the library, the auditorium, and the gymnasium from the four floor plans gives 48 rooms. At two outlets per room this yields 96 data outlets. Restrooms, stairwells, and mechanical/locker spaces receive no outlets. The closets/equipment room hold patch panels and are not counted as outlet rooms.

Floor	West wing	Center	East wing	Rooms (outlets)
Basement	2	6	2	10 (20)
First	3	8	3	14 (28)
Second	3	6	3	12 (24)
Third	3	6	3	12 (24)
Total	11	26	11	48 rooms / 96 outlets

Serving closet	Rooms	Outlets	Office used
IDF-W	11	22	West-wing top
IDF-CW	13	26	Center-west
MDF (center-east)	13	26	Center-east (Equipment Room)
IDF-E	11	22	East-wing top
Total	48	96	4 offices

Part 1 — Cabling Plan and Budget

Media and topology

Horizontal cabling uses Category 6A UTP (23 AWG, riser-rated CMR) from every outlet back to a 48-port patch panel in its serving closet — a standard hierarchical star. The backbone between the MDF and each IDF uses 10 Gigabit multimode (OM4) fiber terminated on a small fiber patch panel (LIU) in each closet. Fiber is used for the backbone because it cleanly carries the inter-closet 10G uplinks and removes any copper-distance concern.

Each horizontal cable runs from the outlet, through the ceiling/raceway to the riser, vertically to the first-floor closet, and into the patch panel as one continuous run with no splices.

Cable-run length estimate

Run lengths use the standard structured-cabling estimate: average run = $[(\text{longest} + \text{shortest}) \div 2] \times 1.1$ (routing slack) + ~20 ft of service/termination slack (about 10 ft at each end). The longest path — a far end-of-wing room two floors above its closet — is about 120 ft horizontal + 28 ft vertical ≈ 150 ft, comfortably inside the 90 m (≈ 295 ft) Category 6A horizontal limit, so every drop works.

Zone	Drops	Min ft	Max ft	Avg run (with slack)
Wing closets (IDF-W, IDF-E)	44	30	150	≈ 115 ft
Center closets (IDF-CW, MDF)	52	25	140	≈ 105 ft
Horizontal subtotal	96			≈ 10,520 ft

Adding a 10% waste/re-pull factor gives about 11,600 ft, purchased as twelve 1,000-ft boxes (12,000 ft). The fiber backbone totals roughly 550 ft across three runs: MDF↔IDF-W ≈ 210 ft, MDF↔IDF-E ≈ 130 ft, MDF↔IDF-CW ≈ 110 ft (plus slack).

Part 1 budget — cabling, outlets, wall plates, and patch panels

Item	Qty	Unit	Extended	Pricing source
Cat6A bulk UTP, 23 AWG, CMR riser, 1000-ft box	12	\$200	\$2,400	Monoprice — Cat6A bulk
Cat6A RJ45 keystone jacks (incl. ~15% spares)	110	\$3.50	\$385	Monoprice — keystones
2-port faceplate + low-voltage mounting box	50	\$4.00	\$200	Monoprice — wall plates
48-port Cat6A patch panel (1 per closet)	4	\$100	\$400	Monoprice — patch panels
OM4 fiber backbone lot: 3 pre-term riser trunks, 4 fiber LIUs, LC patch cords	1	\$850	\$850	Monoprice / FS.com — fiber
Install consumables: J-hooks/D-rings, ties, labels, firestop, station raceway	1	\$600	\$600	Monoprice — cable mgmt
Part 1 total			\$4,835	

Part 2 — Ethernet Equipment Plan and Budget

Switching architecture

Each closet holds one managed, Layer-3, PoE switch. The MDF switch doubles as the core/aggregation point: its four 10G SFP+ ports land the three IDF fiber uplinks plus the firewall, while its 48 RJ45 ports also serve the 26 center-east drops. PoE is included throughout to power future wireless access points, cameras, or VoIP phones without extra cabling.

Port headroom check: the design provides $24 + 24 + 48 + 48 = 144$ access ports for 96 outlets. That is 50% more ports than outlets, well above the required minimum of 10% more (105.6 ports). Uplinks use the switches' dedicated SFP+ ports and do not consume access ports.

Equipment per location

Location	Equipment	Access ports	Serves
MDF (center-east)	USW-Pro-48-PoE (core + access), firewall, ISP demarc, rack, UPS	48	26 center-east drops + aggregation
IDF-CW	USW-Pro-48-PoE, rack, UPS	48	26 center-west drops
IDF-W	USW-Pro-24-PoE, rack, UPS	24	22 west-wing drops
IDF-E	USW-Pro-24-PoE, rack, UPS	24	22 east-wing drops
Total	5 managed switches	144	96 outlets (≥110%)

Part 2 budget — switches, uplinks, patch cables, and support

Item	Qty	Unit	Extended	Pricing source
UniFi USW-Pro-24-PoE (L3, 2× 10G SFP+) — IDF-W, IDF-E	2	\$699	\$1,398	Ubiquiti Store (store.ui.com)
UniFi USW-Pro-48-PoE (L3, 4× 10G SFP+) — IDF-CW & MDF core	2	\$1,099	\$2,198	Ubiquiti Store
10G SR SFP+ optics (fiber backbone, 2 per link × 3)	6	\$25	\$150	FS.com / Ubiquiti
10G SFP+ DAC (firewall ↔ core, in-rack)	1	\$25	\$25	Ubiquiti Store
Cat6A patch cords (closet + work-area, incl. spares)	220	\$4.10	\$900	Monoprice — Cat6A patch
Wall-mount network rack/enclosure, 12U	4	\$160	\$640	Monoprice — racks & cabinets
Rackmount UPS, ~1500 VA	4	\$220	\$880	Monoprice / CyberPower
Rackmount PDU / surge strip	4	\$45	\$180	Monoprice
Horizontal cable manager	4	\$25	\$100	Monoprice
Part 2 total			\$6,471	

Part 3 — Network Security Plan and Budget

Firewall / gateway

A single UniFi Dream Machine Pro at the MDF terminates the one shared, secured Internet connection and acts as the school's firewall and router. It performs NAT for all internal subnets, stateful and application-aware (deep-packet-inspection) filtering, intrusion detection/prevention, DNS/category content filtering for student traffic, and inter-VLAN routing — with no recurring license. It sustains about 3.5 Gbps of IDS/IPS throughput and supports well over 1,000 client devices, comfortably covering the 200–300 users required. For extra headroom (5 Gbps IDS/IPS, 200+ managed devices) the Dream Machine Pro Max is a drop-in upgrade for about \$220 more.

Because the school runs no Internet-facing servers, the firewall needs no inbound port-forwards: the default WAN-to-LAN policy is deny-all, and only outbound, policy-controlled traffic is permitted.

VLAN / subnet design

Staff and student traffic are placed on separate VLANs and IP subnets. Switch-to-switch and switch-to-gateway links are 802.1Q trunks carrying all VLANs; each outlet is assigned to the appropriate VLAN (staff jack vs. student jack). The gateway routes between VLANs and enforces the firewall policy below.

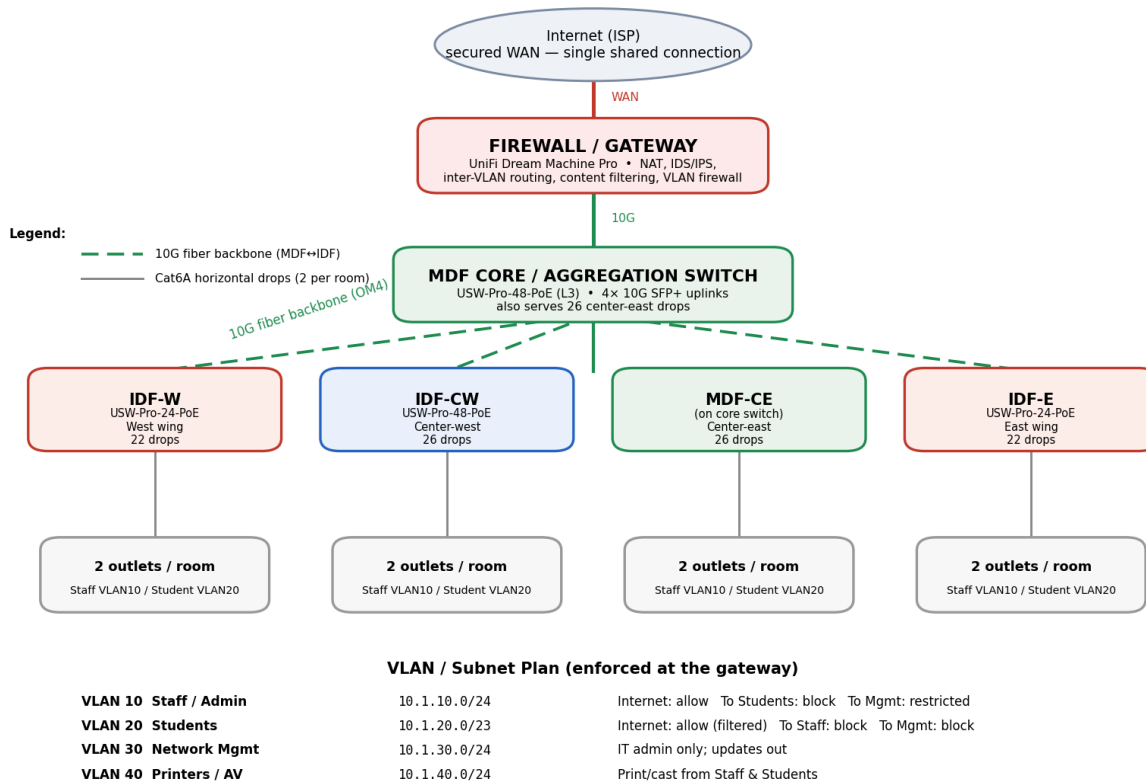
VLAN / purpose	Subnet	Notes
VLAN 10 — Staff / Admin	10.1.10.0/24	Up to 254 staff devices
VLAN 20 — Students	10.1.20.0/23	Up to 510 hosts; sized for growth + future Wi-Fi
VLAN 30 — Network Management	10.1.30.0/24	Switches, gateway, APs; IT access only
VLAN 40 — Printers / Shared AV	10.1.40.0/24	Reachable for print/cast only
WAN	ISP-assigned public IP	NAT/PAT for all internal subnets

Firewall policy

The firewall can permit or deny traffic from any internal subnet or host to any Internet subnet or address, satisfying the project requirement. The baseline policy is:

- Any internal VLAN → Internet: allowed outbound (student VLAN additionally content-filtered for acceptable use).
- Internet (WAN) → inside: denied by default (no Internet-facing servers, so no port-forwards).
- Students (VLAN 20) → Staff (VLAN 10): blocked.
- Students (VLAN 20) → Management (VLAN 30): blocked.
- Staff (VLAN 10) → Management (VLAN 30): allowed only from the IT-admin host group; otherwise blocked.
- Staff (VLAN 10) → Students (VLAN 20): blocked by default.
- Any user VLAN → Printers (VLAN 40): only printing/casting ports allowed.
- Management (VLAN 30) → Internet: limited to software/firmware updates.

Maury High School — Logical Network & Security Diagram



Part 3 budget — security

Item	Qty	Unit	Extended	Pricing source
UniFi Dream Machine Pro — firewall / gateway / router	1	\$379	\$379	Ubiquiti Store
IDS/IPS, DPI firewall, content filtering, inter-VLAN routing	incl.	\$0	\$0	UniFi OS (no license)
Part 3 total			\$379	

Project Budget Summary

Section	Estimated materials cost
Part 1 — Structured cabling & passive plant	\$4,835
Part 2 — Ethernet equipment	\$6,471
Part 3 — Network security	\$379
Total estimated materials	\$11,685
Optional installation labor (separate)	≈ \$7,000

Pricing sources

- Monoprice (monoprice.com) — Cat6A bulk cable, keystone jacks, wall plates/boxes, patch panels, patch cords, fiber, racks, cable management. Cat6A 1000-ft CMR spools list at roughly \$180–\$230.
- Ubiquiti US Store (store.ui.com) — USW-Pro-24-PoE \$699, USW-Pro-48-PoE \$1,099, Dream Machine Pro \$379, Dream Machine Pro Max \$599 (verified June 2026).
- FS.com / Ubiquiti — 10G SR SFP+ optics and OM4 fiber assemblies.
- CyberPower / Monoprice — rackmount UPS and PDU pricing.