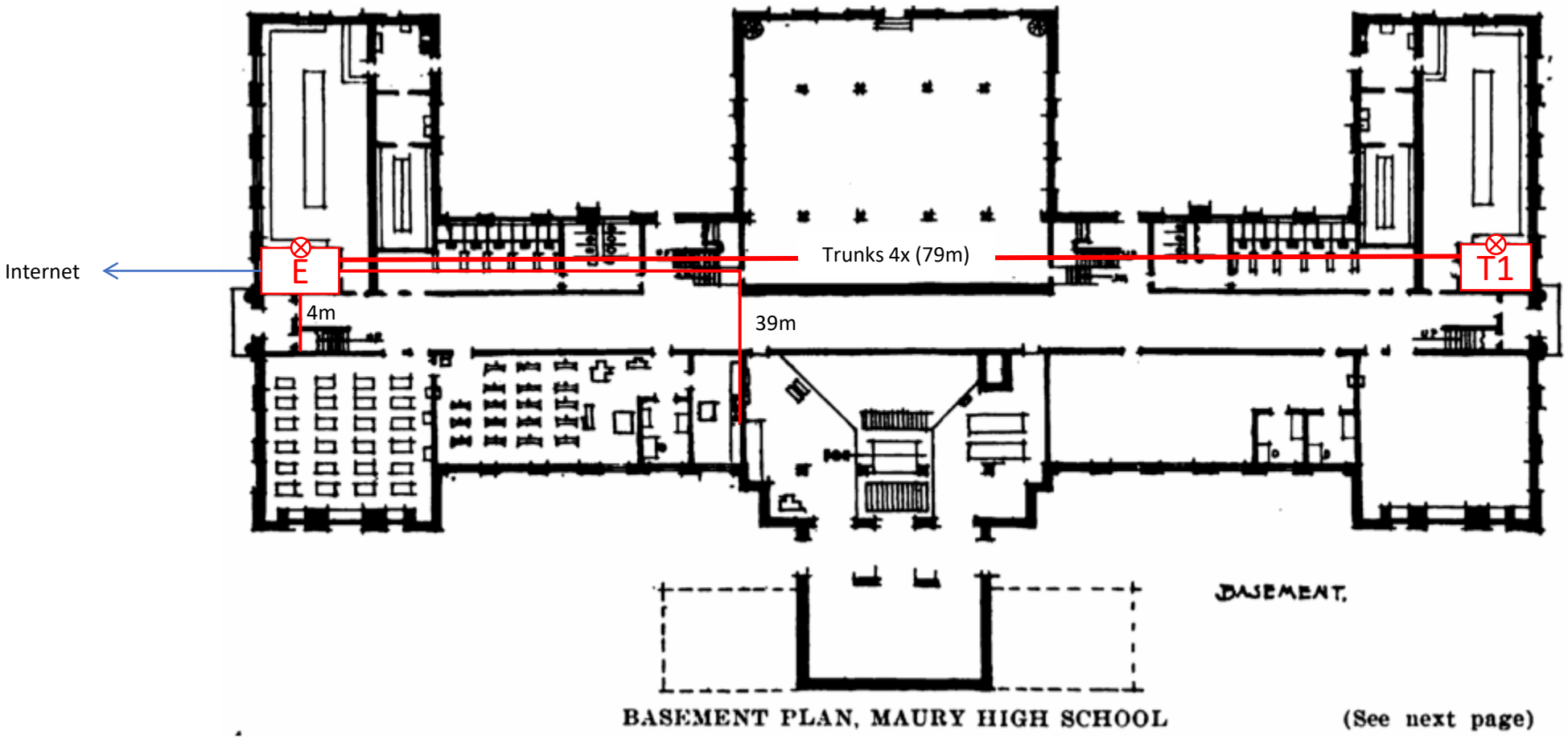
Case Analysis – Wiring Maury High School

IT 315: Introduction to Networking and Security | 01218081 | Jacen Davis

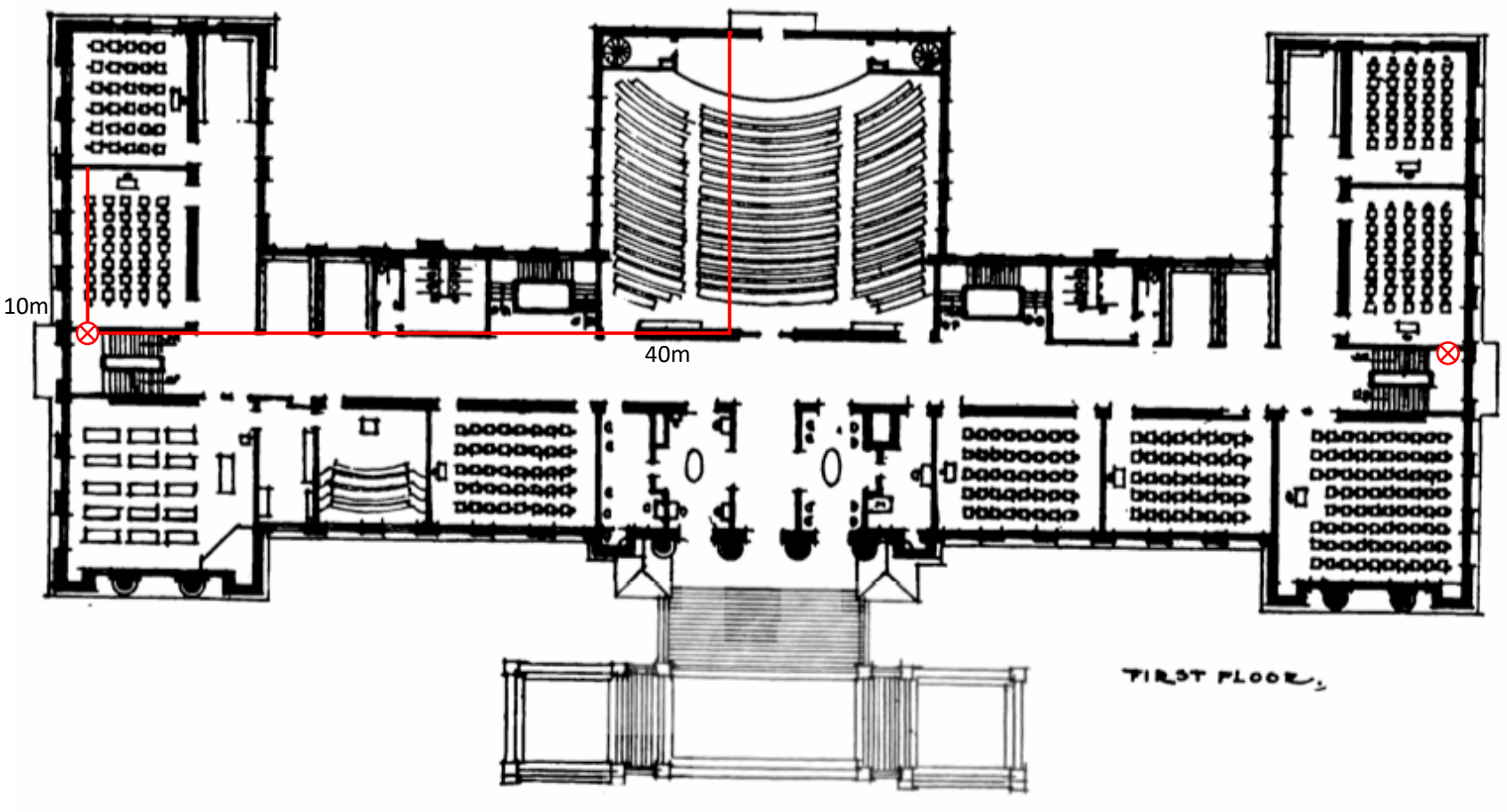
Part One: Wiring the Building

Plan and Budget for Wiring the School.

Basement Diagram



Floor 1 Diagram



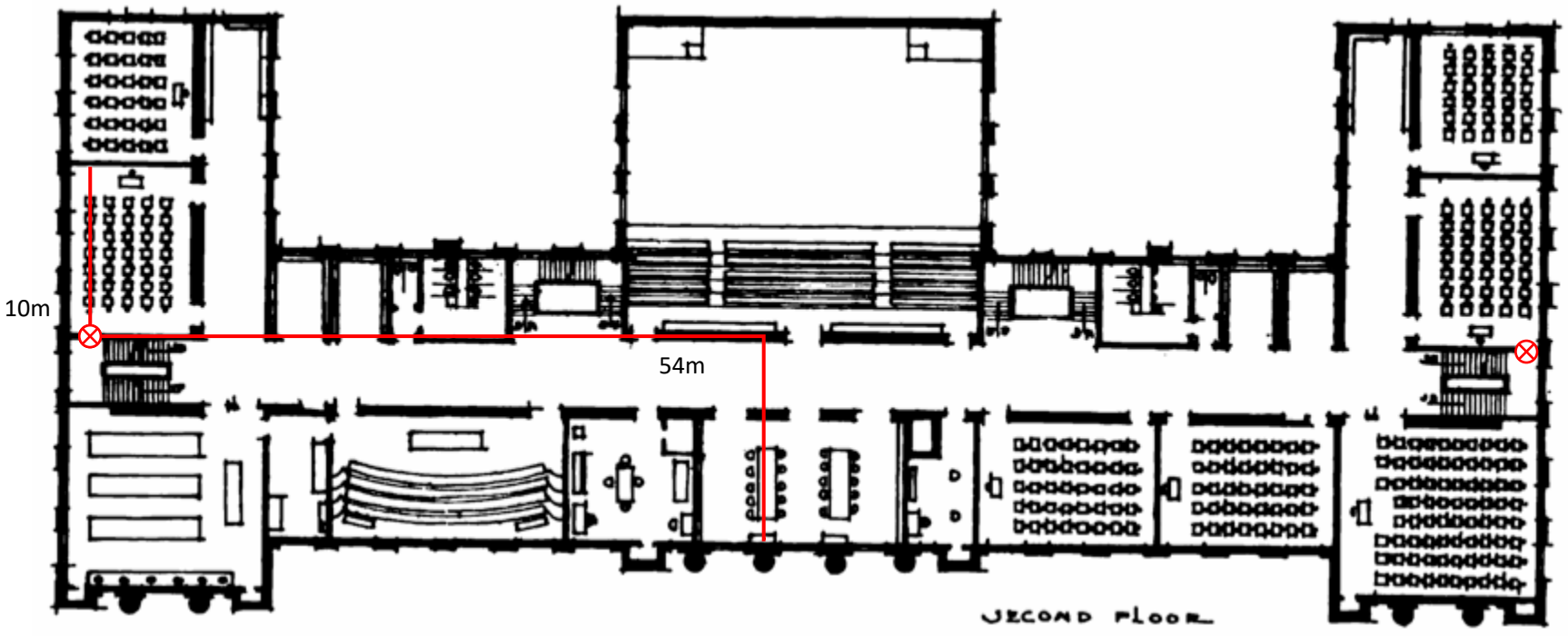
T# Telco Closet

Cable Rise 3m

Cable Run

0.092 inches = 1 meter

Floor 2 Diagram



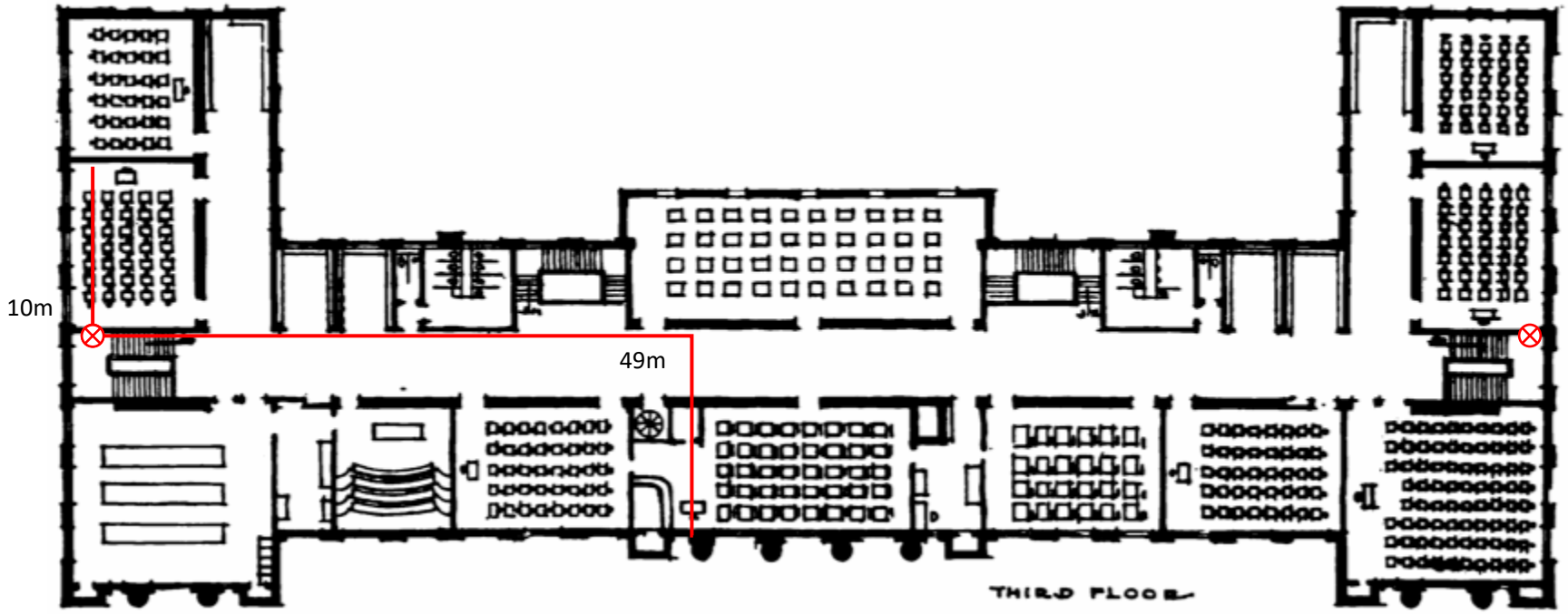
T# Telco Closet

Cable Rise 6m

Cable Run

0.092 inches = 1 meter

Floor 3 Diagram



T# Telco Closet

Cable Rise 9m

Cable Run

0.092 inches = 1 meter

Estimating Cable Lengths

- **Total Cable (in feet) needed: 45,000 feet**
- Floor Run Cable Estimation –
  - Basement Longest & Shortest Run: 39m and 4m
  - First Floor Longest & Shortest Run: 43m and 13m
  - Second Floor Longest & Shortest Run: 60m and 16m (We'll use this)
  - Third Floor Longest & Shortest Run: 58m and 19m
- Calculating Cable Length Needed -
  - Average Length (AL) = (60 + 13) / 2 = 36.5 meters
  - Total Average Cable Length (TACL) = (Slack + Drop + AL) = 1.1 + 3 + 36.5 = 40.6 meters
  - Total Outlets (N): 300 cable outlets
  - Total Cable Length = TACL * N = 40.6 * 300 = 12,180 meters = 39960.6299 feet
- Final total includes +10% padding: 40,000 feet + 5,000 feet = 45,000.

Source: Davis, Jacen. (2022). Hands-on #3: Wiring Constant Hall. *Appendix A: Determining Total Cable Length*.

Physical Cabling/Wiring Materials Budget

Name/Description	MSRP	QDP	# Required	Total
Riser Rated Cat5e Blue Ethernet Cable, Solid, UTP (Unshielded Twisted Pair), POE Compliant, CMR, Pullbox, 1000 foot - 10X6-061TH	$ 120.84 ea	($ 106.17) ea	45	$ 5,437.80 ($4,777.65)
Bulk Cat6 Gray Ethernet Cable, Solid, UTP (Unshielded Twisted Pair), Pullbox, 500 foot - Part #: 10X8-021TF	$ 104.86 ea	N/A	4	$ 419.44
Keystone Wall Plate, Beige, 2 Port, Single Gang - 301-2K	$ 1.07 ea	($ 0.96) ea	165	$ 176.55 ($ 158.40)
Slimline Cat5e Keystone Jack, Blue, RJ45 Female to 110 Punch Down - 310-120BL	$ 2.74 ea	($ 2.26) ea	330	$ 904.20 ($ 745.80)
Rackmount 24 Port Cat6a Patch Panel, Horizontal, 110 Type, 568A & 568B Compatible, 1U - 69BK-16024	$ 56.68 ea	($51.01) ea	14	$ 793.52 ($ 714.14)
Total				$ 7,731.51 ($ 6,815.43)

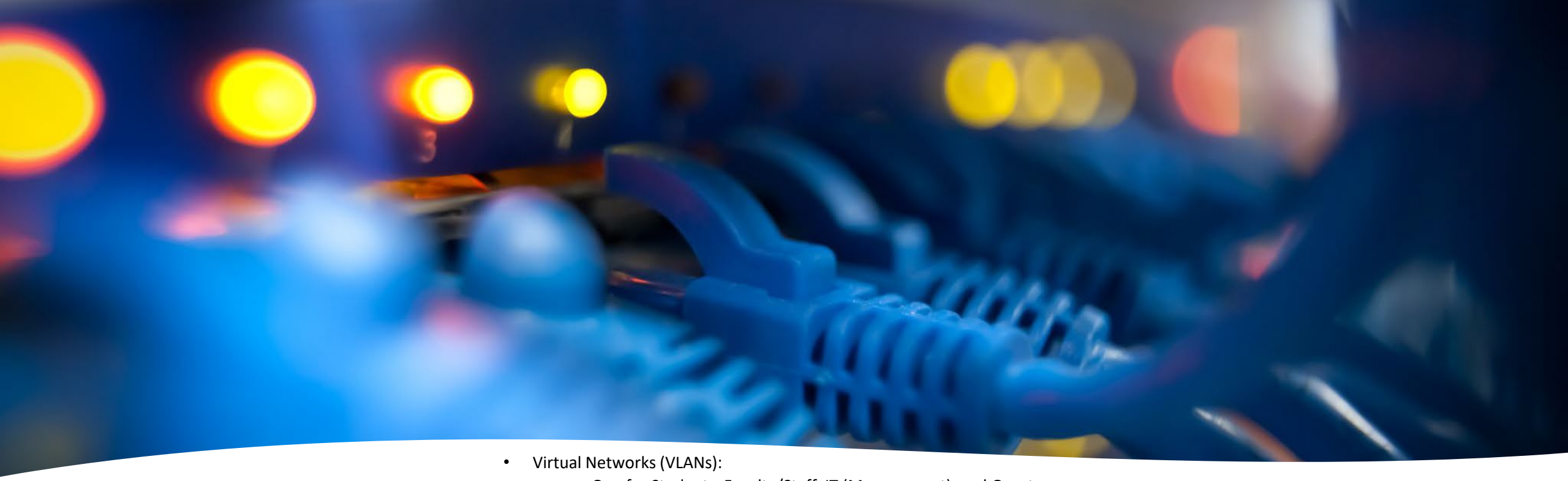
Source: Cable Wholesales. https://cablewholesale.com/.

Part Two: Selecting Network Hardware

Plan and Budget for the Network Backbone and Wiring Closets.

Managed Switches Selection

- Workgroup “Access” Switches (8x):
  - NETGEAR 48-PORT GIGABIT SMART SWITCHES
  - Amazon.com: NETGEAR 48-Port Gigabit Ethernet Smart Switch (GS748T) - Managed, with 2 x 1G SFP and 2 x 1G Combo, Desktop or Rackmount, and Limited Lifetime Protection: Electronics
- Core Switches (4x):
  - NETGEAR 26-PORT SMART SWITCHES
  - Amazon.com: NETGEAR 26-Port PoE Gigabit Ethernet Smart Switch (GS324TP) - Managed, with 24 x PoE+ @ 190W, 2 x 1G SFP, Desktop or Rackmount, S350 series : Electronics



Managed Switches Configuration & Gateway Redundancy

- Virtual Networks (VLANs):
  - One for Students, Faculty/Staff, IT (Management), and Guests.
  - Break up large data links into smaller, virtual data links.
  - Manage traffic congestion (broadcast, etc.).
- Layer 2 Trunking (Core Switches):
  - Create Trunk links between core switches and workgroup switches.
  - And between core switches and dual firewall configuration.
- Layer 2 Redundancy (Gateways):
  - Firewalls will act as default gateway(s) for configured subnets/VLANs
  - Firewalls will use the Common Address Redundancy Protocol (CARP)
    - Share an internal virtual LAN IP for all subnets/VLANs.
    - Avoid connections/device failure from taking internal and external routing down.

Sources: NETGEAR. (2021). Data Sheet | GS748T ProSafe Smart Switch Series. https://www.downloads.netgear.com/files/GDC/GS724TV4/GS724Tv4-GS748Tv5_DS.pdf. | NETGEAR. (2022). Data Sheet | S350 Smart Switch Series. https://www.downloads.netgear.com/files/GDC/smart-switches/S350_Series_GS308T_GS310TP_GS324T_GS324TP_GS348T.pdf. | Electric Sheep Fencing LLC, Rubicon Communications LLC. (2022). High Availability – Layer 2 Redundancy | pfSense Documentation. https://docs.netgate.com/pfsense/en/latest/highavailability/layer-2-redundancy.html.

Networking Hardware Materials Budget

Name/Description	MSRP	Discount/QDP	# Required	Total
Cat6 Blue Copper Ethernet Patch Cable, Snagless/Molded Boot, POE Compliant, 6 foot - *Part #: 10X8-06106*	**$ 2.93**	**($ 2.49)**	**350**	**$ 1,025.50 ($ 871.50)**
Workgroup Switch	**$ 479.99**	**N/A**	**8**	**$ 3,839.92**
Core Switch	**$ 359.99**	**($ 249.99)**	**4**	**$ 1,439.96 ($ 999.96)**
Total				**$ 6,305.38 ($ 5,711.38)**

Sources: Cable Wholesales. https://cablewholesale.com/ | Amazon. https://amazon.com/.

Part Three: Selecting Network Firewall and Final Design

Plan and Budget for the Network Firewall and Final Network Diagram

Firewall Selection

- **NETGATE 7100 1U BASE PFSENSE+ SECURITY GATEWAY**
  - Netgate 7100 1U BASE pfSense+ Security Gateway Appliance
  - 18.6 Gbps IPv4/v6 Traffic Max Throughput
  - 9.14 Gbps Firewall Traffic Max Throughput
  - 1.89 Gbps IPsec VPN Traffic Max Throughput
  - Rack mountable, Upgradable, Software Support (TAC Professional).
- **10G SFP+ DIRECT-ATTACHED COPPER TWINAX PASSIVE CABLE (1 METER)**
  - 10G SFP+ Direct-Attached Copper Twinax Passive Cable (1 Meter) – Netgate
  - High-Availability Pairing (HA Pair).

Firewall Configuration

High Availability Pairing (HA Pair):

Two Firewalls are required.

Increases availability and reduces Single Point of Failure (SPOF).

Increases Bandwidth from the Internet to Organization (Dual links).

Routing Capabilities:

Will act as the primary and edge router to the Internet and between the subnets.

Firewall Segmentation:

Segment critical services from the rest of the network.

Network for public facing services placed in DMZ network.

Network for private (Intranet) resources placed in separate network.

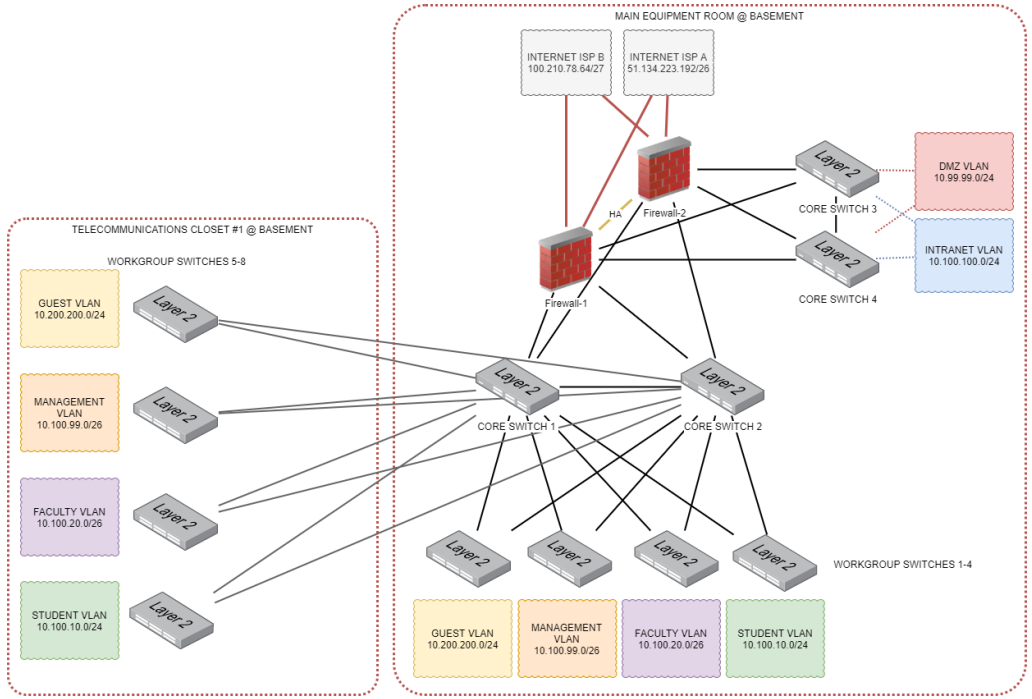
Source: Electric Sheep Fencing LLC, Rubicon Communications LLC. (2022). pfSense® Software Configuration Recipes – High Availability Configuration Example | pfSense Documentation. https://docs.netgate.com/pfsense/en/latest/recipes/high-availability.html

Firewall Materials Budget

Name/Description	MSRP	QDP	# Required	Total
NetGate 7100 Firewall	$ 1,199.00	N/A	2	$ 2,398.00
TAC Professional Software Support	$ 399.00	N/A	2	$ 798.00
10G SFP+ DIRECT-ATTACHED COPPER TWINAX PASSIVE CABLE (1 METER)	$ 34.20	N/A	1	$ 34.20
Total				$ 3,230.20

Source: NetGate. https://shop.netgate.com/products/.

Final Network Topology Design & Firewall Rules Table



General Firewall Ruleset

Source	Direction	Destination	Pass/ Block
GUEST	OUTBOUND	INTERNET, DMZ	PASS
GUEST	OUTBOUND	*	BLOCK
MANAGEMENT	OUTBOUND	INTRANET	PASS
MANAGEMENT	OUTBOUND	*	BLOCK
FACULTY	OUTBOUND	INTERNET, DMZ, INTRANET	PASS
FACULTY	OUTBOUND	*	BLOCK
STUDENT	OUTBOUND	INTERNET, DMZ	PASS
STUDENT	OUTBOUND	*	BLOCK
VPN USERS**	INBOUND	DMZ, INTRANET	PASS
VPN USERS	INBOUND	*	BLOCK

**VPN Users not shown

Final Materials Budget

Component	Cost
Physical Cabling/Wiring	($ 6,815.43)
Networking Hardware	($ 5,711.38)
Firewall/Edge	$ 3,230.20
Total	$ 15,757.01