No Time like the Present: Building a Next Generation Network Infrastructure

WASBO Spring Conference Presentation 2022

Presenters: Michael Gerlach, Director of Business Services, Fond du Lac
Troy Seyfert, Director of Technology Services, Fond du Lac
Mike Dailey, CESA 9

Learning Objectives

1. Evaluate the opportunities that may exist in your district around strategic planning as is relates to improving your network infrastructure.

2. Examine the FCC e-rate category 2 funding program and understand how to apply that funding program to to improve the technology network in your district.

3. Understand the Open Systems Interconnection Model (OSI) of networking systems and why all business officials should understand how that model can shape facility planning.

4. Understand how investments in network infrastructure can impact teaching, learning, & operations.

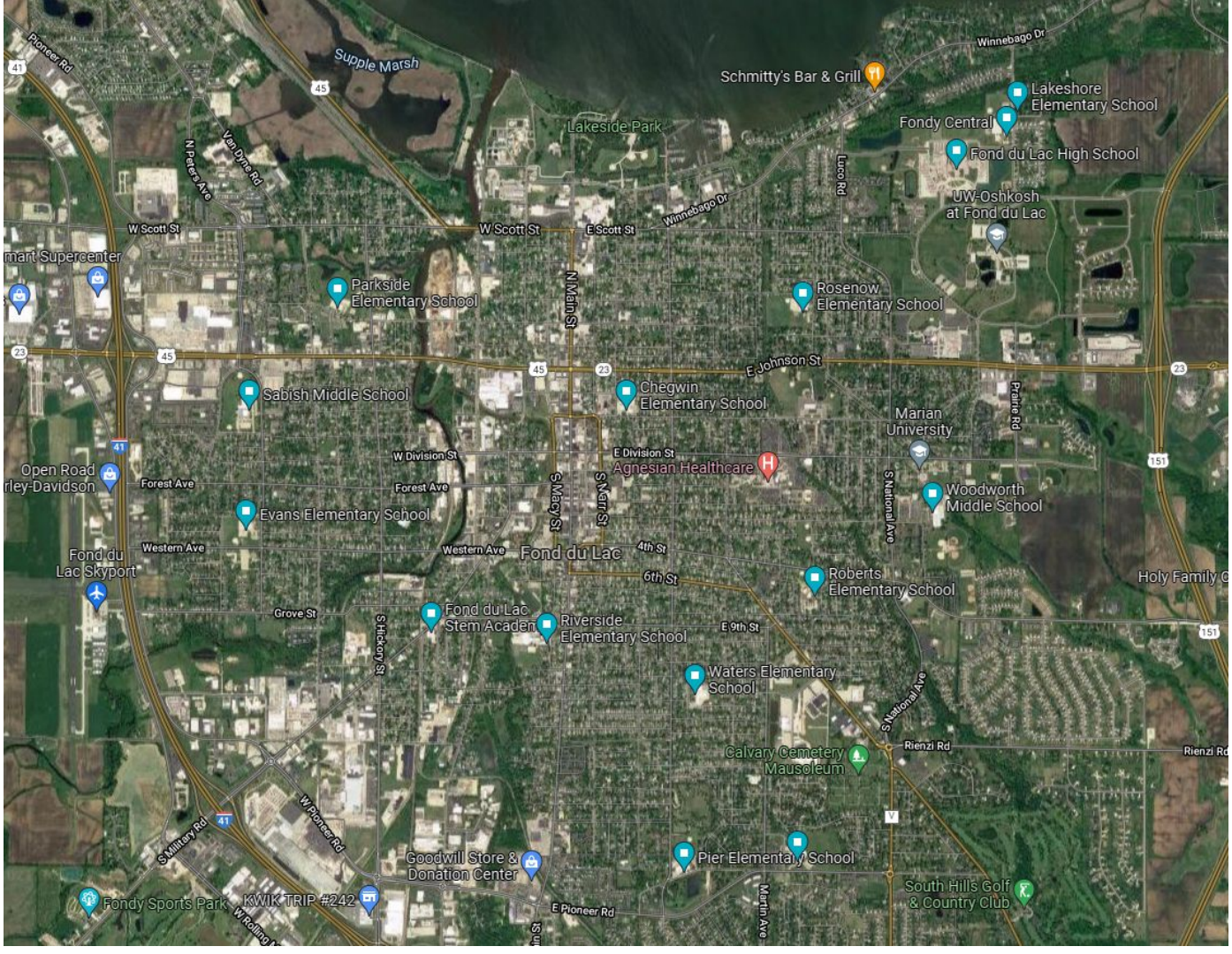
Background

Fond du Lac School District: Located at the “bottom” of Lake Winnebago in east-central WI.

Student enrollment of 6,600 through 15 school sites throughout the city of Fond du Lac. The city of approximately 43,000 is located between Green Bay to the north and Milwaukee to the south.

School sites form a neighborhood school model of 9 elementary schools feeding into 3 middles schools and 1 large high school. There is also a STEM charter school site along with an Alternative High School Learning site. Schools range in structural age from 1908 to 2001. Only 1 building (FHS HS) built post 1995. Next youngest was built in 1976.

All schools are connected in the District by single mode fiber optic cable through the Fond du Lac Community Area Network (CAN) installed in the late 1990’s.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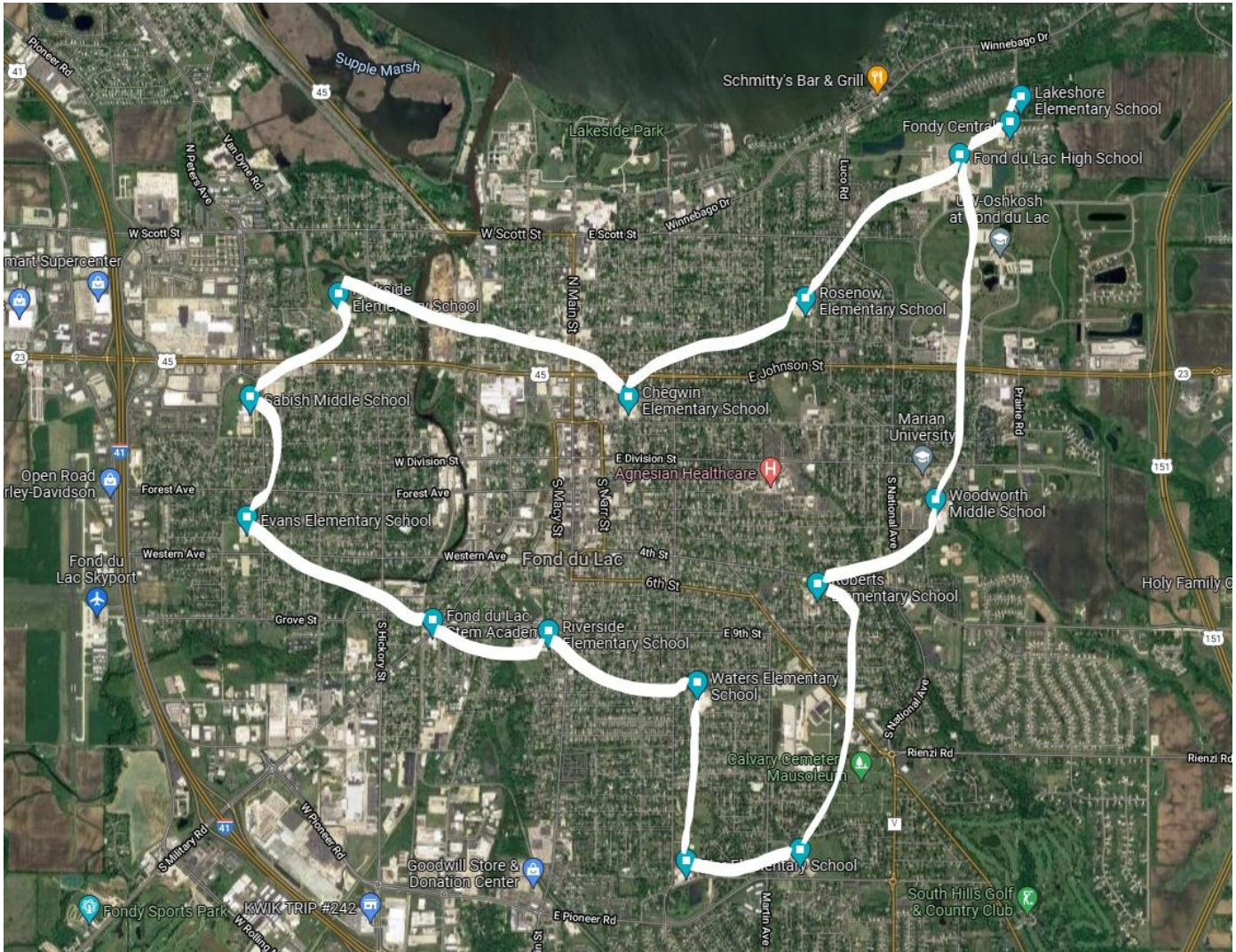
Fondy Central
Fond du Lac High School
Lakeside Park
Pioneer Rd
N Peters Ave
Van Dyne Rd
Lucio Rd
UW-Oshkosh at Fond du Lac
W Scott St
E Scott St
Parkside Elementary School
N Main St
Rosenow Elementary School
E Johnson St
Sabish Middle School
Chegwin Elementary School
Marian University
Prairie Rd
W Division St
E Division St
Agnesian Healthcare
Open Road Harley-Davidson
Forest Ave
S Macy St
S Marr St
S National Ave
Woodworth Middle School
Evans Elementary School
Western Ave
Fond du Lac
4th St
6th St
Fond du Lac Skyport
Roberts Elementary School
Holy Family C
Grove St
S Hickory St
Fond du Lac Stem Academy
Riverside Elementary School
E 9th St
Waters Elementary School
Calvary Cemetery Mausoleum
Rienzi Rd
W Pioneer Rd
S Military Rd
Goodwill Store & Donation Center
Pier Elementary School
Fondy Sports Park
KWIK TRIP #242
E Pioneer Rd
South Hills Golf & Country Club
Martin Ave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Capital Referendum Background

Capital debt retirement related to the building of Fond du Lac High School in 2000.

The District engaged in a Facilities Study that identified $145 million of potential capital improvements needed across all school sites.

Ultimately the Board settled on 2 referendum questions totaling $98.5 million. Would provide for renovations for all school buildings and adding air conditioning. Focus was on HVAC, roofing, plumbing/bathrooms, lighting, building exterior, updated classroom ceilings, floors, painting.

Minimal budget for technology infrastructure improvements outside of funds to update the District's phone system to VOIP.

Referendum questions were approved in the Spring of 2019.

What was the state of the District's network?

Single mode fiber optic through the CAN

Multi mode fiber optic links for internal building data closets

Mixture of category 5 and category 5e data cabling throughout all buildings

Cisco switch and wireless access point environment. Last updated between 2012 and 2015.

Internet bandwidth through Wiscnet at 10G, using CAN circuit. Bandwidth speed to the edge was dependent on network design, transceiver interconnects, and traffic on various legs of the network.

Network performance: high bandwidth usage at given times led to drop offs; numerous dead zones in buildings. Centralized design that didn't provide deep visibility into network performance. Required significant amount of personnel time & effort to manage and troubleshoot.

Impact on learning: unreliable access placed limits on functionality i.e. LMS use, digital education, student assessment interruptions.


Self
Sight Word Poems

So what was wrong with that?

In November of 2019 the District's Director of Teaching, Learning, & Technology left for another opportunity. Superintendent became the interim-Teaching & Learning Director; Business Services became the interim-Technology Director.

Leadership: The District was planning to hire a full time Director of Technology.

Technology: Existing network was capable of fulfilling bandwidth demands in the present, most of the time.

Referendum: No funds were available to provide for upgrades.

At the time, the District lacked the expertise to provide leadership on technology questions. Will bandwidth be an issue in the future? Would we have brand new schools with 5, 10, 20 year old infrastructure? Is future functionality that much of a concern? What do we want teaching and learning to look like?

Opportunity Convergence

Recognized that the District had approximately $800,000 in un-spent erate category 2 pre-discount budget that would expire in 2020. Note: e-rate FY2020 was a “special” transition sixth year of the initial 5 year cat2 pre-discount budget cycle. FY2021 was the beginning of a new 5 year cycle.

Referendum work would completely replace ceilings, renovate interior spaces, new construction additions. Plan was to pull back all data wiring, wireless access point, switches, and reinstall.

What if the District could update data infrastructure through the erate category 2 process at the same time the building renovations were taking place? Opportunity to have brand new facilities that function at a high level for teaching & learning. Could realize installation cost savings with the renovations.

What is Erate Category 2?

Federal subsidy program through the FCC providing schools and libraries discounts for specific technology services and equipment. Summary

Category 2: provides specifically for the updating of data wiring, access points, hardware, and switches.

5-year budget opportunity between 2015 and 2020 based on student enrollment and Free & Reduced Meal rates as a measure of discount.

District: 60% discount. $800,000 pre-discount budget; Cost to the District would be $320,000.

Open Systems Interconnection Model (OSI)

Description of the functions of a technology network. End users function in in the Application level.

1. Application: end user software experience.
2. Presentation
3. Session
4. Transport
5. Network: Wireless access points
6. Data Link: Switches
7. Physical: Fiber optic cable, ethernet cable

OSI Model Planning

Teaching, Learning, and District operations happen in the Application layer through software interfaces.

Limits in bandwidth speed and application experience were a result of age and fragmentation in the Physical/Data/Network layers.

Without updates in the Physical Layer, new renovated facilities would continue to have limits on Teaching & Learning experiences.

All school leaders should consider this correlation in facility planning and technology planning.

Source: https://commons.wikimedia.org/wiki/File:Stuck_in_a_Rut.jpg

Source: https://commons.wikimedia.org/wiki/File:McKenzie_Ave_at_dusk,_Saanich,_Canada_01.jpg

Outcomes

In January 2020 engaged in the erate category 2 bid process to update cabling, switching, UPS', and WAPS at 4 phase 1 referendum schools.

Replaced cat5/5e cabling with Cat 6A ethernet cable supported by cable tray.

Replaced multi-mode fiber data internal data links in buildings with single mode fiber.

Replaced legacy Cisco Switching and WAPS with an Aruba networks Switch and WAP environment supporting the latest wireless access standard of 802.11 AX. Goal to be 1 Gigabit + to the edge of application in classrooms.

Why do we consider this “next generation” network planning?

What experience do we want the end-user to have?

Where does teaching & learning take place in the OSI model?

Why we were looking for solutions that allowed for greater “visibility”?

How has the pandemic accelerated change in teaching, learning, & instruction as it relates to network infrastructure?

Partnerships: *No one accomplishes anything alone.*

Engaged with network design and support from Cooperative Education Service Agency (CESA) 6 technology director Chris Whitman and CESA 9 erate support from Michael Dailey.

RMM Solutions won the erate bid and provided network install and support services.

Aruba Networks provided network design explanations on functionality. Centralized management implemented.

Leibert UPS systems were installed with a design to deeper Power over Ethernet (PoE) support of the network. Future applications likely to require more PoE.

Work supported by District Director of Facilities, John Williams; Director of Technology, Troy Seyfert; District technology staff.

Referendum Construction partners: CD Smith Construction, Bray Architects, MSA engineering.

Before: Look for…..

Cabling Before: Is run behind ceilings. Organization is minimal, haphazard, no cable tray, many add-ons, surface mounted raceway in classrooms.

Data Switching Before: Is disorganized without a standard for labeling or management.

Wireless Access Points Before: Buildings had limited density and a mix of wireless generational standards.

Problems: Poor end user experience with dead zones, slow speed. Difficult to diagnose network issues, disorganization limits updates, building code concerns moving to a plenum HVAC environment.

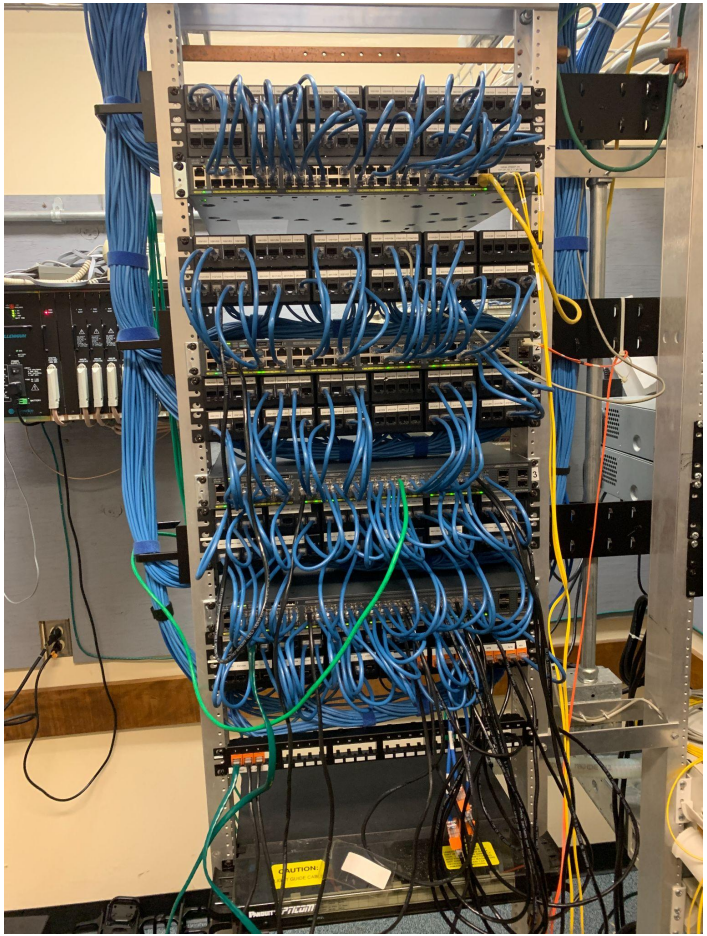
After: Look for.....

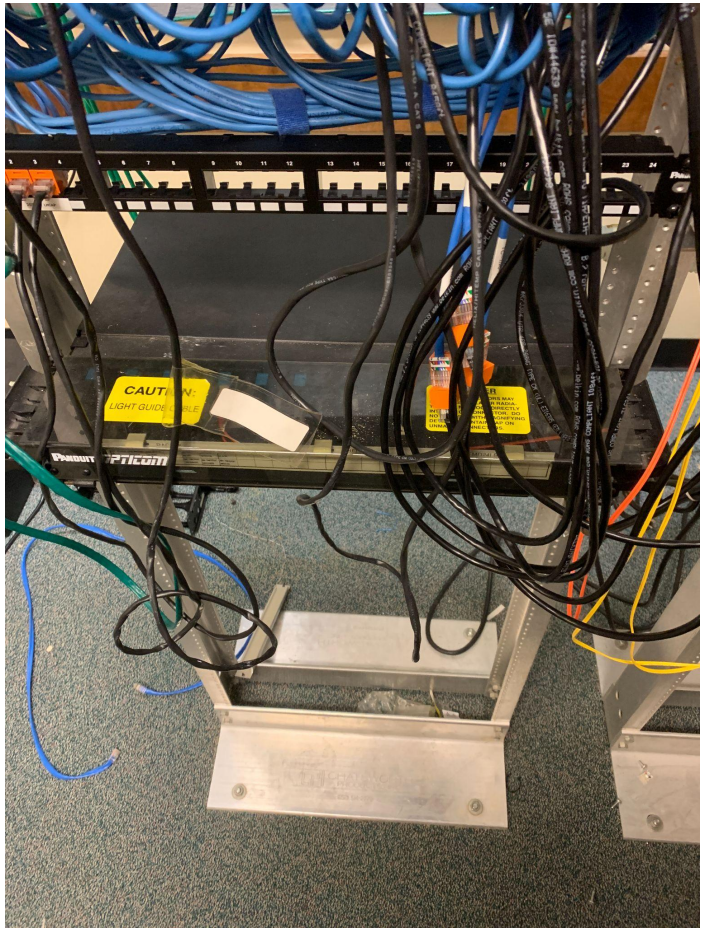
Cabling After: cables run through cable tray with good dispersal avoiding interference. Category 6A cabling providing minimum 1G to applications maximum of 10G. Minimal surface raceway in classrooms.

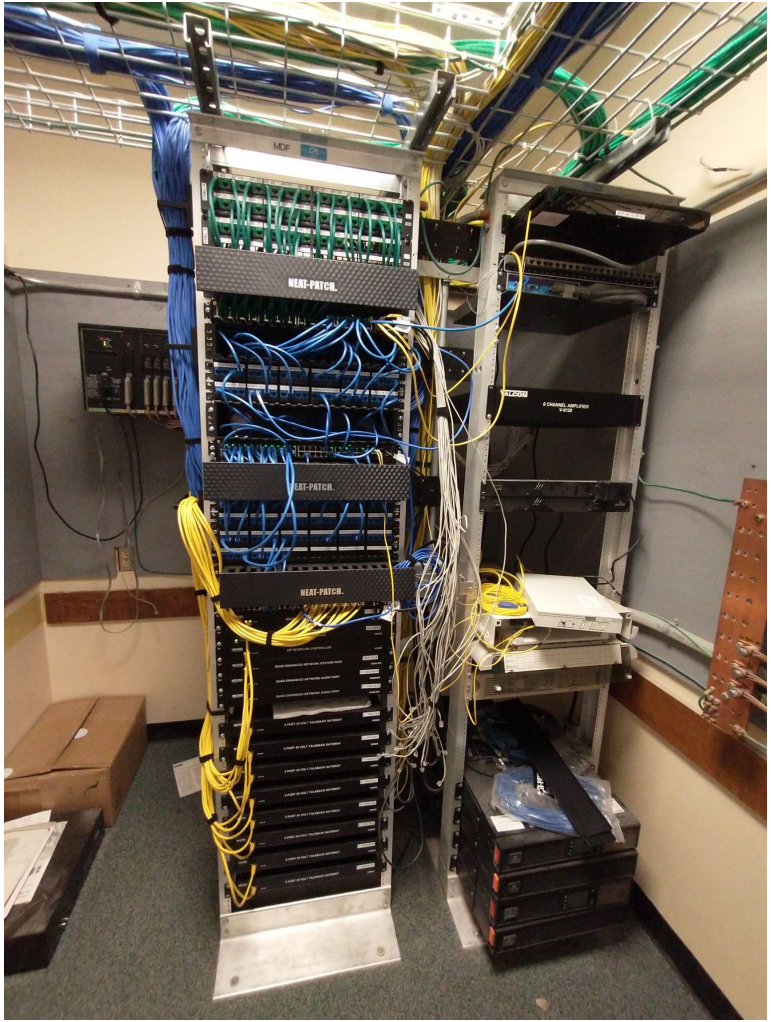
Data Switches: Organized racks, switches, & closets for performance, future application growth, and maintenance.

Wireless Access Points: increase in density/number, for maximum bandwidth.

Solutions: Network bandwidth capacity & reliability (teaching & learning), increased, management & maintenance enhanced.



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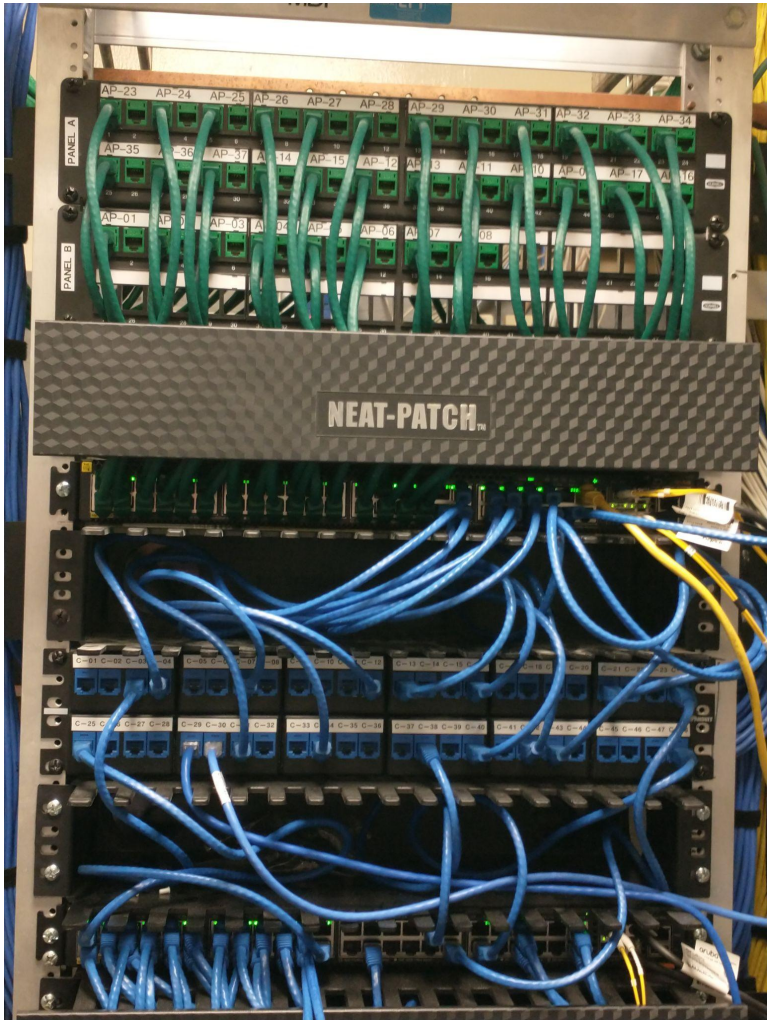
PANEL A
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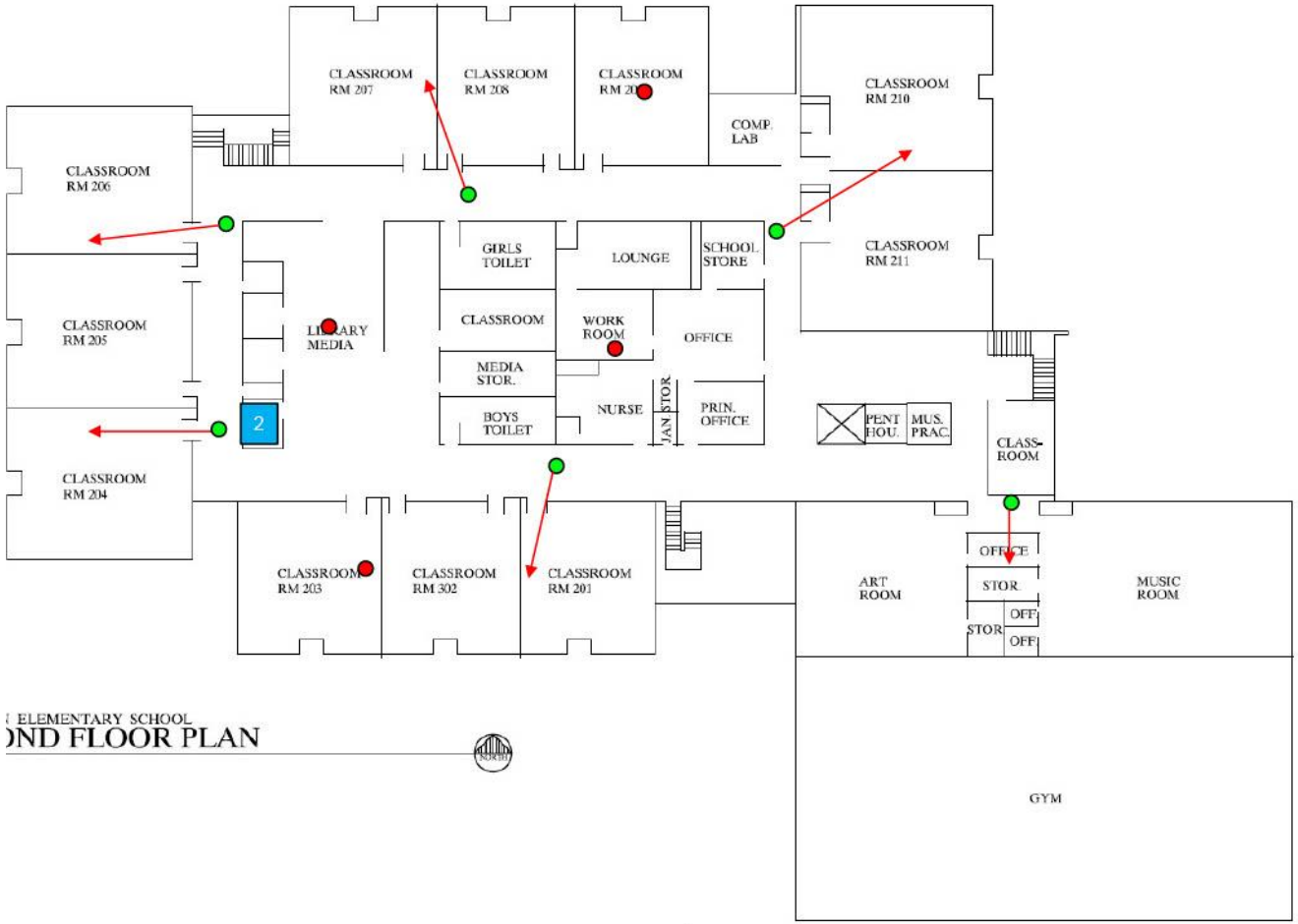


ELEMENTARY SCHOOL
OND FLOOR PLAN

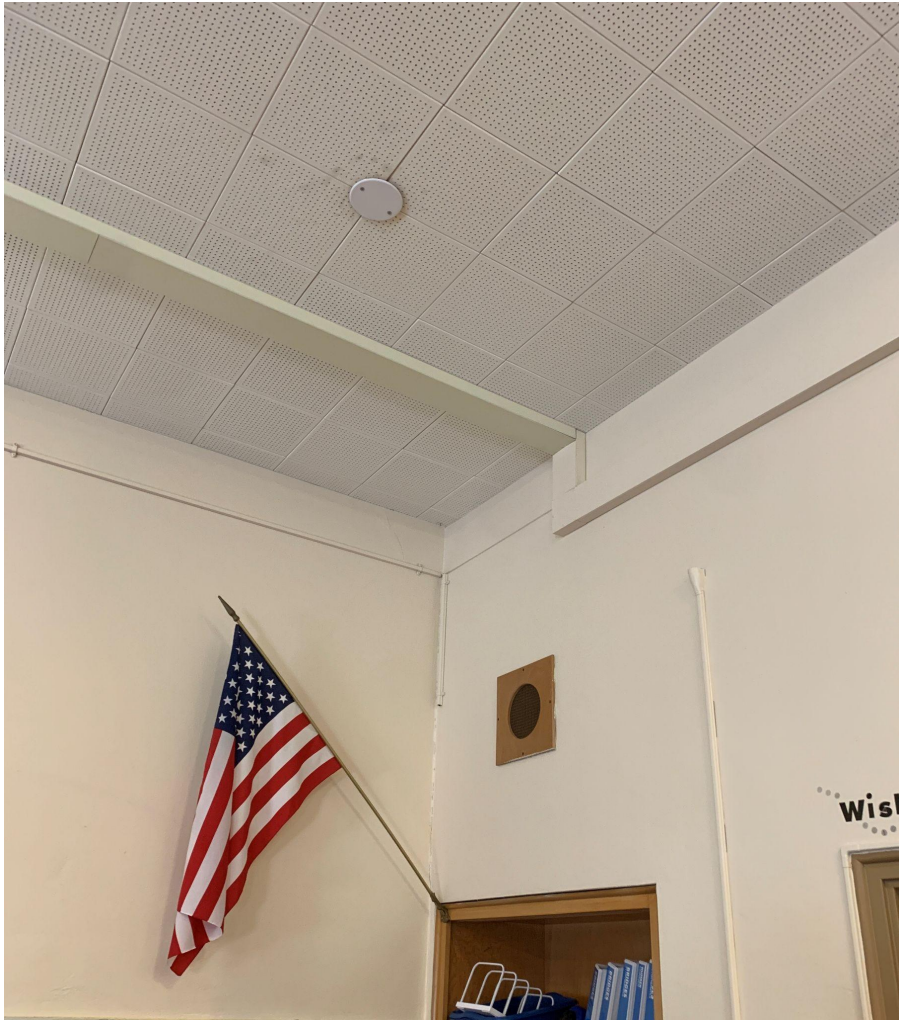
Chegwin – 2nd Floor

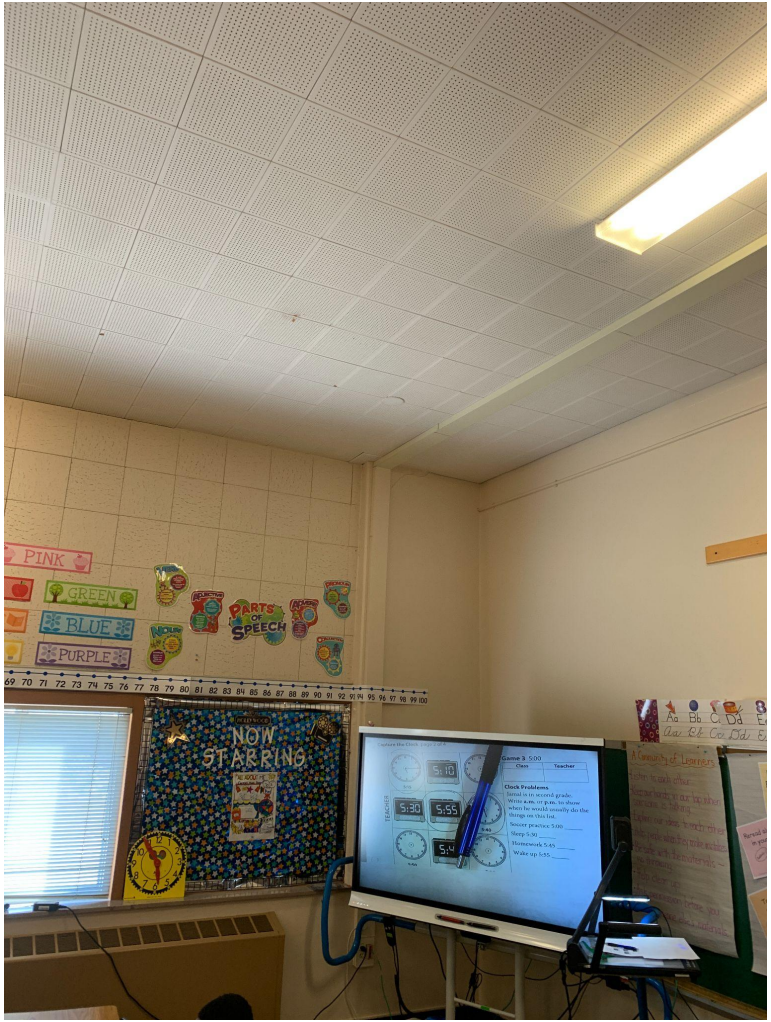
Fond du Lac School District
Chegwin Elementary

SECOND FLOOR FINISH PLAN
Scale: 1/8" = 1'-0"

RMM Solutions
EMBRACE THE FUTURE WITH TECHNOLOGY


NONFICTION

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GREEN
BLUE
PURPLE
PARTS OF SPEECH
NOW STARRING


LEARN
Kid Next Door

Takeaways

Leadership: Opportunities abound. Be open to realize how you can be a catalyst for improvements in your school even if it is not an area of your interest or expertise. ***Referendum Without Tech + Legacy Infrastructure + E-rate = Opportunity.***

Understand your limits: Without any formal training or background in networking, support from others was critical. CESA's 6 & 9, RMM Solutions, Aruba Networks, CD Smith Construction, MSA Engineering, Bray Architects. Facilitation was really the only aspect a business official could bring to this group.

Prepare for change: Construction began in January 2020; erate bid awarded in March 2020, COVID March 2020.

Commitment to complete the remaining schools. Erate reauthorized; completed Phase 2 schools in September 2021. Seeking Board commitment to finish the District over the next 2 years.

Consider investments in the physical data layer of your network as part of any school/facility improvement plan!