CHABOT-LAS POSITAS

COMMUNITY COLLEGE DISTRICT
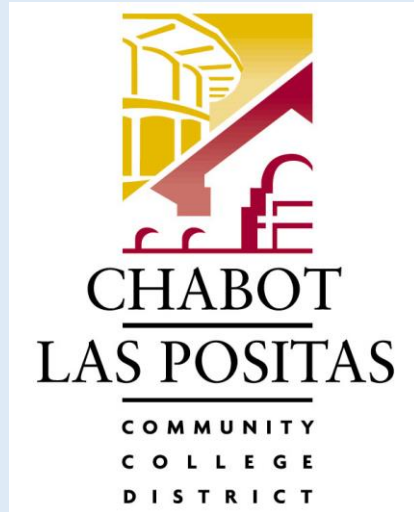
INFORMATION TECHNOLOGY SERVICES
MEASURE A BOND
2018-2020 UPDATE

With the release of funds for the **Measure A Bond**, CLPCCD ITS and College Technology departments began planning the new deployments and replacements of computer and networking technology. Successive technology upgrades with Measure B Bond projects allowed staff and students to take advantage of infrastructure that improved as applications demand it. Projects with Measure A Bond will continue to enhance the technology infrastructure and provide an infrastructure that is well maintained by the CLPCCD ITS and the College Technology departments.

The scope of the Technology projects for Measure A bond has included:

- Wireless Network Upgrades at all sites.
- DAS implementation (LPC and Chabot)
- Laptop, Tablet and Desktop refreshes and growth at CLPCCD locations.
- Telephone System Upgrade at LPC
- Classroom Audio-Visual upgrades at LPC and Chabot
- Network equipment replacement and upgrades at all sites.
- Limited cabling infrastructure (not included in Bond, Deferred Maintenance or other funding).

This document describes the technology projects completed and in process from the commencement of Measure A Bond expenditures in 2018 through 2020.

DESKTOP/LAPTOP REFRESH CYCLE

The College campuses continue to see increased usage of computer desktops and laptops. Used for the final Measure B procurements, the WCSA purchasing contract has proven to be fast, efficient and cost effective. As such, Measure A procurements have continued with the WCSA purchasing vehicle in lieu of doing a public bid procurement. Since this also allows the campus technology groups to have direct interaction with the manufacturer (HP) for customized configurations at attractive pricing, it is advantageous to continue with this procurement process.

Desktops

CLPCCD ITS and College Technology departments have used a four-year Life Cycle model for replacement of desktop PCs/Macs. Desktops are provided and maintained by the College Technology staff in any area where a permanent computer installation is required. The use of desktop PCs in offices, labs and classrooms ensures a cost-effective computer deployment and that the proper hardware/software is available for instructional support.

Following the four-year refresh, the following desktop upgrades were executed.

Measure A Desktop Upgrades per Year

Year	Chabot	LPC
2018	439	445*
2019	560	770
2020	319	570

- * includes the rollout for the new B1000 building

Laptops

Laptops have been provided by request for the following types of users:

- Administrative users who work remotely
- Classroom use
- Remote access (2020 COVID)

Within the classroom, there is an increasing demand for tablets or laptop carts that can be used during lectures and labs. These devices are primarily used for Internet searches, but may be used with USB connections to specialized equipment such as in science labs. These are used in a variety of curriculums, including, but not limited to Biological Sciences, EMT, Public Safety, Math, English.

Administrative staff at the Colleges and District have been provided with laptops as business requirements have dictated. These have typically been Microsoft Surfaces.

With the onset of the COVID-19 virus, the direction to work from home demanded a rapid rollout of laptops for remote access to CLPCCD sites. Within the span of a few weeks, laptops were configured for remote secure VPN access, and deployed to CLPCCD staff, in quantities as shown below. An additional initiative provided laptops to students who did not have sufficient resources for the remote learning.

Site	VPN Qty.	Student Access
LPC	123	500
Chabot	520	200
District	75	n/a

This represented a dramatic change in working environment for the users, and support by the technology staff.

SERVER REPLACEMENTS

CLPCCD District ITS has continued to migrate standalone servers to the HP blade/SAN environment, including mail, file, print and Banner application servers. At present, there are more than 150 servers running in the virtualized environment, as well as standalone HP servers still in production for select applications.

As dedicated server hardware reached the end of its usable life, the College IT staff have continued to move to Virtualized servers. Where dedicated hardware serves the functionality best, hardware upgrades have also been performed.

LPC Server Upgrades

Server Upgrade Details	Quantity.
Standalone servers upgraded to new hardware	10
Servers added:	
Standalone	7
Virtual	5
Server converted from standalone to virtual	3
Servers decommissioned	3

Chabot Server Upgrades

Server Upgrade Details	Quantity.
Standalone servers upgraded to new hardware	2
Servers added:	
Standalone	
Virtual	
Server converted from standalone to virtual	5
Servers decommissioned	0

Enterprise Server Upgrades

The Banner systems have continued to be enhanced to support the CLPCCD business requirements. The major changes have been:

- ITS rolled out Banner 9 across all modules. Work continues to convert Banner 8 customizations before complete Banner 8 retirement.
- ITS, working with several departments, implemented the Faculty Load and Compensation (FLAC) tool to replace the Autopay program that was developed in house.

FLAC allows adjunct faculty and full-time faculty working on overload to accept assignments through Classweb.
- Working with the College Financial Aid Departments, ITS implemented the CampusLogic service to assist students in tracking and completing their FAFSA applications. The project is intended to improve the Student-Centered Funding Formula metrics around Financial Aid and increase revenue.
- The Banner Oracle Database was upgraded to version 12.2.0.1.
- The DegreeWorks degree audit/student education plan software was upgraded to provide a better user experience and comply with the retirement of Adobe Flash.
- Ellucian CRM recruit was implemented to improve student outreach and enrollment reporting.
- ITS and the Admissions and Records Departments partnered with a 3rd party contractor to develop an online Dual/Concurrent Enrollment application using Docusign. This tool has greatly increased the number of applications to the program.
- Business Services and ITS successfully rolled out new handheld devices to support the annual inventory process.
- ITS implemented a new COBOL compiler at a significant savings to the District.

Enhancements to Banner are ongoing. As the Banner architecture continues to move towards a network of distributed servers/systems, CLPCCD ITS continues to tune the implementations to provide the most robust environment for its users.

AUDIO-VISUAL UPGRADES

At the beginning of the Measure B bond, College Technology individually developed AV Technology standards for the "smart" classrooms at each campus. As of 2016, many of the classrooms are nearing ten years of use and technology has advanced. With the Measure A bond funds, AV upgrades to classrooms and presentation spaces have begun. The new technology for High Definition (HD) audio-visual resolution in these rooms includes:

- High Definition (HD) AV resolution
- 6500+ ANSI Lumen Projectors (laser), for crisper and brighter displays
- Crestron input controllers with touch-screen input
- Cordless AV connectivity for instructors
- Wireless student collaboration
- Assisted Listening systems
- Document Cameras
- Improved instructor microphones
- Enhanced speakers

The following upgrades have been performed:

Chabot AV Upgrades

Upgrade Details	2018	2019	2020
Classroom Upgrades	3	17	4
Projector replacement	37		
LCD installations in offices	2		
Other equipment		58	
Digital Signage			18

LPC AV Upgrades

Upgrade Details	2018	2019	2020
Classroom Upgrades			
Projector replacement			
Conference room replacements			
2420 Video Wall			1
Digital Signage			

For all new building construction or modernization, the AV systems are included as part of the construction drawings and specifications. Coordination with the A&E teams occurs at all phases of the project development (Programming, SD, DD, CD).

TELEPHONE AND VOICEMAIL SYSTEMS

The telephone systems at the Chabot and Las Positas campuses operate as independent systems for both calling and voicemail. All systems use analog and digital telephone sets connected to the main telephone system over copper cabling. Inbound/outbound PRI service is used for telephone calls to and from campus. During power outages, the centralized telephone systems are kept powered by large UPSes or generators. This keeps the telephones working in the building for a minimum of four hours during emergencies.

Las Positas was provisioned with a Siemens HiCom 300 system, which was expanded to its maximum capacity, and considered an obsolete product by the manufacturer. Additional expansion on campus was needed to support connectivity in the new B1000 building. The Chabot and District Office sites used Avaya telephone systems. For consistency of operation and to leverage existing knowledge, the bid for the LPC system was based on Avaya technology. The public bid was issued in February of 2018 and awarded to AdvanTel in April. With a condensed implementation calendar, this project to replace 900 telephone handsets, telephone, voicemail and E911 servers was completed in August of 2018. In addition to the new hardware and software. this project included new auto attendants, call centers, switchboard console and staff training. The LPC users quickly learned the new functions and commands of the Avaya

system. The rollout was a great success and the system has performed solidly since its initial deployment.

LPC IT BUILDING**/D**ATA **C**ENTER**/MPOE/MDF U**PGRADES

There are several key locations at CLPCCD sites that centralize server and network connectivity, as listed below:

- MPOE – Minimum Point of Entry, or the location where AT&T telephone services and CENIC internet services enter the location. These are: LPC B1900A, Chabot B200 MPOE room and Dublin District Office first floor IDF.
- MDF – Main Distribution Facility, or the location where data network connectivity for each site is concentrated. These are LPC 1900A, Chabot B300 Network room and Dublin District Office first floor IDF.
- LPC IT Building – The primary District Administrative Data Center with Banner email and other Administrative servers, is located in the Las Positas IT Building 1900 and has been in operation since 2009. This building also houses the LPC Server room, where college servers provide data and application services to the campus.
- Chabot Server room – Building 300 houses the Chabot campus servers and a number of District servers. As part of the B300 remodel in 2010, the server room was upgraded and expanded. A UPS and generator was added to maintain uptime during power outages.
- District server room - The third floor IDF 337 is equipped with server racks for the ongoing operation of servers with District Office data and applications.

Since these locations house computers, network switches, telephone equipment and internet routers, they must have the most robust and high performing services with adequate space, power, HVAC and security. When first constructed, these locations were provisioned with a level of capability to meet the current requirements and foreseeable growth/operation. With the targeted expansion for Measure A, a number of upgrades and enhancements are required.

LPC IT Building

Since the design of the LPC IT Building, the operation of the District Admin data center and LPC server rooms has changed. The following upgrades were put in place.

- **LPC IT Building Power upgrade** – The LPC IT building was constructed with UPS and generator protection for the Network room, LPC Server room, District Data Center, Test labs and a small number of other offices/rooms. When a power failure occurs, the UPS maintains power for 30-60 seconds until the generator initiates and begins to provide supplemental power. For the rest of the building, power was not provided, leading to HVAC, lights, computer and equipment to turn off when power is abruptly cut. Staff in offices without UPS outlets are unable to continue working when the power goes down. This presented a critical operational issue because it is even more important when running on generator power, for staff to monitor the server operation and performance. In February of 2020, a project was performed to convert all the electrical panels in the

LPC IT building to be on the building generator. This still causes a temporary outage to some rooms until power is restored by the generator, but it does provide staff with the ability to continue working during the power outage.

- **EMS Panel Emergency Power** – The LPC ITS building EMS panel was installed with non-UPS power. This meant that during power failures, the panel was not powered, leading to problems with control of the HVAC environment during critical outages. In February of 2019, the panel was upgraded and rewired to a UPS/generator power outlet.
- **HVAC Improvements** – The LPC IT Building HVAC is supplied primarily by the Central Utility Plant (CUP), with a backup chiller in the event of CUP downtime. There have been many instances where changes in CUP programming has led to adverse effects where HVAC has failed in the LPC IT Building. With only 15 minutes of time before the server rooms exceed heat thresholds, CLPCCD ITS and LPC Technology have very little reaction time when HVAC fails. In addition, the room humidifying system malfunctioned many years ago and needs to be replaced. Preliminary discussions of how to provide more stability to the LPC IT Building HVAC have begun.
- **Fiber Backbone Additions** – Increasingly, servers require fiber backbone connectivity for 10Gb+ connectivity. Fiber is currently terminated in the Network room, with long patch cords running to some connections in the Data Center. Fiber connectivity is requested for the LPC Server room. This project is being scoped.

Chabot College

- **Chabot MPOE/MDF Upgrade** – Chabot's Building 200 is slated for removal during the Measure A projects. This building provides a key point of connectivity for the Internet connection to CENIC and all telephony on campus. While the timeframe for B200 removal is uncertain, it is a lengthy process to build and then transition services over to a new location and new infrastructure. As a "Project Zero" priority, design for replacement facilities in B300 began in early 2019. Construction for the new MPOE in B300 began in June of 2020, with completion by December of 2020. Following completion of construction, CLPCCD ITS and Chabot Campus Computer Services will develop and execute projects, including provisioning of a new telephone system, rerouting of Internet connections from CENIC, rerouting of copper and fiber backbones to campus buildings, implementation of DAS, etc. It is expected that the conversion of existing services and implementation of new services will take 12 to 18 months to execute.

DATA NETWORK EXPANSION

The number of network connections will continue to increase with building construction of Measure A projects. In some buildings, there may be as much as a 30% growth in the new building compared to the existing space. Coupled with the increased requests for laptop carts in the classrooms, the network connectivity may double. The speeds of those connections will move towards a consistent 1Gbps connectivity for desktops and 10Gb+ connectivity between buildings and the Internet. CLPCCD ITS will continue to scope and configure the data network equipment for the new/modernized buildings as they come online.

In addition to the new building infrastructure, there is an ongoing requirement to maintain and expand the existing data network. Upgraded Building Automation devices including electrical panels, meters, lighting control and energy monitoring require connection to the data network for communication to the controls server(s). Often this requires connectivity to mechanical and electrical rooms that have never had data connections. In some cases, these devices also require power over ethernet (POE or POE+) connections for power.

As bandwidth and vendor obsolescence dictates, data network equipment has been replaced as needed. CLPCCD has executed multiple equipment bids and select purchases on piggyback contracts for the following network upgrades:

Network Equipment Procurements

Timeframe	Equipment	Cost
July 2017	Cisco 5520 Wireless controllers (4) 750 Cisco 3802 Access Points Antennae, mounts and accessories	
July 2017	Cisco FirePower firewall (4) Cisco FirePower Management System	LPC and Chabot
April 2018	Cisco 9407 switches (2)	For LPC B1000
May 2018	Cisco Nexus core switch	LPC Data Center
July 2018	Cisco 9407 switches (8) Cisco 4451 router (1) Cisco 3650 POE+ switches (80)	LPC and Chabot
April 2019	Cisco 1562 Outdoor Access Points (4)	LPC and Chabot
July 2019	Cisco IE 4000 Outdoor switches (8) and 10G SFP+ modules	LPC and Chabot
November 2019	Cisco 9500 Core Switches (2)	LPC and Chabot
March 2020	Cisco 9500 Core Switches (2) Cisco 3802i APs	LPC and Chabot

As connectivity for new building infrastructure dictates, CLPCCD ITS will structure new public bid procurements for the switching and wireless infrastructure.

Wide Area Network (WAN)

The Wide Area Network (WAN) provides site-to-site connectivity for access to Banner, email and other mission-critical applications. Beginning with increased connectivity requirements to support Measure A, the site-to-site connectivity was upgraded from the AT&T Opt-E-MAN system to the AT&T ASE system.

As carrier technology was enhanced, AT&T began offering the Switched Ethernet (ASE) service as a more cost-effective and higher performance upgrade. On the OPT-E-MAN network, CLPCCD had begun experiencing significant network bottlenecks during peak business activity when accessing servers with Measure A/B bond information. CLPCCD ITS converted to the ASE service in the March of 2019, relieving slow-downs and network congestion, with room for the increasing Measure A activity.

WAN Connectivity Speeds

Connection	OPT-E-MAN 2008-2019	ASE 2019+
Chabot	100 Mbps	250 Mbps
District	20 Mbps	100 Mbps
LPC	100 Mbps	500 Mbps
EDCE (2020)		50 Mbps

Measure A will continue to fund equipment and bandwidth in support of the increasing application connectivity required across the WAN. The ASE network can grow to provide 1Gps network speeds. As utilization increases, CLPCCD ITS will evaluate the need for speed upgrades. The additional benefit to the ASE network is that upgrades can be put in place with a minimum of service disruption and installation.

Wired Network Upgrades

With the procurements listed above, CLPCCD ITS was able to perform the following upgrades to the network infrastructure:

- **Small IDF switches** – Cisco 3560, 2950 and other older switches were replaced. These switches had been installed with Measure B purchases in 2005, 2009 and 2012. All of these switches had well-exceeded the typical switch life of seven (7) years. These switches were replaced with Cisco 3650 POE+ 24-port and 48-port switches.
- **Dense IDF switches** – CLPCCD ITS typically deploys Cisco 4506 chassis switches with redundant power supplies for IDFs with more than 100 connections. The Cisco 9407 switches provide the next generation switching platform, and were procured for deployment in the following campus IDFs: LPC B1000 (first and second floors), LPC B803, LPC B1807A, LPC Server room, Chabot 509, Chabot 457, Chabot 3912, Chabot 1600C. This provided high performance network switching for large connectivity locations and new buildings on campus.
- **Campus Core Routing** – The central routing for each of the campuses is performed by Cisco 6509 switches. Some of these switches have been in service since 2005 when the first Measure B acquisitions were done. While still a premier product, the Cisco 650x line has limitations for the support of dense 10G connectivity, and no support for the higher 25G, 40G or 100G connections. The Cisco 95xx and 96xx switches are the successor product for the 650x switches. CLPCCD ITS procured and installed 9500 switches for routing diversity, VRF and 10G support to large buildings on campus.

- **Nexus Data Center Switch** – To augment the current switching capacity in the Data Center, a Nexus switch was procured. That switch is racked and ready to be configured for server connectivity.
- **Outdoor Switches** – In several locations on campus, network connectivity is required in outdoor environments, where moisture and hot/cold temperatures exceed the operating thresholds of regular switches. These locations include PE areas and solar fields. Many of these areas also need outdoor wireless. CLPCCD ITS has procured Cisco IE4000 switches and deployed these switches into these harsh environments to support wired and wireless connectivity requirements.

Currently, the network equipment is stable and covered by manufacturer support contracts until 06/30/23. CLPCCD ITS will continue to monitor and enhance building backbone speeds to optimize performance for staff and students. Taking into account the network expansion as new building come online, the current network topology and equipment should satisfy current and future connectivity for several years to come.

Wireless

One of the highest priorities in the Measure A project list was to upgrade the wireless at the CLPCCD sites. Based on the 802.11n standards, the wireless network funded by Measure B was implemented in an ad hoc, or "as-requested" fashion, that led to irregular and sometimes unreliable service. One of the highest priorities at the beginning of the Measure A Bond projects was an upgrade to end-to-end pervasive wireless at all sites.

The 802.11n wireless technology had been replaced with a newer standard, 802.11ac, which provided for greater speeds and client connectivity. Since the 802.11ac technology had significantly different transmission characteristics, CLPCCD ITS initiated Measure A projects to:

- Survey inside of campus buildings with an Ekahau predictive analysis to design the placement of 802.11ac Wave 2 access points.
- Augment cabling and electrical infrastructure to support additional 802.11ac Wave 2 access point installations.
- Assess centralized controllers and licensing requirements to support 802.11ac Wave 2 access point rollouts.
- Bid and award a wireless upgrade package, including hardware, software, monitoring tools and installation services.

The Bid was awarded in July of 2017 with the project initiation in October of 2017. Working around classes and campus activities, the LPC and Chabot wireless upgrades was executed as many small projects during evenings, breaks and weekends. The LPC campus was completed in May of 2018. Chabot College was completed by September of 2018, except for the B1300 Performing Arts Center and Child Care. The last two locations were completed in the spring/summer of 2020.

Post-installation Ekahau surveys demonstrated that the resulting wireless network matched the predictive design in providing comprehensive coverage inside buildings. As expected, the wireless coverage in the buildings was significantly improved, as shown below by the survey results for the LPC Library (B2000) and Faculty (B2100) building.

Wireless AP Signal Coverage B2000/B2100
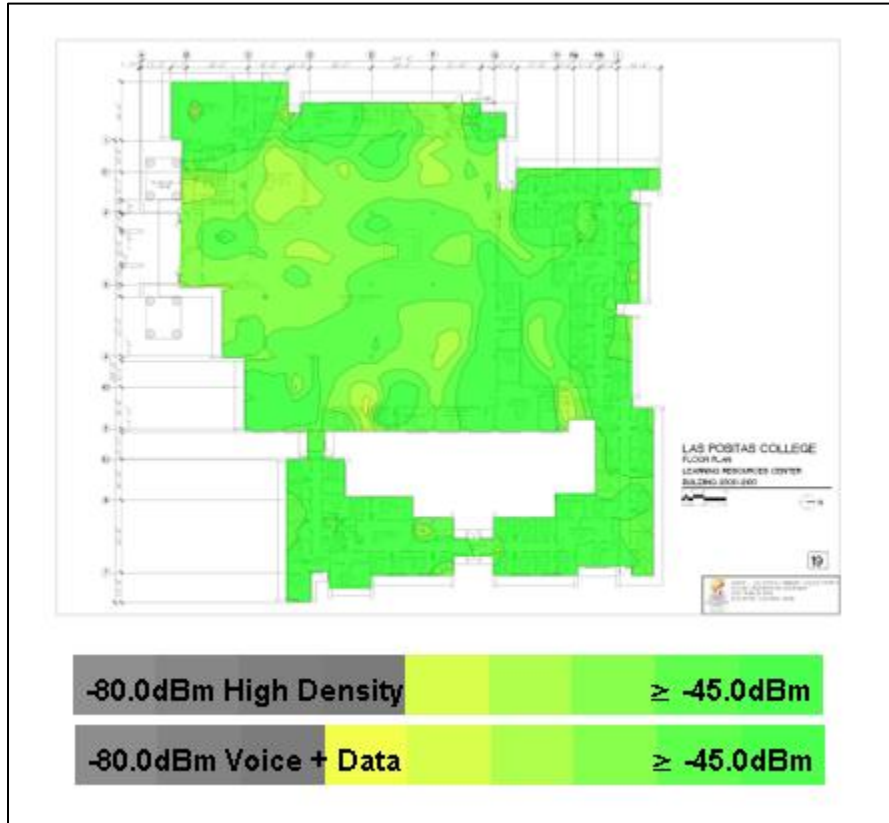
Inside surveys were performed for all buildings to ensure that the thorough coverage was provided. Though not designed for utility areas such as electrical or mechanical rooms, the wireless coverage was typically able to reach all areas of the inside building.

At final rollout, the expansion of the wireless network was three-fold the original network, with the added performance benefits of the new 802.11ac technology.

Wireless AP Deployment Counts

	Before 802.11a/b/g/n	After 802.11ac
Chabot	118	339
LPC	80	298
District	7	22

With the completion of the wireless access for inside buildings, a second phase of design and implementation focused on outdoor wireless. Because of the Low-E glass installed in new buildings, the wireless signal stays confined to inside the building. As such users sitting outdoors, even if they are close to the building, do not receive sufficient signals to do their work on the wireless. CLPCCD ITS assessed the areas of student assembly and began the rollout of outdoor wireless connectivity.

At Chabot campus, the outdoor wireless connectivity was focused on areas where outdoor events occur or student sitting/gathering areas, such as the Grand Court and Cesar Chavez Courtyard, as shown below:
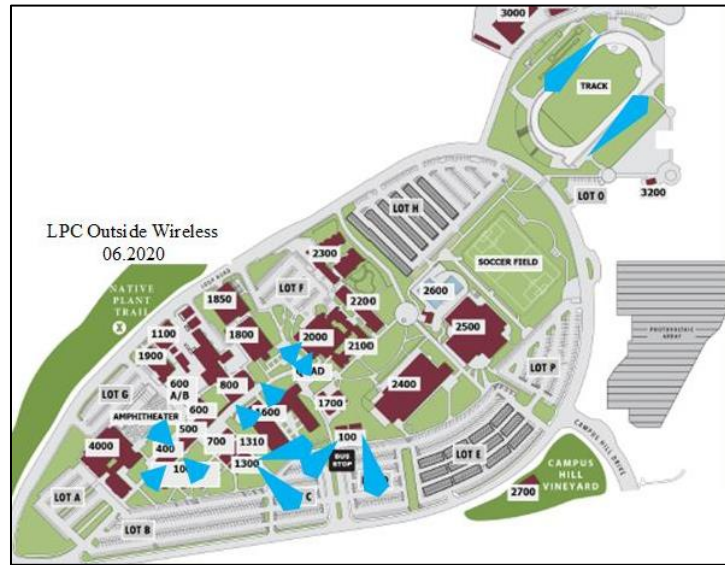
Chabot Outdoor Wireless Coverage
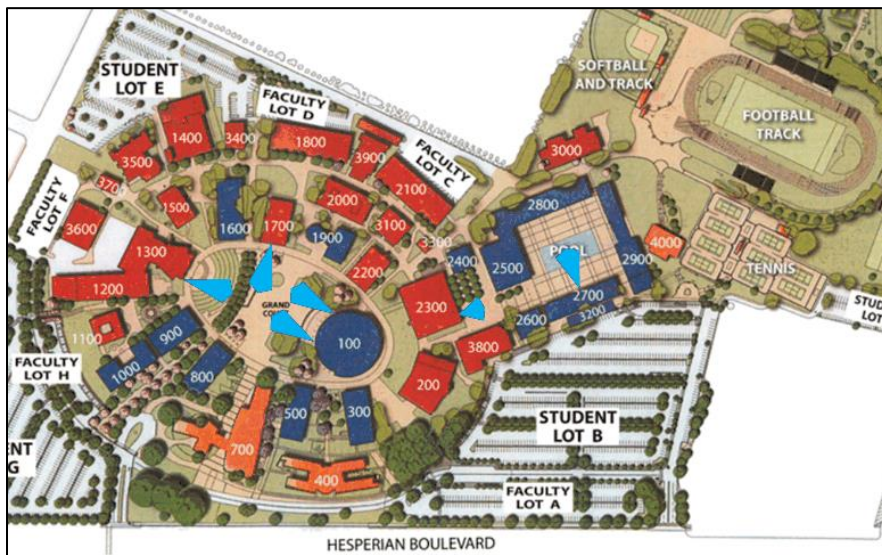
An assessment of providing outdoor wireless to the Track area, by B1800, B700, B400 and other outdoor student congregation areas is underway.

At Las Positas, the outdoor wireless covered several outdoor student congregation areas:

**LPC Outdoor Wireless Coverage**

The most recent wireless additions provided connectivity to Parking Lots C and D so LPC can provide student services to students in an outdoor socially distanced manner.

One of the limitations of providing outdoor wireless is the AP signal does not penetrate well through the Low-E glass or metal exteriors of new buildings. APs, or AP antennae need to be mounted outside of the buildings. For all newer buildings, the design of outdoor wireless with appropriate building penetrations is part of the building telecommunications cabling design. This ensures that both indoor and outdoor wireless can be provided pervasively for students.

Firewalls

As noted in the Network Equipment Procurement table above, CLPCCD ITS purchased Cisco FirePower Next Generation firewall systems. These firewalls provide advanced functionality for Advanced Malware Detection, URL filtering and Application Visibility and Control. The implementation of these firewalls was based on removing the access-lists from the core routing switch and implementing multiple security zones and profiles for CLPCCD sites. The topology was designed as shown below:
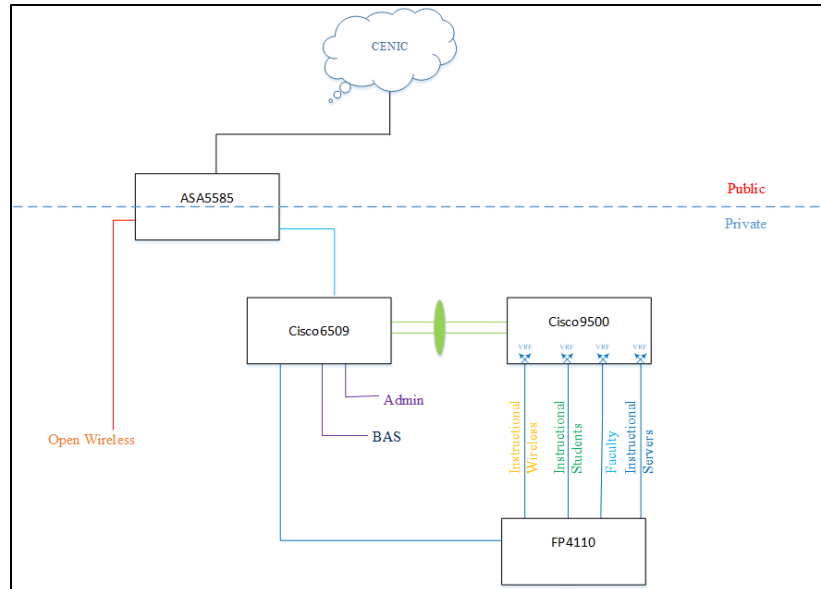
As shown in this topology, the Open Wireless networks were migrated to a new leg on the existing ASA5585 firewalls. This isolated the wireless connectivity to a separate point of monitoring and relieved the campus routing core from the task of processing network traffic from thousands of users on each campus. Migration of the VLANs to separate virtual routing/forwarding realms is in progress. The FirePower firewalls are being configured with discrete legs for each security profile. This will enable a more granular view of traffic, with the ability to detect and respond more quickly to security issues. The first leg will manage the traffic for the remote student access Splashtop connectivity. Instructional subnets will be migrated next.

In October of 2020, the connection to the CENIC network was upgraded to 10G at each campus. This provided a much-needed upgrade in bandwidth, particularly to support remote access and new cloud applications.

Network Monitoring tools

With the growing sophistication of hacking tools, it becomes increasingly important for CLPCCD ITS to have a more detailed view of the network traffic. This includes the use of tools to:

- Monitor networks to alert and address potential bottlenecks and performance issues.
- Detect and alert unusual network traffic. Provide mitigation response to prevent network issues.
- Log events and traffic that could be later analyzed for incidence handling.
- Document configuration changes to network infrastructure.

A number of the tools have been installed and put into production:

- **Network Monitoring and Alerting** – CLPCCD ITS uses Intermapper for network monitoring and altering. This is a basic outage alerting software that can email or page appropriate personnel when a device disappears and reappears on the network. Two Intermapper servers have been put into production, one for each campus. Intermapper Trap alerting has become invaluable in the early notification of temperature and power issues, thereby averting failures.   In addition to monitoring IT infrastructure, CLPCCD ITS has developed maps to monitor solar devices and EMS panels. This allows the Maintenance and Operations department to get rapid text or email alerts if their control devices malfunction on the network. CLPCCD ITS plans to expand map coverage to include security devices such as Emergency Call Stations, IP cameras, security panels, etc., when the new security master plan products are installed. The Intermapper software is on annual maintenance, so performance upgrades can be obtained as needed.
- **Log Management –** Monitoring and logging network events is a standard security task. In September of 2018, CLPCCD ITS installed Kiwi Syslog Server for logfile archival. Though log events are stored as ASCII text files, they are searchable when traffic investigation is required. Typically, a six-month window of logs is available for inquiry.
- **Change Management –** CLPCCD ITS invested in the Solarwinds tools for change management and monitoring. Coupled with individual logon authentication on the switches, Solarwinds provides alerting to network staff whenever a configuration change is executed on a network device.

Sample Alert for Network Configuration Change

180: Aug 10 16:52:14: %SYS-5-CONFIG_I: Configured from console by wendyp on vty0 (172.28.80.37)	

8/10/2020 4:52 PM

Node: LPC-1654-4506.clpccd.org (Running) - 1 config(s) with mismatches

LPC-1654-4506.clpccd.org Config differs from Last: 8/10/2020 02:01 AM - Running » View diff viewer

2 changes

Config: 8/10/2020 02:01 AM - Running	**Config: 8/10/2020 04:52 PM - Running**
BEFORE	AFTER
!	!
! Last configuration change at 12:07:29 PDT Thu Jul 23 2020 by mikef	! Last configuration change at 16:52:14 PDT Mon Aug 10 2020 by wendyp
! NVRAM config last updated at 15:41:58 PDT Fri May 22 2020 by aseung	! NVRAM config last updated at 15:41:58 PDT Fri May 22 2020 by aseung
!	!
version 15.1	version 15.1
no service pad	no service pad
service timestamps debug datetime localtime	service timestamps debug datetime localtime
183 UNCHANGED LINE(S)	
interface GigabitEthernet2/20	interface GigabitEthernet2/20
switchport access vlan 228	switchport access vlan 228
spanning-tree portfast	spanning-tree portfast
!	!
interface GigabitEthernet2/21	interface GigabitEthernet2/21
Interface : GigabitEthernet2/21	Interface : GigabitEthernet2/21
switchport access vlan 201	switchport access vlan 23
spanning-tree portfast	spanning-tree portfast

This is a critical functionality to have in place when many staff may have permissions/access to make changes on the network configurations. It is also particularly

important if a change causes an unpredictable disruption to the network connectivity. The Solarwinds tools also provides nightly backups of the network equipment configurations, so rapid recovery from equipment failures is possible.

CABLING

A number of buildings on the campuses are still equipped with low grade voice and data cabling installed in the 1990s. This cabling is inadequate to provide reliable and high-performance connectivity. The following buildings have the greatest needs for upgrades:

- Chabot College – Buildings 1100, 1500, 2000, 2400, 3000, 3900
- Las Positas – Buildings 800, 1800, 2200, 400, 2100

Some of these buildings have also been identified for modernization or replacements. Since construction projects take years to design and build, CLPCCD ITS assesses the need and contracts with cabling firms to do smaller cabling-only upgrades that have a substantial, positive impact to student network access.

The following projects have been executed:

- **Wireless AP cabling** – To provide the pervasive wireless connectivity, it was necessary to add cabling to most buildings on the LPC and Chabot campuses. Even newer buildings, who had been provisioned with ceiling outlets for wireless equipment did not have the density or proper location for AP installation. Multiple cabling projects at LPC in February, March and May of 2018 provided data outlets which were used subsequently for wireless data access points and DAS universal access point connectivity. At Chabot, cabling projects were executed in February, August and December of 2018 and March, June and July of 2020.
- **LPC 804/805** – The Cisco classrooms at LPC are located in B800 where the oldest Cat5 network cabling exists. These labs often experience network performance issues during imaging and student use. While these classrooms are targeted for replacement in the new B2100 building, that will not occur for several years.   A project to recable these labs with Category 6A cabling in May of 2018 was performed, with a substantial performance improvement noticed immediately. Since this class also teaching proper techniques for cabling, the new cable installation also gave the class an example of excellent workmanship by skilled professionals.
- **LPC 803** – The general use computer lab in 803 also suffered from network connectivity and performance issue. Coupled with a Deferred Maintenance carpet replacement project, the computer lab was completly rewired with Category 6A cabling. A new Cisco 9407 switch was installed to replace the existing 4506. When complete, the computer lab had end-to-end state of the art infrastructure.
- **Chabot B200 IDF Upgrade** – Critical infrastructure is located in the Chabot B200 MPOE and IDF, include connections to Campus Safety/Security, the CLPCCD site-to-site connectivity and the CENIC Internet connections. The cabling was installed piecemeal on several racks depending on the year that the cabling was added. Four

individual 3560 switches were mounted in different locations in the room. A project was created to reroute and consolidate the cabling to a single rack location that could be patched to a new 4506 switch. This provided a much more organized and robust infrastructure, commensurate with the mission-critical purpose of the network in this building.

- **Chabot B2300 cabling** – Much of B2300 was recabled during renovation projects for Veterans, Health Services and other areas in the building. An area excluded from these renovations was the Spectator area, which was connected with an outdated switch and home-grown cabling. Coupled with additional access point outlet cabling project in March of 2018, it was possible to install new cabling to the building IDF, remove the outdated switch and bring this area up to the CLPCCD Category 6A cabling standards.

- **Chabot new voice/data backbones** – As listed above, a number of Chabot buildings needed cabling upgrades. A more critical issue was that these buildings were running on multimode fiber backbones and old copper backbones, deployed in the 1990s. Performance was poor and unreliably. In November of 2018, a project was bid to replace the copper and fiber backbones running to buildings 1100, 1500, 1600, 2000, 2100, 24300, 2400, 3000, 3100, 3400, 3500, 3800 and 3900. This project involved opening vaults all over campus, and working around campus instruction and activities to maintain student/staff safety. Much of the work was performed during break weeks. Looking forward to the new MPOE/MDF location, these cables were installed with extra service loop length, so that the cables could be pulled back and reterminated in the new MPOE/MDF as a future project. When completed in June of 2019, all buildings could then be migrated onto the new backbone infrastructure.

DISTRIBUTED ANTENNA SYSTEM

Cellular service at the College campuses is spotty and unreliable. The best cellular service is available in the outdoor areas, but even that is of limited strength. In the newest buildings on campus, such as the LPC SSA or Chabot CSSC, the cellular service is almost completely blocked by the building infrastructure, most specifically the high efficiency, IR reflecting, low-emissions glass. DAS uses cabling and specialized equipment within the buildings to distribute, repeat and magnify the cellular signal provided by the carriers from one central point of the campus. Another high-priority Measure A Bond project was the installation of Distributed Antenna System (DAS) technology to provide cellular service *inside* buildings on campus.

To assess the situation, CLPCCD ITS engaged the services of Wireless Metrix to perform a signal survey in all buildings in each campus. A typical pre-DAS building coverage pattern is shown below:

LPC B1800 Cell Coverage
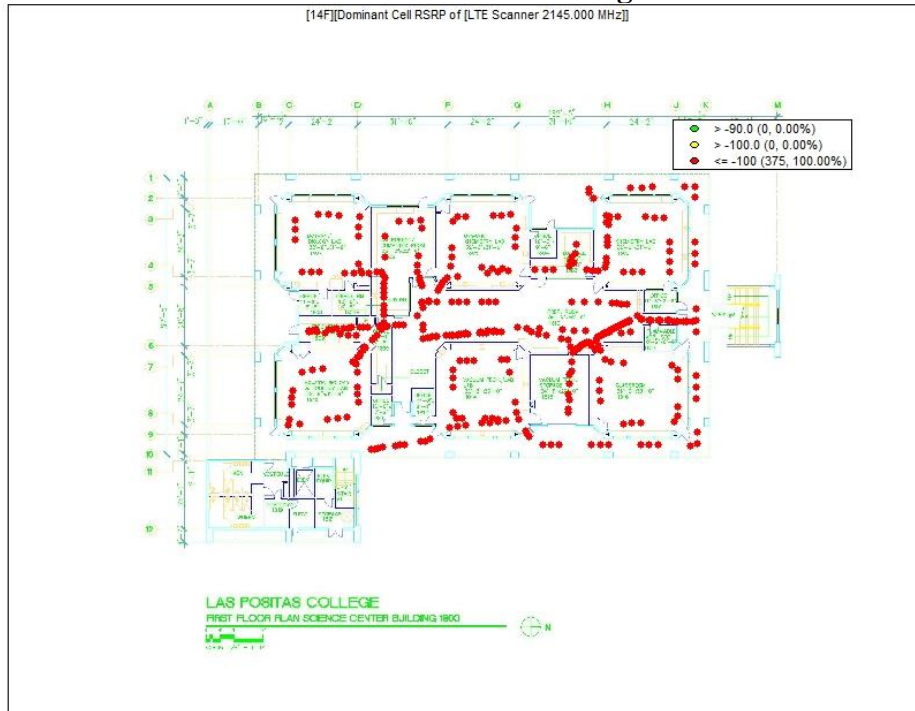
* Red dots are indicative of signal strength too low to support calls.

The DAS system needs to support multiple carriers, so it is usable with any cellular carrier (AT&T, Sprint, Verizon, T-Mobile) who brings connectivity to the campus. The carrier signals are re-broadcasted through a proprietary campus DAS cable and equipment network to cellular antennae that are placed in the ceilings of each building. The cellular carriers provide Signal Source equipment from their cellular network in the campus MPOE.

At the CLPCCD sites, the Measure B construction projects provided single mode fiber backbone and Category 6A copper station cabling infrastructure in new and renovated buildings. This infrastructure could be used for the DAS equipment. Since not all buildings had the new infrastructure, CLPCCD ITS executed projects to perform upgrades as follows:

- **IDF Upgrades** – In a number of smaller buildings, the IDF consist of cabinets mounted on the wall in a storage room, or unused corner. The IDF cabinets were not deep enough to support the installation of the DAS equipment, and needed to be completely dismantled and replaced with 30" deep cabinets. This upgrade work was done in the LPC pool, LPC Veterans (1310), LPC classrooms 101 and 104, LPC CUP, Chabot B1100, Chabot B3500, Chabot PAC B1300 and Chabot M&O B3000.
- **Fiber Retermination** – The DAS transmission requires specific reflectance levels for the single mode fiber connectivity. In many installations, fiber that was field-polished many years ago, needed to be reterminated with fusion splicing to achieve the proper reflectance characteristics. Completed for the LPC deployment, this work is being scoped for the Chabot Campus.
- **Supplemental Fiber Backbones** – In select older buildings on campus, single mode fiber was not available at all, or with enough strands, to connect second floor IDFs. At

LPC, additional 12 strand zero-water peak single mode fiber was installed in the Science B1800 and PE B2500 buildings. At Chabot, many buildings were without single mode fiber connectivity, and that was corrected with the Backbone Cabling project as described in the Cabling section above.

- **Supplemental Category 6A cabling** – In non-modernized buildings and early Measure B construction projects, there was an insufficiency of Category 6A cabling to support DAS equipment. Coupled with cabling project for the wireless rollout, outlets in walls and ceilings were added to support DAS equipment connectivity.

With these infrastructure upgrades, the campus buildings were cable-ready for a DAS Solution that could make use of the single mode fiber and Category 6A cabling.

Reviewing the industry options for DAS solutions compatible with the CLPCCD cabling infrastructure, CLPCCD ITS worked with CommScope engineering to assemble a bill of materials for the CommScope ION-E DAS solution at the Las Positas campus. Through a public bid procurement in July of 2018, Day Wireless was selected as the supplier/integrator for the DAS solution. The equipment consisted of ION-E five (5) Central Access Nodes (CAN), forty-one (41) Transport Equipment Nodes (TENs) and 150 Universal Access Points (UAPs), with a common-carrier GPS system. It was a multi-month project to get the equipment staged and installed. The first carrier broadcast through the campus was AT&T, whose services were enabled in September of 2019. Verizon service was enabled shortly thereafter, in October of 2019. Campus-wide, students and staff can now take advantage of "five-bars" service *inside* of buildings, meeting the performance and safety/security requirements. T-Mobile service is pending their reorganization with Sprint.