

Network Report

Jan – June 2021

CREATED AUGUST 10, 2021

Information Technology Services
Communication Technologies: Networking



THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

News and Information:

- As many of you may already be aware, Communication Technologies has been re-organized into other units within I.T.S. All Communication Technology units except for Voice Services have been moved under the authority of Infrastructure and Operations, headed by John Mack. Voice Services (Cheri Beasley and staff) have been moved to Customer Experience and Engagement under the authority of Kate Hash.
- As we start the Fall semester and people come back into the office for the first time in over a year, networking problems will be found. Please help the Service Desk and us by providing very detailed information within the service request. There is little we can solve without a MAC address. If the issue is critical, a person must be reachable via a phone number left in the request. All additional details will assist us in resolving issues more quickly.
- We are losing one of our best to retirement. Len Needham has announced that he will be retiring by the end of the year. Len has been enormously impactful inside and outside of his career at UNC. He has over 28 years of actual state service time and started working for Jim Gogan in 1995. For the last year he has served as Interim Manager of the Network Deployment group. In 2020, he received the Order of the Long Leaf Pine. He most recently completed his term as President of the Southeastern Association of Fire Chiefs after 41 years with the fire department. Len is Chief of the Bahama Fire Department.
- Keith Miller left his position as our Wireless Architect to pursue other opportunities.
- Jonathan Davis (JD) started working for us on August 9th as our new Wireless Architect. Jonathan is very accomplished as a wireless engineer and is a Certified Wireless Network Expert (#366) in addition to many other industry certifications.
- Back in 2020, we experienced an outage in the ITS Manning Data Center from a cascade of bugs on two different switching platforms (SLX and EXOS). I am happy to report that after thousands of hours of work between our team and the vendor, we were able to perform firmware upgrades on July 1st that fixed the major issue on our spine level SLX switching platform. I would like to specially recognize Jerry Woodside for the herculean efforts that were required to work with the vendor to get this fixed. Robert Henderson, Cindy Henshaw and Frank Seesink also contributed significantly to the resolution. This problem ranks among the most difficult problems I have seen our group tackle.

- There are many new projects that we are undertaking in the next year, so I encourage you to review that section for more details.
- Apple and Google have made some changes to their operating systems which will make onboarding macOS and Android 10+ operating systems onto eduroam more difficult. We have worked with our onboarding vendor (SecureW2) to make these changes less impactful. Many communications have been sent to the CTC regarding the issues.
- For main campus, we replaced UNC-PSK with 21-22-UNC-PSK as the secondary SSID to eduroam on August 9th. Communications were sent to ITEC and CTC prior to the change.

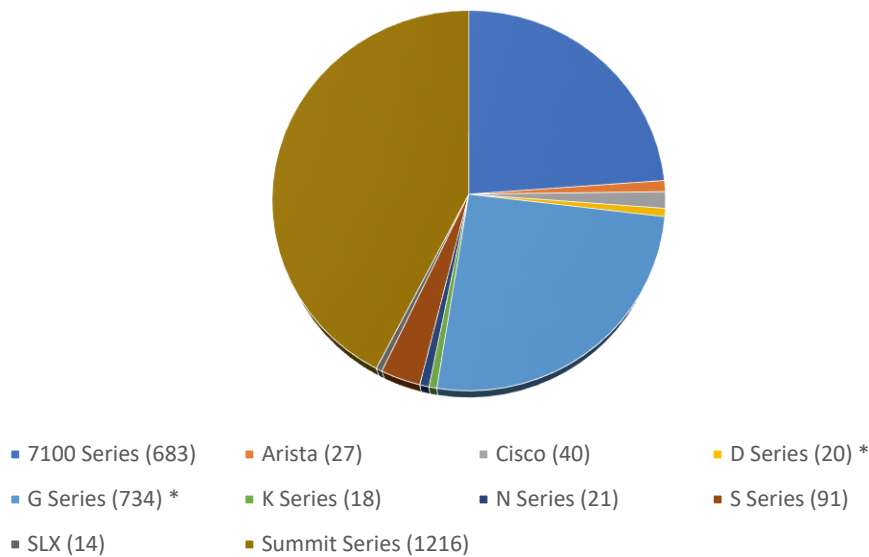
*Sincerely,
Ryan Turner
Head of Networking*

Key Campus Metrics

WIRED

Number of switches on campus:	2,972
Number of ports:	175,278
Peak download rate:	14 Gbps (Feb 17)
Peak upload rate:	15 Gbps (May 8)
Traffic sent to Internet:	9.8 PB
Traffic received from Internet:	6.4 PB

Switch Distribution - Entire Campus



* Indicates a platform currently no longer supported by vendor

- The School of Medicine had its core replaced with SLX switches. This is part of our effort to continue modernizing the distribution network across campus and creating the capacity for 40 and 100 Gbps connectivity to buildings.
- We made good progress on removal of very outdated N series switches as well as out of support G series. G series are out of support and provide less than adequate PoE capability. We hope to have all G series replaced inside of 3 years.
- We have installed 47 Extreme 5520 switches which are providing us with a lot of new capabilities, including 802.3bt power over ethernet and native cloud connectivity (more on this in projects)

Explanation of major model types:

Cisco Nexus 7706 – These chassis-based routers act as the core of our network and feature high density 40G/100G capabilities. These switches provide almost all core routing for campus and were the part of our major core redesign in 2018. They also serve as the layer 3 core for ITS data centers, providing an aggregate of 400 Gbps from ITS Franklin and ITS Manning.

Arista – We used a variety of Arista switch models to provide high-density, high-speed connections to ITS Research Computing as well as other research entities across campus.

Extreme Summit Series – Summit series are comprised of multiple models of the current generation of switches. As we eliminate the older generation switches, we will break down this category into more granular models. These switches have a minimum of 1G to the desktop, 10G to the server, and either 10G, 40G or 100G uplinks. They come in copper or fiber-based form factors. Most will support 802.3at power over ethernet. Newer models will support 802.3bt Power over Ethernet.

Extreme SLX series – These high density 40G/100G switches are currently used as spine layer switches in the new data center design. They can support a high number of 100G ports, will support 400G in the future, and feature a deep packet buffer system that can eliminate packet drops from a congested network. They come in chassis and fixed format, and we will be considering this line for replacement of our current distribution Tier 1 switches (S series).

Extreme 7100 series – Currently supported previous generation of fixed format switches, these feature 1G to the desktop, 10G to the server, and 10G or 40G uplinks. This switch is no longer available for purchase and runs a network operating system that will eventually be deprecated by the manufacturer. Most will support 802.3at Power over Ethernet.

Extreme G series – Past generation of modular switches that feature 1G to the desktop. They are no longer available for purchase and have no software support. As modular switches, they can support up to 4 cards of 24 ports each. These switches will support only 1 card of 802.3af power, and its 10G capability is channelized, substantially limiting its ability to carry high data rates. These switches will not be adequate for the power needs of the current generation access points and replacing them is a priority as we life cycle.

Extreme K / S series – These past generation of chassis-based and fixed format switches act as the workhorses for many of our key distribution points across campus. They currently carry software support. They support 10G connectivity at density but lack in their 40G capabilities. Many of these switches will be replaced in the next 2 years as we attempt to move away from chassis-based switching in as many places as possible toward fixed format high density 40G/100G switches.

Extreme N series – These are switches that were introduced over 10 years ago and still exist in limited parts of campus. They are 1G switches. These continue to be a priority for replacement during the next year. Few exist on the campus network.

WIRELESS

Number of APs on campus: 10,035
 Peak concurrent connections: 15,700 (March 3)
 Devices onboarded to eduroam: 14,109
 Top Onboarded OS: iOS at 39%

AP Distribution - Entire Campus



■ AP-225 (3586)
 ■ AP-315 (3187)
 ■ AP-135 (648) *
 ■ AP-325 (833)
 ■ AP-303H (374)
■ AP-205H (366)
 ■ AP-224 (304)
 ■ AP-335 (96)
 ■ AP-134 (43) *
 ■ AP-275 (46)
■ AP-277 (48)
 ■ AP-515 (488)
 ■ AP-377 (5)

* Indicates a platform currently no longer supported by vendor

- We have installed hundreds of WiFi 6 access points across campus in the last 6 months. We are targeting 1,000 access point life cycles in the next year.
- For the first time we have noticed a tick down in iOS onboarding and an increase in Android devices.
- We pushed out changes to the onboarding platform (SecureW2) to improve the behavior with macOS Big Sur.
- Google made changes to their newer operating system that will continue to complicate onboarding for our users. SecureW2 updated their Play Store app to improve the onboarding experience for Android 10 and 11 devices on August 5th.
- We are going to be closely monitoring any issues we see with clients at the beginning of the Fall. With more and more faculty, staff, and students coming back to campus, we expect to 'discover' new bugs that have been hidden since a relative period of inactivity. For example, during normal times, we had nearly 50,000 wireless devices concurrently connected to the network. In the last 6 months, the biggest number we saw was 15,000.

Explanation of major model types:

AP-1XX – Aruba access points that feature 802.11n capabilities. Aruba has set the end of support date for AP1XX access points as some time in 2021.

AP-2XX – Aruba access points that feature Wave 1 of 802.11ac capabilities. Aruba has set the end of support date for these access points as some time in 2023.

AP-3XX – Aruba access points that feature Wave 2 of 802.11ac capabilities. Aruba has not set the end of support date for these access points, and we consider these still current generation.

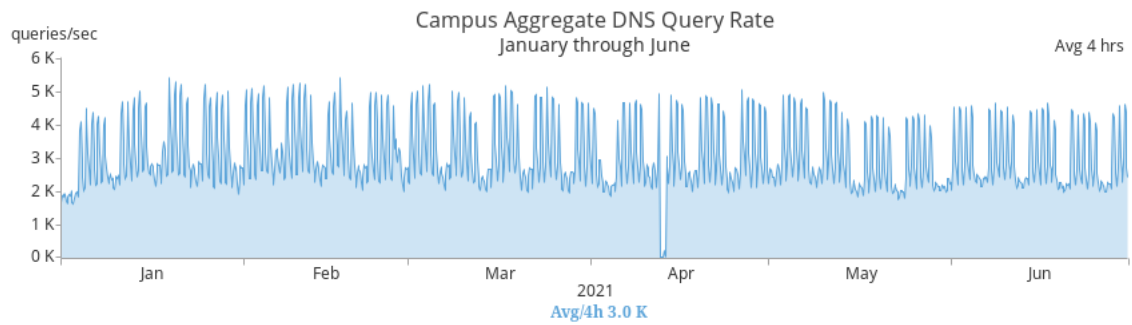
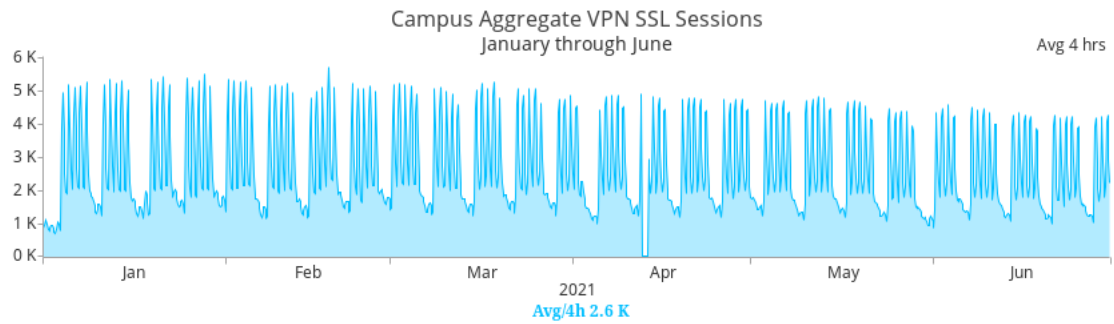
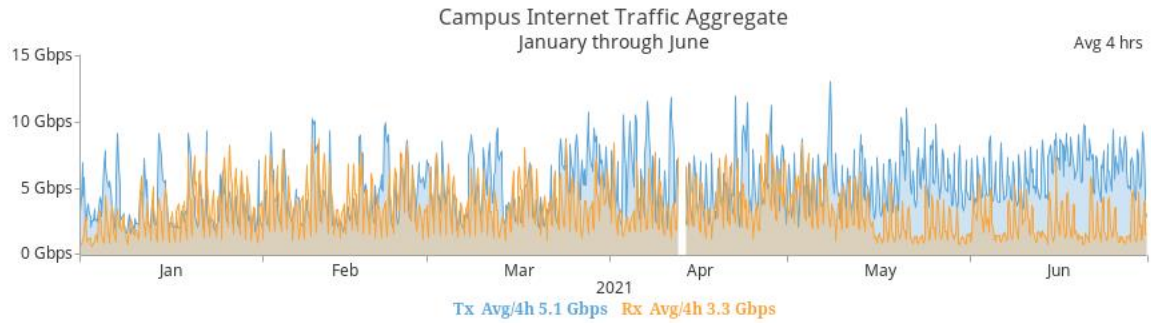
AP-5XX – Current supported and installed model of access point which is WiFi 6 certified.

Service Now Metrics

January through June 2021

Group Name	Service Request	Incident	Count
IP Services	227	19	246
Deployment	298	146	444
Systems	4	7	11
WAN	13	3	16
Wireless	19	46	65
Operations / Engineering	312	106	418
Count	873	327	1,200

ADDITIONAL GRAPHS



- You can clearly see that more folks are transitioning from home to UNC during this period, but the number of connections is still very high by historical standards.

Major Initiatives Review

Border Connectivity Upgrade

The campus is currently connected to our Internet provider with 4x10 Gbps links. Astute readers of this report may think this is enough as our reported maximum throughput in either direction is generally below 25 Gbps. However, there is a problem. We have an increasing number of devices that can generate large flows going off campus nearing 10 Gbps. When this happens, one of our 10 Gbps lanes gets clogged. Networking gear does not load balance like you think it would, so when one of our 10 Gbps links is clogged with a large flow, you have a 25% chance of going out the path that is clogged. You would view this as an outage or service degradation. We are going to mitigate this by changing our border connectivity to 2 x 100 Gbps links. There will be stages to this work that will gradually allow us to utilize the full potential of the 200 Gbps of combined bandwidth. We hope this will be completed before the end of the year, but chip shortages for essential components could push this into next year. Announcements will be made throughout the process.

Campus Core Upgrade

Related to the border upgrade, we will be upgrading all our core routers with 100 Gbps line cards. We currently connect our core with multiple 40 Gbps links. This will also mean upgrading our main campus router from its current platform. This work will take time and will occur in stages. I suspect the next several reports will update on the status of this initiative.

Campus Distribution switch upgrade

We are finally starting to upgrade our campus distribution switches (Tier 1s) to switches that are 40 Gbps and 100 Gbps capable. We have over 20 Tier 1 switches. These switches feed many downstream buildings. Currently, we can only provide 10 Gbps connectivity to buildings, but this will allow us to scale beyond that. Our current distribution network is 10 years of age or older. We expect this work to take the next year to complete and will be upgrading in batches.

Campus Resiliency

We have been working hard to reduce not only outages but outage potential over the last couple of years. This includes things like management VLAN, WAP management, and VOIP segmentation. The primary outcome of this is that a loop or problem in one area in the segmented VLANs will not propagate to other parts of campus. You may be able to remember how phone loops would affect an entire area of campus. New phone firmware reduced the likelihood of this, but now we have a different VLAN for phones in every Tier 1, essentially segmenting a traffic issue to one part of the network. Another huge focus has been network tool development. We now have programs that run and compare active/active or active/standby network equipment configuration. It highlights inconsistencies between the two and allows us to fix problems before something bad happens. We have developed tools that

provide significant degrees of network orchestration. These tools prevent typos that can take a service down. Building redundancy into the design has been another focus in the campus data center.

Campus AV Networks

Virtually every major renovation project or new building construction is including significant investments in Audio Video infrastructure. This is presenting unique challenges for our team as it is challenging our design principals.

- The School of Education is currently renovating two rooms in Peabody Hall. This renovation will include new AV gear from Extron. The AV system has been designed by Extron and will be installed by Kontek. To support the new AV gear, we've installed 4 new Extreme Networks 5520 switches to support the multicast requirements. This project is estimated to have close to 180 endpoints when completed.
- The School of Journalism started construction on the Curtis Media Center which should be coming online soon. With the help of Extron, a new AV system has been designed for this building that will span all floors. Eventually the AV system will tie into the existing AV system in Carroll Hall. This setup required us to implement layer 3 routing at the edge with L3 PIM enabled for multicast. We will use the Extreme Networks 5520 switches here with 2x25G uplinks to support the required bandwidth needed for this AV setup.

ITS UCS and storage 4x100 Pods

After months of working to resolve a bug with our data center spine switches, we are now confident in moving forward with connecting ITS UCS and storage services to 40 Gbps connections. During the past year, ITS has experienced several service outages due to the current 10 Gbps connections being overutilized. This upgrade will create significant headroom where link saturation will be unlikely. Infrastructure and Operations has recently completed migrations of all UCS and storage connections to the new 40 Gbps interfaces. Jerry Woodside and Reid Bradsher are co-leads on this project.

School of Medicine Distribution Switching upgrade

We have upgraded the School of Medicine Distribution network to 100G capable switches and have redesigned the network to mimic what we have on main campus. This project will enable us to connect buildings at speeds that are necessary to facilitate large data transfers across and out of campus.

Cloud based networking management

We are working with our primary switching vendor (Extreme) to validate and test their newest models of switches on their cloud-based management environment. This will take over a year of work to complete. Our early participation in the development of this platform is expected to generate enhancements specifically designed with our needs in mind.

Life Cycle Update

The following locations have received substantial new switching gear during the past quarter:

McGavran Greenberg
Carolina Crossing

The following locations have received substantial new wireless gear during the past quarter:

Hooker Michael Research
Rosenau
Car Mill
CLLC Russet Run
Kerr Hall
Peabody

The following locations are being **targeted for switch and wireless upgrades** in the coming quarter (subject to change):

CSLD
School of Law

Critical Incidents Review

June 17, 2021

Link Saturation for Storage Node in ITS Manning

While this outage was not due to a defect or configuration change, we reported on this to the CTC and are including it in the outage report. We were alerted by the Operations Center late in the evening that they were seeing things go down in their monitoring view. As with almost all problems, the initial indications can be incomplete or misleading. We were able to determine that there was link saturation between UCS and a storage node that was resulting in communication issues for things virtualized within UCS. This link saturation did affect ITS services, and many administrators worked through the night to restart services. We are actively working with I&O's team to migrate all links subject to saturation to 40 Gbps links.