

Network Switch Hardware Standard

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Background Information

There are currently over 100 different models of network switch hardware in use on the University of Michigan – Ann Arbor campus. This variety in the type of equipment deployed across campus creates some very real operational and financial challenges. It also makes it difficult to streamline network operations, deployments and procurement. In an effort to simplify the network architecture on campus and gain cost savings associated with standardized network design, deployment and operation, ITS is proposing utilizing the network hardware standard outlined below to address the above mentioned concerns. The standard uses common network use cases found across campus to determine the network hardware to be used for those use cases.

Scope

This use cases and hardware recommendations contained in this document apply to In-Building networks. They do not apply to Data Center or Backbone network connectivity. There may be overlap between the types of equipment recommended and used in those cases with ones used in In-Building networks. However, the use cases, selection criteria and equipment configuration are different for In-Building, Data Center and Backbone networks.

Campus use cases

Administrative, classroom and residential

This use case is intended to apply to a majority of network users on campus. Most faculty, staff and students are expected to fall under this use case. Users defined in this use case depend on the network to carry out activities such as watching streaming video, browsing the web, interacting with UM systems such as cTools and Wolverine Access, accessing files located on remote storage devices, communicating via email and for voice and video chat or conferencing.

Research, lab and clinical

This use case is intended to apply where the aggregate bandwidth in the environment exceeds 1Gbps. This would be areas such as research and teaching laboratories, clinical settings involving transfer of medical imagery and transferring large amounts of data at high speeds to/from other institutions or across campus. While most classrooms will fall under the prior use case, some classrooms may require the additional bandwidth discussed in this use case.

Bandwidth intensive research

This use case is intended to apply to environments where individual clients transfer data at speeds exceeding 1Gbps and therefore need a 10Gbps connection. This type of connectivity is the next generation of research connectivity and is in use on-campus currently in laboratories with visualization stations and/or where the size of the individual data files processed is greater than 500GB. Given that 10Gbps connection methods are still in relative flux outside of the data center, it is important to choose a solution that not only meets today's needs, but also one that will not become quickly outdated. For example, while it is possible to connect at 10Gbps using copper cabling, copper cabling has severe limitations at speeds 40Gbps and beyond. Additionally, any equipment being considered to provide 10Gbps connectivity to end devices should be able to support 40Gbps connectivity to upstream network devices to ensure optimal transmission speeds.

Wi-Fi deployments

Wi-Fi deployments in almost all buildings on campus share network infrastructure with the wired network. However, Wi-Fi places additional demands on the network infrastructure due to its shared nature, as each access point (AP) is capable of supporting numerous end users. This situation is exacerbated as faster Wi-Fi network technologies such as 802.11ac are deployed in campus buildings. The latest Wi-Fi network standards can deliver transmission speeds in excess of 1Gbps, speeds comparable to or faster than current "general purpose" wired connections. Additionally, as more access points are connected to a network switch, the model of network switch used needs to accommodate not only the additional power requirements from APs that support the latest Wi-Fi standards but also avoid problems associated with oversubscription.

Network hardware

Use Case	Model	Explanation
Administrative, classroom and Residential	Juniper EX-2200	This switch offers 1Gbps connection speeds for both upstream and end-device connectivity. This level of connectivity is expected to be sufficient for most users for the next 4-5 years. The Power over Ethernet version of this model is recommended in instances where Voice over IP (VoIP) handsets are in use.
Research, lab and clinical	Juniper EX-3300	This switch offers 1Gbps connection speeds for end-device connectivity and 1/10Gbps connection speeds for upstream connections. The additional upstream capabilities offered by this device

Use Case	Model	Explanation
		position it well for future growth. Not all high-bandwidth use cases on campus will meet the hardware model recommended for this use case. The Power over Ethernet version of this model is recommended in instances where Voice over IP (VoIP) handsets are in use.
Bandwidth intensive research	Juniper EX-4550	This switch offers 10Gbps connectivity for end-devices and 10Gbps connectivity for upstream connections. Furthermore, a 40Gbps connectivity module is also available for upstream connectivity.
3-6 Wi-Fi APs	Juniper EX-2200	This switch has 12 ports capable of 802.3at Power over Ethernet. The upstream capacity of this switch is adequate for supporting users connected to the APs and any additional wired connections.
7-12 Wi-Fi APs	Juniper EX-2200 OR Juniper EX-3300	The switches have 12 and 24 ports capable of 802.3at Power over Ethernet respectively. For areas with high user density such as auditoriums, the EX-3300 model is preferred due to its higher upstream bandwidth and Power over Ethernet capacity.
>12 Wi-Fi APs	Juniper EX-3300	The switch has 24 ports capable of 802.3at Power over Ethernet. The upstream capacity of this switch is adequate for supporting users connected to the APs and any additional wired connections.

Appendix

Sharing upstream connections

There are multiple ways for network switch hardware to share a single upstream connection. Some switch installations on campus use technologies such as Juniper's Virtual Chassis or Cisco's StackWise to connect multiple switches together to make them function and appear as one larger switch. Other installations have switches cascaded off of another switch, which is then connected to upstream devices. In either scenario, the net result is one where a large number of end-device ports are relying on a relatively small upstream connection for their connectivity. This results in oversubscription of the upstream connection and can lead to

intermittent connectivity problems due to bandwidth contention. Interconnecting switches together in these fashions also creates operational risk and could lead to problems detecting, troubleshooting and fixing outages. ITS recommends units “home-run” each switch to a building Distribution Layer switch (DL) in all instances. In instances where it is not possible to “home-run” each switch, this is generally due to inadequate fiber between the telecommunications room (TR) and the building entry room (BE); ITS recommends cascading the switches and then moving them to their own connection to the DL once the reasons for not being able to “home-run” have been addressed.

Exceptions to the above rule can be made in circumstances where a unit is exceeding the 1Gbps upstream connection per 48 downstream ports limit. For example, a unit may choose to connect a TR containing five 48-port switches via a single 10Gbps upstream connection.

Low density installations

There are instances where a unit needs only a handful of data connections in a telecommunications room (TR). This need is addressed in different ways on campus. Some units work with others that have equipment in the TR and get permission to connect their devices to the network equipment owned by the other units. While some other units install their own low density, typically 8-12 ports, network hardware in the closet just for their own connections. ITS recommends that units work together to share equipment instead of purchasing their own separate hardware. While ITS recognizes that units may have various business needs to own and maintain their separate network hardware and that there is a lack of financial mechanisms available to units to share ownership of equipment, it is still in the best interests of the University for all of its units to find ways to make the most efficient use of their resources. In instances where a unit needs a handful of connections and it is not able to locate those connections on networking hardware it shares with another unit, ITS recommends using the EX-2200C 12-port switch. Installation of low-density switches should be used as a last resort as they use up valuable fiber strands and do not add enough port capacity to the TR for more than a few additional connections.