Gigabit Passive Optical Network (GPON) Powers Learning at Ryerson University’s Largest Residences
Pitman Hall
Pitman Hall

- Pitman Hall is Ryerson’s largest residence.
- 14 floors and 565 rooms.
- It was built in 1991.
- The majority of rooms are a single format.
Communications Technology Prior to 2016

- The existing cabling, both for voice and data is IBM type 3 (category 3 performance)
- Supporting a bandwidth of 16 MHz and applications of only 10Mbs Ethernet.
- Both the cabling and the existing Nortel Networks 470 T Ethernet switches do not support Power Over Ethernet (POE).
- Limited wireless connectivity is available in Pitman hall.
- Both the phones and data are hard-wired connections
Communications Technology Prior to 2016
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Daphne Cockwell Complex (DCC)
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- **Construction start:** November 2015
- **Opened:** August 2019
- **Residence space:** 18 floors, 11,376 m² (122,450 square feet), 100 units
- **Residence capacity:** 332 students
Daphne Cockwell Complex (DCC)

- Based on experience from Pitman Hall we were able to reduce the size of the Telecom Rooms on each floor by deploying GPON
- Horizontal fiber to the suites and backbone fiber to the Equipment Room – reduced conduit sizes
- Extremely short copper cables
Today’s Environment

- However, the residence hall, where students spend a significant part of their time on campus, has tended to be left as a coverage-only model using hallway deployments.
Today’s Environment

➢ The result is a wireless network that increasingly underperforms the rest of the campus.
Today’s Environment

- This emerging trend represents a whole new scale for consumption of wireless network resources and capacity.
- Many residence hall Wi-Fi networks began as networks of convenience and they were intended to supplement wired connectivity.
- Now the general move is for Wi-Fi to replace wired networks for many types of users, especially students.
Today’s Environment

- The network must be high performance. The network must be able to deliver a wire-like experience in each and every room.
- The network must work equally well, if not better, in 5 GHz to offload all possible traffic from the congested 2.4 GHz spectrum.
Microcell Architecture

- The primary way to increase capacity within any Wi-Fi system is to add APs.
- For residence halls, one of the best architectures for increasing AP density to meet the growing user demand for increased capacity is the “microcell” A microcell architecture uses APs that are set for very low transmit power with a small cell radius that covers only a few rooms at most.
Microcell Architecture
Passive Optical Networks (PON)

- **GPON**: Gigabit Passive Optical Network
- GPON conforms to the [ITU-T G984.1](https://www.itu.int/d议事/en/itt/organisat/eurasian actividad.action2.action?lang=en) specification
- 2.4 Gbps download speed coupled with a 1.2 Gbps upload speed. Each GPON fiber is split to serve 16, 32, or 64 users per fiber.
- This is the technology used for Passive Optical LAN’s (POL)
Passive Optical LAN – Higher Education

- University of Mary Washington
- Texas A&M University Kyle Field
- Howard University
- Clemson University
- Oklahoma State
- James Madison University
- University of Missouri
- University of Mississippi
- Penn State
- Washington State
- Capilano University
- Ryerson University
Passive Optical LAN - Comparison

Legacy copper-based LAN

- Data Center / MDF
- Campus / Building / IDF
- Closet / IDF / Zone
- Access

- Local Provisioning and Management
- Distance Limited MMF 550m / Copper 100m
- Distance Limited MMF 550m / Copper 100m
- Access

Optical LAN

- Data Center / MDF
- Campus / Building / IDF
- Closet / IDF / Zone
- Access

- Centralized Provisioning and Management
- Single Mode Fiber
- Passive Optical Splitter
- Building Automation
- Voice, Video, Data
- Security, Surveillance, Wireless
- Passive Network Up to 30km/18mi Distance 300x Greater Reach
Pitman Hall – The Opportunity

- Existing pathways full
- No room in existing Telecom Closets to establish new switches
- Needed to reduce the size of any new pathways
- Needed to limit the amount of equipment space required.
Pitman Hall – The Project(s)

- Project was divided into two separate projects
- Pathways, spaces and cabling was one Project (Divisions 25, 26, and 27)
- Project began May 2, 2016 needed to finish by August 12, 2016
- Second Project was equipment deployment
- Project needed to start August 15, 2016 and end Sept. 2
Phases of a Project - PMBOK
Phases of a Project

Tuckman's Team & Group Development Model

- Forming
- Storming
- Norming
- Performing

Effectiveness of Team vs Performance of Team
Phases of a Project - Reality

- Wild enthusiasm
- Disillusionment
- Confusion
- Panic
- Search for the guilty
- Punishment of the innocent
- Promotion of non-participants
After Only 2 Weeks

FIGURE 1. A cartoon depicting the stages of a project.

- **Phase One**: Our project plan will follow the usual arc.
  - Unwarranted optimism supported by delusions of competence.

- **Phase Two**: The obstructionists will slither out of their lairs and try to smother our dreams.
  - Ignorance and envy will fuel rumors that get repeated until they morph into common knowledge.

- **Requirements**: Resources will be allocated based on misinformation and favoritism.
  - And requirements will drift until the project is both undesirable and impossible.

- **Conclusion**: That brings us to the second week.
  - I want my unwarranted optimism back.

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Project 1 – Pathways, Spaces and Cable
Fiber Riser

- 9 1/4" EMT conduit with 4x2x2500 ft. fiber
- Refer to detail 1/200 SMD
- 1 3/4" EMT conduit with 2x2x2500 ft. fiber
- 1/2" EMT conduit with 2x2x500 ft. fiber
- 1/2" EMT conduit with 4x2x2500 ft. fiber
- Typical room riser
- Pull boots/peeloff in main home runs
- 2" EMT conduit with multiple riser cable bundles

Ground: 2nd Floor
P1 Level: 14th Floor
15th Floor
16th Floor
17th Floor
18th Floor
19th Floor
20th Floor
21st Floor
22nd Floor
23rd Floor
24th Floor
25th Floor
26th Floor
27th Floor
28th Floor
29th Floor
30th Floor
31st Floor
32nd Floor
Penthouse
Typical Dorm Room
NOTES:

1. CONTRACTOR SHALL REMOVE EXISTING DEVICES AND DRYWALL AS REQUIRED TO COMPLETE THE SCOPE OF WORK. CONTRACTOR SHALL REPLACE THE EXISTING DEVICES AND RE-DRYWALL ALONG WITH PAINT TO MATCH THE EXISTING WALL.

2. RESPONSIBILITY CONTRACTOR TO MAKE GOOD ALL SURFACES AS REQUIRED TO MATCH EXISTING FINISHES. ALL CLEANING TO BE FINISHED TO "WAVE IN" CONDITION AFTER THE WORK IS COMPLETE.
Riser Fiber

- 12 fiber
- 6.6 mm (0.26 inches)
- Pre connectorized with SC APC
- 2 fibers each room
Passive Optical LAN – Optical Network Terminal (ONT)
Room Wireless Access Points
Passive Optical LAN – Optical Network Terminal (ONT)
Hallway Wireless Access Points
Telecom Room
e-Limiter+
e-Limiter+

- 36 channels per chassis (4 per card)
- Meets NEC class 2 and communication circuit requirements for limited power circuits
- 100VA
- ONT: Max Power Delivered (Watts): 60W
  PoE Standards: IEEE 802.3at and IEEE 802.3af
Optical Network Terminal
Equipment Room
Residence GPON Architecture
Passive Optical LAN – Fiber Splitter
Optical Splitters

Optical splitters are critical to the Passive Optical Network
- Splits an incoming light source into 2 separate paths
- Repeating this split multiplies the number of devices that can be connected to a single port

Typical splits in the LAN
- 1x16, 1x32, 2x32
- Other splits available
Passive Optical LAN – Optical Line Terminal (OLT)

OLT1150E

- 19” or 23” mounting
- 11RU high
- 1.12Tbps backplane*
- 80Gbps per slot*
- 14 multi-service slots
- 56 PON ports
- up to 1,792 ONTs
- up to 7,168 10/100/1000
Availability

- GPON Optical LAN solution provides for > 99.999% availability with a dual PON interface to the ONTs
- Pitman Hall has been operating for over 3 years with zero downtime.
- Since both residences are the same we are able to reuse maintenance spares if required
- Same management platform
Futureproofing

- **10-GPON** conforms to the ITU-T G987 specification
- 10 Gbps download speed coupled with a 2.5 Gbps upload speed.
- **NG-PON2** (also known as **TWDM-PON**) conforms to the ITU-T G989 specification
- 4 wavelengths - Each upstream/downstream wavelength is capable of providing up to 10 Gbit/s symmetric bandwidth to each subscriber