



# ENHANCING WI-FI AT HAMILTON PUBLIC LIBRARY

A CITYLAB PROJECT

BUSINESS REQUIREMENT DOCUMENT

**Authors:**

Foluke Raji

Khushi Shah

Yash Mukesh Makwana

Maigreth Lacouture Diaz

Mohammed Sinaj Kalathil

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## Executive Summary

The Hamilton Public Library has been in existence for over a century now. The first Hamilton Public Library building opened on September 16, 1890 which is today known as the Central Library Branch (The biggest and the busiest). The youngest of the Branches was opened in 2003, the Stoney creek Branch and in total, they have 22 Branches serving the diverse people of Hamilton and will continue to do so.

They are a customer focused organization that puts the customer first in everything they do. Their action is embedded in their mission statement of “freedom to discover” and their values (intellectual freedom, inclusiveness, innovation, respect and accountability) which guide their day to day activities and helps them in making decisions on projects to embark on to move the organization forward.

The senior leadership team is led by Paul Takala, who is the CEO & Chief Librarian. Other key leadership member relevant to our project are Sherry Fahim, Director, Digital Technology & Creation and Tony Del Monaco, Director, Finance & Facilities. One of the systems managers is Sukh Jatana (Digital Technology Infrastructure) who is also the sponsor of this project.

The Library Board establishes library services for the community based on public input, market research and by monitoring satisfaction with services and they are made up of nine citizens and two City Councilors. The CEO & Chief Librarian reports to the Board and the city of Hamilton is the body that approves budget and business plan that is carried out in HPL.

The Hamilton Public Library will continuously seek new ways to assist the learning and growth of all individuals. HPL has a strong strategic plan for 2018 through 2021 that supports a learning and an innovative organization. They are ready to meet changing technology need while focusing on ensuring that they reduce barriers to using their services even as they promote HPL in the Hamilton area.

Some of the completed project in accordance with the 2018-2021 strategic plan includes Migration to Office365 and numerous hardware and software system upgrades, early learning systems, printers, monitors and Windows 10 upgrades. - New Digital Literacy programs designed and delivered in the community - Advancing Digital Literacy in collaboration with partners in the community including McMaster, Mohawk City School, the IEC and Google Canada on various initiatives.

HPL has changed dramatically over the years in terms of building, equipment and infrastructures to make the Library space a better place for users in conformity with its mission and vision statement and will continue to do so. Hamilton is a growing community and with a lot of immigrant coming into the country, more people are moving into Hamilton, which means, more users for HPL and hence the need to have a good digital infrastructure in place that will truly give the freedom to discover.

HPL's wireless network complements computer access and enables members to use online resources and the Internet with their own wireless-enabled devices. In response to challenges faced by HPL users (Customers need to Submit "Agree T&C" every time they connect, Not Enough Coverage across all public spaces, Session Timeout, Not Much Stats or Usage reports are available, Not Flexible to provide separate WIFI access (Internet Only) to external users at HPL for a set duration.) and In anticipation and response to changing needs and technology and in order to support and Create trusted services and spaces that welcome everyone (HPL Values), this project seeks to optimize efficiency by providing a user-friendly log in page for guest without having to log in multiple times to Terms and condition on the same day. In addition, HPL is looking to enhance the WIFI across the 22 Branches to eliminate dead spot, resolve connection time out and weak/low signal strength.

## Project Overview

### **Problem/Opportunity:**

The user experience at the HPL is not the best as they are currently facing the following challenges:

- Customers need to Submit "Agree T&C" every time they connect.
- Not Enough Coverage across all public spaces.
- Session Timeout
- Weak signal strength.
- Not Much Stats or Usage reports are available.
- Not Flexible to provide separate WIFI access (Internet Only) to external users at HPL for a set duration.

### **Goal:**

The goal of this project is to enhance WIFI user experience at HPL across all branches by solving all the current problems around dead spot, connection time out, weak signal strength and multiple log in to accept terms and condition.

### **Objectives:**

The objective of the HPL Wi-Fi- project is to give a HPL a clear understanding of the Wi-Fi network in terms of the signal strength, coverage, capacity, connectivity and user experience putting into consideration limitations and also opportunity for improvement.

The report and its recommended solutions will inform an action plan for improving HPL's public Wi-Fi network. The future state is intended to be achieved by applying BA techniques in Document analysis, Requirement Gathering and data Analysis. This will be done through the analysis of both qualitative and quantitative data provided, analyzing the surveys provided by HPL, collaboration with stakeholders, research on WIFI in public spaces, Research on current infrastructure at HPL and its capabilities to come up with a recommended solution that will improve and enhance the user experience across all HPL branches. This project seeks to eliminate dead spots from all Branches, create a user-friendly experience for user at log in by not having to log in multiple times to terms and condition, high speed internet without interruption or session time out.

**Success Criteria:**

- Users are able to log in to terms and conditions once in a 24-hour period, multiple log in to terms and condition page eliminated.
- An increased number of access point in all branches with less than 6 point.
- WIFI Boosters/repeaters/extenders found across all HPL location
- Dead spots completely eliminated across all HP branches.
- Users are able to access WIFI without session time out.

**Assumptions, Risks, Obstacles:**

Our Assumptions are as follows:

- That some of the WIFI equipment's are outdated and needs to be upgraded.
- That Data provided by HPL is true and accurate.
- That all relevant stakeholders will attend all meetings and will give information sufficient to help in the project.
- That management will accept our recommendations.
- That a budget will be assigned to make this project a success.
- That all team members will have the required skills needed to work on the project.
- That all branches are having issues around dead spot, weak signal strength and connection time out.
- That the number of users has decreased due to the pandemic.

**Risks:**

**Financial risk:** There is no budget for this project, the sponsor is waiting for the recommendation before they allocate the budget, this will cause delay and negatively impact the overall success of the project.

**Scope Creep:** Scope creep is very common in technologically inclined project, already at the kick off meeting, the sponsor already mentioned some other capabilities they are looking into, scope creep can cause a major setback for this project.

**Technology Risk:** This include user privacy, data Breaches and compliance. Users using the HPL WIFI will be transmitting personal data or otherwise over the WIFI connection, it is important that solution to problems will not breach Data and, user privacy will be secured over HPL Network in compliance with legislation regarding what is expected of a Library by the Ontario Ministry of Heritage, sport, tourism and culture which is to ensure free, equitable access to public library service in Ontario.

**Requirement Risk:** Incorrect gathering of requirement or inability to gather enough requirement is another risk to the project.

**Reputational Risk:** Customer they say is the king. Without the users, the library will be of no use. The goal of the project is to enhance the overall user experience, failure to do this will result in reputational damage for HPL which can lead to loss of users/customers.

**Obstacles to the project:**

**Cost:** Cost is an important part of this project, there might be some major recommendations to solve this problem currently faced at HPL which will come at a cost, for example, if more access points will be needed, the total cost to install an individual Access Point (AP) varies greatly depend on the number if user, the design of the building and additional hardwired network needs. Also, upgrading of the existing WIFI infrastructure if currently out of date will be a major cost and currently, there is no budget attached to this project. This will pose as a risk to the success of this project.

**Time:** The time allotted to the project less than 4 month and no cost/budget attached to the project. Enough time is needed to meet with stakeholders, we might be unable to meet with all stakeholders and maybe not more than one meeting because of the limitation of time. We need to understand how HPL WIFI infrastructure work, who controls and manages it, building time, visit library to see spaces that are considered dead zones, the time resources are shortened and it's a major obstacle to this project.

**Natural Disaster (COVID-19):** The pandemic is a major limitation for the project team to visit HPL Branches across Hamilton to look at the library spaces, test the WIFI strength, check the dead spot areas, have a feeling of having to sign in to terms and conditions multiple times and any other thing that will be useful in making a recommendation for the project.

**Limited statistics and information:** The survey provided by HPL is does not have enough information to determine the problems faced by users in accessing WIFI at the library. HPL agreed that there is a challenge with the statistic and usage report provided as they are not sufficient to help in requirement gathering or to even determine the fact about the current state.

**Non-availability of users for interview:** The focus of this project is to enhance user experience, not having enough information directly from these set of people is an obstacle. There is limitation in capturing real time user experience. The survey previously done by HPL did not fully capture the user experience relating to WIFI in details to make an informed decision on user experience and we are not able to go to the location physically to interview or have a conversation with the users.

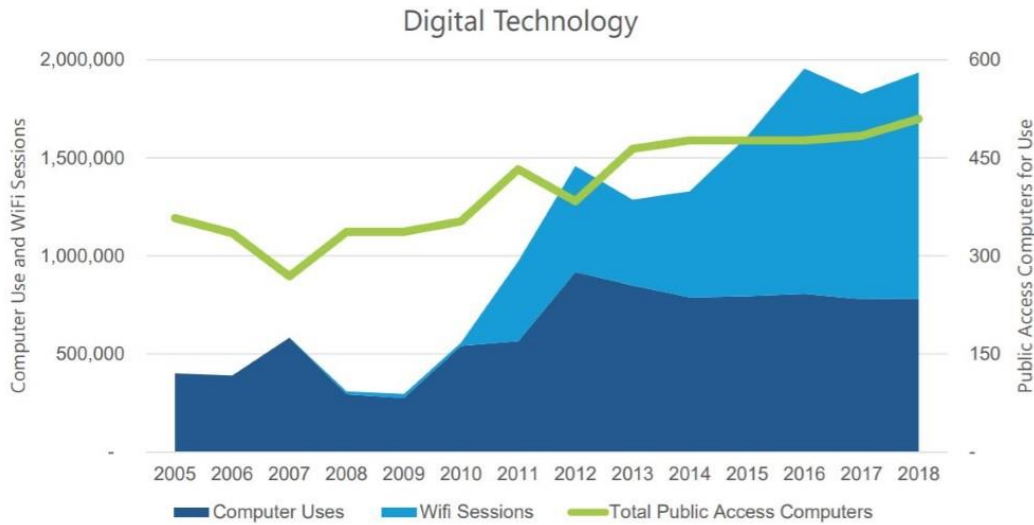
## Background

Hamilton Public Library is committed to equip the community with the Freedom to Discover and in the process of achieving this goal, HPL is continuously striving to provide better and updated services to the community since its inception in 2001. Over the years, the number of people accessing services offered by HPL has increased drastically. To keep up with the increasing demand, HPL carries out various projects to facilitate better services to the public. Hamilton Public Library provides free Wi-Fi to guests and members of HPL across all branches in Hamilton via their wireless guest network. In an effort to enhance the Wi-Fi user experience at HPL, this project was designed in partnership with CityLab. This is the first phase of the project where the current infrastructure will be analyzed to provide recommendations to a group of networking students for implementation.

Library members and guests are facing various issues regarding the Wi-Fi usage and this needs to be resolved to ensure a seamless Wi-Fi user experience at HPL across all the 22 branches. HPL's public Wi-Fi should be analyzed for its coverage, signal strength, capacity and connectivity. Known issues regarding the Wi-Fi at HPL included users being asked to agree to Terms and Conditions every time they logged in, insufficient coverage across the library, dead spots, session timeouts, and that the current Wi-Fi usage data and reports are difficult to customize and analyze.

HPL's free Wi-Fi is one of the most used or accessed service at HPL and data shows us that the demand is on rise. The number of people accessing the public computers and Wi-Fi at HPL has steadily risen over the past 5 years. From 2011, the computer uses remained steady while Wi-Fi sessions drastically went up. The below graph indicates the rising Wi-Fi access at HPL.

## Technology Access



Current Wi-Fi usage data has been made available for analysis to explore any patterns in the Wi-Fi usage across all branches. This data was used to analyze the average session timings, throughput and develop assumptions regarding connectivity at all branches. The recommendations developed from the project be used to enhance the Wi-Fi user experience at HPL.

## Objectives

The objective of the HPL Wi-Fi- project is to give an HPL a clear understanding of the Wi-Fi network in terms of the signal strength, coverage, capacity, connectivity and user experience putting into consideration limitations and also opportunity for improvement.

The report and its recommended solutions will inform an action plan for improving HPL’s public Wi-Fi network.



The objective of this project will be achieved by breaking the problem statement into separate deliverables to be able to provide the needed solution for each of them. The problems are dead spot, weak signal, connection time out, Multiple log in to Terms and condition.

Understanding of each of the problem through the information provided by HPL and also meeting the stakeholders is an important part of finding a solution to the problem. We shall do this through the application of business analysis techniques to change at the enterprise level and also evaluate HPL goals & align Business Analysis activities through strategic enterprise analysis to provide the recommended solution.

An evaluation and an understanding of the problem statement through research is important to measure the step by step milestone of the project.

To achieve the set objective, we shall be gathering and documenting requirement through surveys, brainstorming and interviews, an analysis of both quantitative (trend analysis) and qualitative data (using SWOT analysis), An understanding of our stakeholders, performing stakeholder analysis, a research into how Wi-Fi problem can be solved in a public area and organizing the work done by the project team and stakeholders are ways the project objectives will be achieved.

The timeline for this project is Mid October with the kick off meeting and Mid December when document and final report will be presented.

We shall be meeting from time to time on a weekly basis to discuss the progress of each phase of the project for accountability and to track the work done.

In conclusion, we shall be providing full report of our findings and recommending solutions to the problems of multiple log in to terms and condition to create a User-friendly experience for HPL guest and solution to the dead spot, connection time out and weak signal strength.

## Goals

HPL is looking to make access to the Wi-Fi at Library space a seamless experience for users in alignment with their strategic priorities for 2018-2021 which includes making the physical and digital space to be inviting and accommodating. In addition, to focusing on ensuring they reduce barriers to using their services as they promote awareness of the Library in the communities they serve.

The goal of this project is to improve customer's experience on the Wi-Fi services being provided across the 22 HPL branches by making recommendations that will solve issues around signal strength, network coverage, connectivity/connection time out and multiple logins to terms and condition.

## Project Requirements

**PROBLEM STATEMENT/BUSINESS NEED:** HPL provides free Internet access at all branches via their wireless guest network HPL Guest, enabling members to use online resources and the Internet with their own wireless-enabled equipment. Library members depend on this free access to the Internet; There is a need to know how this service can be improved across the system and in all 22 Branches of the Library. The current state shows Members must agree to terms & conditions every time they connect, Insufficient coverage in public spaces across all library branches, Session timeout which brings about negative user experience. It is important to HPL to create a seamless user experience for all guests using the HPL WIFI, therefore, the opportunity lies in improving and enhancing WIFI across all HPL Branches.

REQUIRMENT ID	REQUIREMENT TYPE AND DESCRIPTION
1.0	<b>BUSINESS REQUIREMENT:</b>
1.1	Providing uninterrupted WIFI Connection at all HPL Branches
1.2	Elimination of Dead spot across all HPL Branches.
1.3	Providing seamless user experience with one log in access within a 24-hour period to avoid multiple log in to terms and condition.
1.4	Enhancing and improving signal strength across all HPL Branches.
2.0	<p><b>STAKEHOLDER REQUIREMENT:</b> Stakeholder Requirements were collected from representatives of the following groups: Project sponsors, Subject matter experts, WIFI End-Users through survey, Managers at HPL Branches and Library Technicians. Series of questions were asked to help determine what the stakeholder requirement will be and they include but not limited to the following:</p> <ul style="list-style-type: none"> <li>• Questions asking for suggestions based on stakeholder's experience or expertise on how to improve or enhance user experience regarding the HPL WIFI project. These questions were asked across board to at least three stakeholders with experience in IT Infrastructure, Digital Technology Technician and networking coordinators.</li> <li>• What is the current bandwidth of the WIFI?</li> </ul>

	<ul style="list-style-type: none"> <li>• What is the best outcome you want to see from this project?</li> <li>• Why is HPL looking to enhance their WIFI?</li> <li>• If the WIFI Coverage is weak and there are different dead spots in the Library, how do we improve the coverage?</li> </ul>
2.1	HPL wants to expand and have the same configuration across all branches for the WIFI.
2.2	Innovative and elimination of dead spot
2.3	Provide seamless user experience for guest
2.4	Elimination of multiple logins to terms and conditions
2.5	Focus on improving Wi-Fi printing, security and user experience, easy access to Wi-Fi.
2.6	Test the public Wi-Fi network for coverage, signal strength, capacity and connectivity
2.7	A research that will give HPL a clear understanding of the HPL public Wi-Fi network in terms of coverage, signal strength, capacity, connectivity and user experience, noting inconsistencies and opportunities for improvement and probably recommend solution.
3.0	<b>SOLUTION REQUIREMENT IS MADE UP OF FR AND NFR</b>
3.1	<b>FUNCTIONAL REQUIREMENT(FR):</b>
3.1.0	<b>ACCESS POINT:</b> More access points to the Wi-Fi network maybe added to branches with less than 6 access point considering the number of people using the WIFI, the coverage area/space, Capacity/Throughput requirements per user / application.
3.1.1	<b>WIFI BOSTERS/EXTENDERS:</b> WIFI Boosters, extenders or repeaters will help to strengthen the network signal and they are cost effective.
3.1.2	<b>LATEST WI-FI TECHNOLOGIES IEEE 802.11AC:</b> switching to this technology is one of the ways to solve the problem at hand, some branches have this technology but not fully utilized; the full capability should be enabled for the branches while other branches should be upgraded to solve the issue around connectivity.

3.1.3	<b>EXTENDED LOGIN CAPABILITY:</b> The login capability where users accept terms and condition only once in a 24hour period.
3.1.4	<b>INCREASE BANDWIDTH:</b> Increasing the bandwidth from the current limit of 100MBPS to increase the capacity of data that is being transmitted over the network.
3.1.5	<b>COVERAGE AREA:</b> These are areas to be across all branches of HPL by the WIFI
3.2	<b>NON-FUNCTIONAL REQUIREMENT</b>
3.2.1	<b>PERFORMANCE:</b> The performance of the WIFI must be at a speed that is high enough to ensure a user experience that will help HPL fulfil its mission of "freedom to discover". There should be no weak spot, connection time out or weak signal. The equipment should perform optimally by sending connection to devices without any glitch.
3.2.2	<b>SECURITY:</b> Different people will visit the Library to access vital information for personal use, some for research and other use. Different data and information will be transmitted through the WIFI, the overall Security of customers while accessing HPL WIFI is important in accordance with HPL privacy policy.
3.2.3	<b>REGULATORY:</b> The recommended solution must meet the regulatory requirement that governs public library in Ontario as stipulated by the Ministry of Heritage, sports, tourism and culture.
3.2.4	<b>USABILITY:</b> The project is to create an experience for the users, a feeling that will make them want to come back to HPL. After the project is complete, the users should have a friendly and problem free user experience while on the HPL WIFI. There should be an easy access to the WIFI.
3.2.5	<b>SCALABILITY:</b> HPL will continue to have increased users because the community they serve is a growing community therefore, the proposed recommendation should have the capacity to work well with increased workload in future if there is a need to.

## Business Case

Hamilton Public Library is vested in serving the community with commitment. HPL emphasize on its underlying values of intellectual freedom, inclusiveness, innovation, respect and accountability in all its projects. Aligning the values of the organization with the strategic and operational direction of HPL is very important and this project is a byproduct of such an effort.

### **Need Assessment**

The need for enhancing the Wi-Fi at HPL identified for providing library members and guests a seamless Wi-Fi experience has come at the right time. The improvement in user experience will enable users to connect to the Wi-Fi faster, and use the network without any interruptions. This change is required to resolve customer complaints regarding the Wi-Fi across all branches. Increasing customer complaints regarding dead spots, time out, and weak signal strength is not good for HPL.

There is a clear business need of enhancing the Wi-Fi at HPL as a lot of library members and guests are depended on this Wi-Fi for various of their works. Only 61% satisfaction rate was marked regarding the Wi-Fi at HPL by the public in the Community Survey of 2017. This alone indicates the need of improving the current state of internet and enabling better services for guests.

A seamless user experience will attract more guests to HPL and would even contribute to increased memberships with HPL.

### **Desired Outcome**

The very first thing we are looking at is the login component, where the user is asked to agree to the terms and conditions every time they connect to the network. This screen should either be bypassed or be accepted in the background if the user is already a HPL member. The login be valid for 8 hours, or more so that even when the user moves out and come back to the Wi-Fi range, the connection is not interrupted and the user is not asked to login again.

Another thing to look at would be the dead spots in the library. Access points maybe enabled by physically wired connections in those areas, or Wi-Fi repeaters and extenders be used to provide network access in those dead spots. This will enable the user to access the Wi-Fi from anywhere inside the library.

The issue regarding signal strength be also resolved as a result of this project and need assessment. It is important to identify ways through which more access points can be added or separate channels be allocated to guests for Wi-Fi access. Bandwidth of the Wi-Fi could be increased so as to enable a better connectivity as well.

The scope of hardware installations, and upgrades maybe evaluated according to needs and demands of each branch separately. The risks in each case would also vary, which are to be identified. Financial analysis and value assessment may also be carried out when implementing any change in the existing infrastructure.

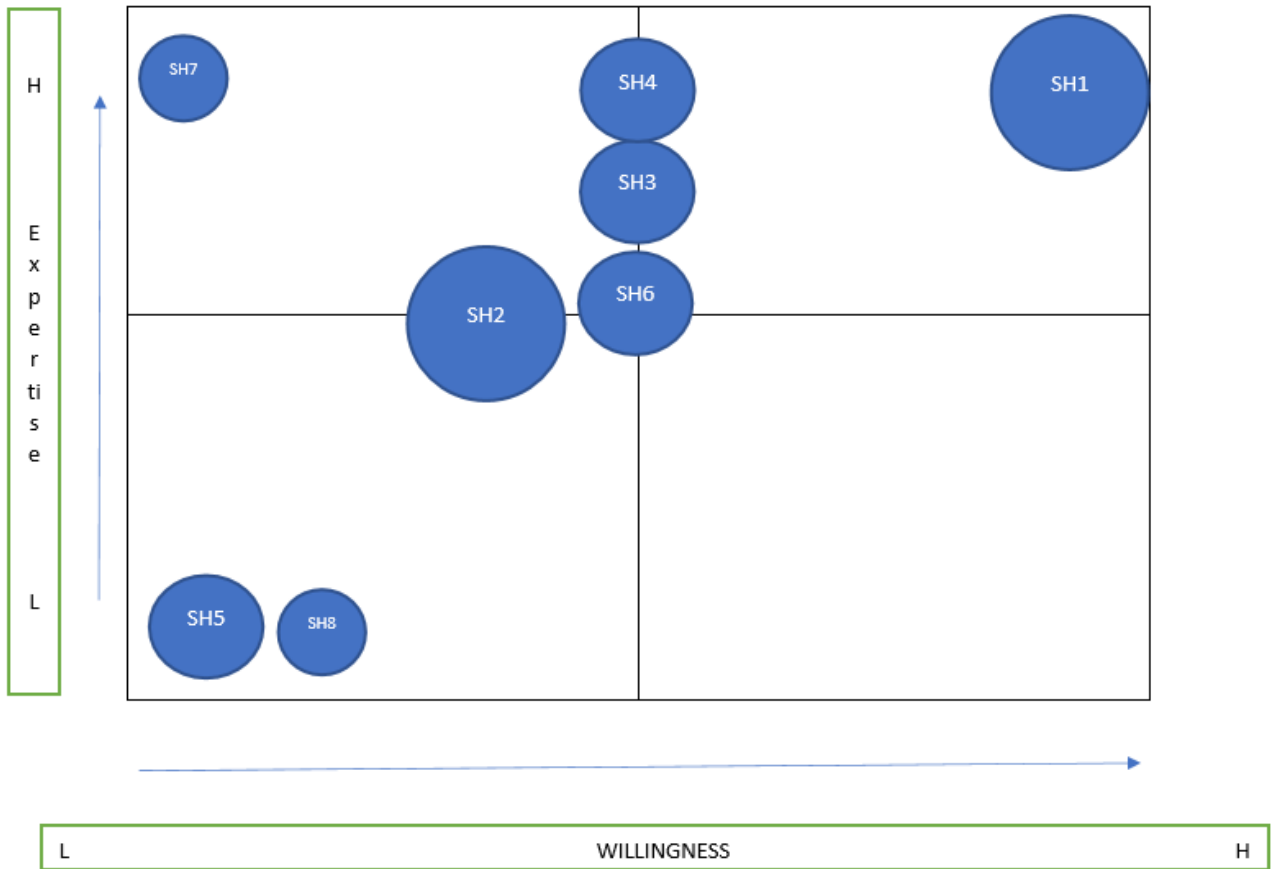
## Stakeholders

Stakeholder	Description	Interest
Sukh Jatana and Kimberly Silk <b>(SH1)</b>	Project Sponsor (Manager of DT Infrastructure) (Senior Planner, Hamilton Public Library)	As Sponsor of the project, his interest is to improve WIFI connectivity, coverage, signal strength, and WIFI capacity in the HPL to provide a better customer experience.
City of Hamilton <b>(SH2)</b>	Responsible for the general operation of the HPL, meeting user expectations and providing a service to the community.	Improve the existing HPL WIFI infrastructure towards more advanced WIFI technology to improve the user experience.
Elizabeth Blackall and Kat Drennan-Scace <b>(SH3)</b>	Branch Managers (Ancaster, Lyndon, and Red Hill).	Improve the user experience when they start a WIFI session, improve short connections in terms of signal, speed and quality of WIFI and improve the user's connection to WIFI, easily and immediately.
Kristin Parkinson <b>(SH4)</b>	Strategic Planning Coordinator	Eliminating barriers to internet access is special for frequent users, having a different WIFI connection for employees in order not to impact the connection capacity for customers, improving internet coverage in the

		external area and thus more people would benefit from the WIFI.
HPL Board <b>(SH5)</b>	The Library Board determines library services to the community-based on public input, market research and monitoring satisfaction with services.	Improve the experience of customers, supervise the projects that are carried out and that are involved in the transformation of HPL in order to benefit the community.
Chris Walsh <b>(SH6)</b>	Community Librarian at Terry Berry Branch HPL	Provide all users with ease to access library resources, improve the user experience in terms of WIFI connectivity when the library is at its maximum capacity, especially during different events.
Denis Hager and Simon Galton <b>(SH7)</b>	Subject Matter Expert (Faculty and Technical Coordinator in Networking Program, Mohawk College) (Professor, Faculty of Computer and IT Networking, Mohawk College)	As an expert, her experience is useful to understand gather information to understand of Hamilton Public Library (HPL) WIFI usage, current issues to improve user experience and improve WIFI Coverage.  the functionality, networks, and components of WIFI in a public WIFI setup.
Customer/Users <b>(SH8)</b>	End Users (Members and users of the HPL services and those who constantly use WIFI connection).	Obtain a better user experience, WIFI connectivity, coverage, dead spots, low signal and WIFI access in all spaces of HPL.

### Stakeholder Mapping

Communicate	Engage
Inform	Communicate





Stakeholders Matrix

<b>Stakeholders Matrix</b>					
	<b>Expertise</b>		<b>Willingness</b>	<b>Value</b>	
<b>Stakeholder Group</b>	<b>Contribution</b>	<b>Legitimacy</b>	<b>Willingness to Engage</b>	<b>Influence</b>	<b>Necessity of Involvement</b>
Sukh Jatana and Kimberly Silk <b>(SH1)</b>	High	High	High	High	High
City of Hamilton <b>(SH2)</b>	Medium	High	Low	High	Medium
Elizabeth Blackall, Kat Drennan-Scace <b>(SH3)</b>	High	High	Medium	Medium	Medium
Kristin Parkinson <b>(SH4)</b>	High	High	Medium	Medium	Medium
HPL Board <b>(SH5)</b>	Low	Medium	Low	Medium	Low
Chris Walsh <b>(SH6)</b>	High	Medium	Medium	Medium	Medium

Denis Hager and Simon Galton  <b>(SH7)</b>	High	Low	Low	Low	Low
Customer/Users <b>(SH8)</b>	Low	High	Low	Low	Medium

**Tactic Quadrant**

<b>Engagement Level</b>	<b>Tactic</b>
<b>Engage</b>  Project Sponsor <b>(SH1)</b>	Interviews, Email
<b>Communicate</b>  City of Hamilton <b>(SH2)</b>  Branch Managers <b>(SH3)</b>  Strategic Planning Cordinatorn <b>(SH4)</b>	Email, Interviews

Librarian <b>(SH6)</b>	
Subject Matter Expert <b>(SH7)</b>	
<b>Inform</b>	Survey in HPL website
End Users <b>(SH8)</b>	
HPL Board <b>(SH5)</b>	

## Scope

The Scope of the following project is to:

1. To find out the root cause and analyze the Wi-Fi service for the Hamilton Public Library for all the 22 branches across the city.
2. To Research about the guest experience related to the HPL public Wi-Fi service.
3. On Analysis of the HPL Infrastructure, it was brought into light and discovered that 21 of all the 22 branches of the HPL had less than 6 access points with considerably a low bandwidth of 100mbps.
4. Analyze the issue with the current available data and create a feasible solution with the possible interpretation.
5. Analyze data with respect to dead spots, time out, slow strength and authentication issues.
6. Recommend the Hamilton Public Library about how to improve their Wi-Fi network during this pandemic as the people are accessing it around the Library infrastructure.

7. Interview the available stakeholders in order to derive the information required to understand the background of the situation.
8. To collect valuable information through the HPL user demographic report. (population growth patterns, branch performance metrics, and population growth patterns)
9. Combine the brainstorming data collect by the team and analyze the minutes of the meeting.
10. To combine the Wi-Fi usage data before and after the pandemic for all the 22 branches. (Total length of connection and duration by the guests).

The following are the things that are out of scope for the project:

1. We cannot recommend an external Wi-Fi network provider as it is not under control of the team.
2. The team cannot recommend high quality Wi-Fi equipment and technological solutions.
3. To personally experience the Wi-Fi strength of the current network at the HPL infrastructure.
4. The team does not have enough time to collect more relevant data that could be useful to provide informational data.
5. During the pandemic it is impossible to visit each and every branch in person to analyze the physical layout, identify dead spots, or check the signal strength of Wi-Fi network.
6. Gathering requirements for enabling Wi-Fi connection outside HPL branches (for example, bus stops).

## Project Constraints

The project constraints are the factors that limit the success and quality of a project. Mainly the project constraints that affected were the risks, time and the cost to implement the change. There were a number of constraints faced by the team to analyze the HPL Wi-Fi project:

- 1) We interviewed a number of stakeholders but it wasn't enough for data interpretation and analysis. The First important constraint was that we could not interview the customers or the guest as they could provide their valuable feedback on the user experience.
- 2) The team had limited access to the stakeholders.
- 3) The pandemic also played as a big constraint throughout the project as the meeting were arranged through online platform which restricts the level of interaction with the team as well as with the stakeholders.
- 4) There was lack of background information provided by the Hamilton Public Library. The information from the stakeholders wasn't enough.
- 5) The team wasn't allowed to interview the IT technicians.
- 6) There was no customer satisfaction matrix or data provided by the Hamilton Public Library.
- 7) No physical accessibility available to the HPL.
- 8) One of the most important constraint was time as there wasn't enough time to collect and analyze the data for all the 22 branches.
- 9) Each HPL branch uses different access policy and Wi-Fi equipment.
- 10) The Wi-Fi also used by the nearby areas which slows down the user experience.

## Risk Analysis

Risk Analysis is the way towards surveying the probability of an unfavorable occasion happening inside a corporate, government, or ecological sector. It allows us to investigate the basic vulnerability of a given strategy and helps us formulate strategies in advance to face any such identified risks.

Enhancing Wi-Fi at Hamilton Public Libraries is a project with large scope and scalability. There are various risks attached with this project which should be identified for a better implementation of solutions arising out of the project.

We attempted to identify various risks relating to the project and we believe that it is important for the project stakeholders to weigh these risks against potential benefits. Risks relating to the project are classified below for better comprehension.

### Financial Risks

- The project will require considerable financial resources as to upgrade the current Wi-Fi infrastructure, and install any additional hardware. This directly demands a budget increment which may or may not be approved.
- Budget allocation and budgetary constraints for each branch may vary. Recommendations adopted by each branch may vary according to the size and traffic of the branch. This may complicate budget allocation from the board.
- Standardizing the Wi-Fi infrastructure at all branches will require removal of current hardware, which is absolute loss of assets.
- Updating the software requirements may involve hiring a software team. Working across all branches may be costly.

### Technological Risks

- Current Wi-Fi infrastructure cannot be completely scrapped as per the project agreement. This poses a risk where in the Wi-Fi infrastructure will remain slow and troublesome despite of solutions or recommendations adapted.
- Installation of Wi-Fi extenders, repeaters, or boosters may not guarantee compatibility across all HPL branches since each branch has different hardware capabilities.
- Implementing changes to enhance the Wi-Fi may demand new companies working on the Wi-Fi network, and this should not anyway harm the customer's data and privacy. Data privacy concerns may rise in an event of change of ISP or major changes made to the Wi-Fi infrastructure in general.
- Internet Service Provider cannot be changed instantly as there would be existing contract or agreement between HPL and the ISP.
- Installation of new routers, changes in the login component etc. May require a complete update of the system and complex debugging may be required to solve all the issues that persist.

## Political Risks

- Provided that each branch is managed separately, different budget allocation may cause conflict between branch management or give rise to organizational politics.
- Increased allocation of budget and massive changes at all HPL branches may invite attention from other city libraries and the course of action maybe subject to scrutiny.
- No major political risks were identified with regards to this project, provided that this project will help the users of HPL have a seamless Wi-Fi experience.

## Business Risks

A risk is a circumstance that can either have enormous advantages or cause genuine harm to a company. In the case of HPL, this is one aspect to look into. The resources demanded by this project maybe huge and after all the work being put, if expected results are not being produced, it will be a huge blow for HPL in the public front.

The following are some business risks we identified:

- Changes made to the authentication or login component may increase data usage at HPL and over exploitation of HPL's resources may occur.
- Implementation of changes may not be favored by the library members, which will result in decreased user traffic over time.
- Hardware upgrades in few branches alone may create a negative impression in the minds of user regarding a particular branch and it may cause harm to the reputation of that branch.

## Requirements Risks

Requirement risks are chances that are related straightforwardly to explicit necessities. The incorporation or expansion of risk can have various effects on a project's risk profile.

The following risks were identified as requirement risks:

- Increasing the bandwidth from current limit of 100mbps must be done in a way that it does not affect the current functionality of the Wi-Fi network.
- Adding more access points to the Wi-Fi network at branches where there are high number of customer visits may result in channel interruptions if not implemented correctly.

- Physically wiring the access points to dead spots in libraries may require changes to be made to the physical concrete structure (for example, heavy drilling) and this may not be possible in few branches or may not be accepted by the branch management.

### Skills Risks

- Communication between the project sponsor, project stakeholders, HPL management and each branch management must be facilitated well to avoid any perception differences.
- If changes are to be made in the current Wi-Fi infrastructure of HPL branches according to the solutions and recommendations arising out this project, it must be implemented across it must be implemented across all branches by the same team. Different companies or teams working on the accepted solution at different branches may cause errors and differences.
- The requirements gathered from this project, along with the recommendations are to be passed to a team of networking and software development students to further handle the implementation of solutions. They must be of expertise and competency so as to manage the project well.

### Other Risks

Other risks include external events and activities, such as natural disasters or disease breakouts leading to employee health issues. Also, not being adaptable, technically aware and detail oriented can be included in other risks in strategy planning risk analysis.

Few other risks for the HPL Wi-Fi project can include:

- A second-wave of COVID-19 in the city of Hamilton, which may force the shutdown of all HPL branches. In this case, the project will be at halt and no improvements to the Wi-Fi can be made.
- A need analysis carried out by the HPL board before accepting recommendations to enhance the Wi-Fi at HPL may suggest that there is no necessity of major changes in many branches. This will again limit the functionality, and may cause dispute amongst the project stakeholders.
- Huge focus on the project and huge budgets may attract criticism from the tax payers and the benefits of the project may be questioned.



## Current State

In an effort to gather requirements for the project, we did an extensive environmental scan and document analysis on HPL, its background, organizational structure, functionality, previous, on-going and future projects, and most importantly about its current Wi-Fi infrastructure. This research helped us identify the current state with utmost clarity, which in fact helped us identify the existing problems in the Wi-Fi network at HPL and group them based on their similarity.

From our observations of the current Wi-Fi infrastructure, analysis of qualitative interview data of subject matter experts and project stakeholders, we formulated various user problems regarding the HPL Wi-Fi. It included issues relating to Wi-Fi access, connection timeouts, slow signal strength and dead spots in the libraries. After analyzing the nature of these problems, we grouped them and attempted to visualize the problem through Use Case Scenarios, and Use Case Activity Diagrams.

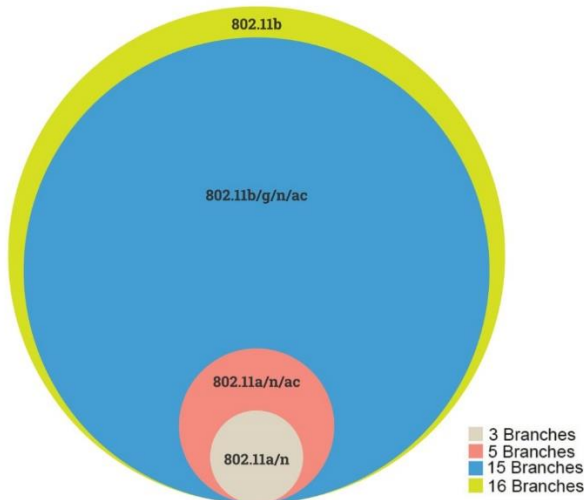
Additionally, there are two areas to be highlighted in the current state. From our analysis of the current Wi-Fi network bandwidth and throughput, we found that only Central Branch has a bandwidth of above 100mbps. All other 21 branches, despite of varying size and user traffic, is limited to a bandwidth of 100mbps. The below chart indicates this:

Summary of Computer & Wireless Hardware

Location	Local	# Public Computers	# of Staff Computers	Wireless Access Points
	Bandwidth	(Includes PACs, Kids ELS & iPads)	(Includes Tablets & laptops)	
Ancaster	100 Mbps	17	10	3
Barton	100 Mbps	25	8	2
Binbrook	100 Mbps	9	4	6
Carlisle	100 Mbps	4	2	1
Concession	100 Mbps	20	8	1
Concession	100 Mbps	20	8	1
Central	1 Gbps	119	151	24
Dundas	100 Mbps	19	11	5
Freelton	100 Mbps	4	2	1
Greensville	100 Mbps	4	2	1
Kenilworth	100 Mbps	21	6	2
Locke	100 Mbps	6	4	1
Lynden	100 Mbps	8	3	2
Mount Hope	100 Mbps	3	1	1
Red Hill	100 Mbps	43	10	2
	100 Mbps			
Saltfleet	100 Mbps	21	10	2
Sherwood	100 Mbps	26	11	2
Stoney Creek	100 Mbps	8	5	1
Terryberry	100 Mbps	45	17	2
Turner Park	100 Mbps	41	12	3
Valley Park	100 Mbps	14	4	1
Waterdown	100 Mbps	35	10	5
Westdale	100 Mbps	18	9	3
Admin	100 Mbps	Incl in CE	Incl in CE	7
<b>Total</b>		<b>510</b>	<b>300</b>	<b>65</b>

Source: HPL Facilities Master Plan (2019)

We were able to identify the Wi-Fi radio standards utilized in each of the branches from the usage data provided by HPL. The analysis identified that only 8 out of 22 branches are utilizing the high frequency radio standards which will enable a faster Wi-Fi connection. Below is an overlapping bubble chart representing the radio type used by each of the HPL branches:



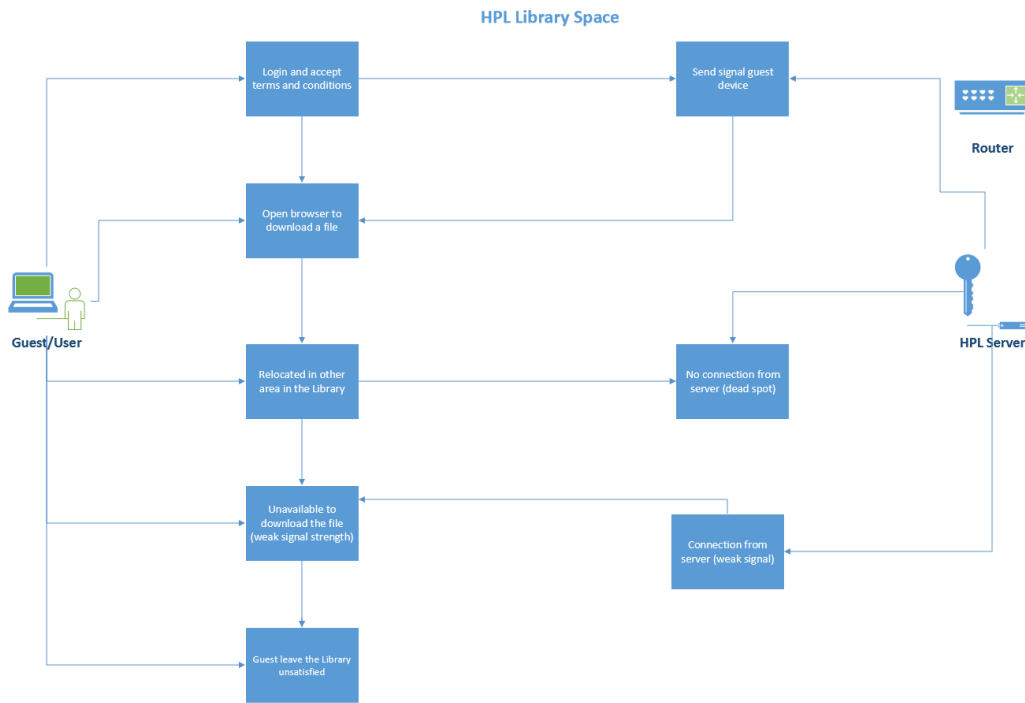
These findings about the current state equipped us with a clarity to develop solutions and recommendations for the future state of Wi-Fi at HPL.

### Problem 1

#### Use Case Brief

<b>Use case Name:</b>	Dead Spot/ Slow signal strength
<b>Scenario:</b>	Not WIFI availability in some part of the Library space
<b>Triggering Event:</b>	Customers go to the Library and log in to the WIFI, they need to change their location within the library but lost the WIFI connection as soon as he stepped into the new location. It was a dead spot.

	Customers go the Library and log in to the WIFI by accepting terms and conditions. They try to download a file over the WIFI but could not because the signal is slow.	
<b>Brief Description:</b>	The HPL library has dead zones within the Library space and weak connection signal bring disruption for the users.	
<b>Actors:</b>	Library Guest, HPL WIFI Network, and the space.	
<b>Related use cases:</b>	Connection time out	
<b>Pre-condition</b>	Must be an HPL user within the Library space. Must accept terms and conditions to login to HPL WIFI connection.	
<b>Post Conditions:</b>	No access to WIFI and inability to connect WIFI	
<b>Flow of Activities:</b>	<p>Library Guest</p> <ol style="list-style-type: none"> <li>1. The guest goes to the Library and login to accept terms and conditions.</li> <li>2. The guest opens his browser to download a file.</li> <li>3. The guest relocated to another area in the library.</li> <li>4. The guest could still not download, because the signal strength was weak.</li> <li>5. The guest feels unsatisfied with his experience in the Library.</li> </ol>	<p>HPL WIFI Network</p> <ol style="list-style-type: none"> <li>1. Send signal to the guest device.</li> <li>2. Area has dead spot, customer could not download a file.</li> <li>3. There was connection is this part of the Library, the signal was weak.</li> </ol>
<b>Exception Conditions:</b>	The guest goes into the library, goes to the middle floor, log in by accepting terms and condition and he was able to download a file because this part of the library has a good WIFI connection.	



Use Case Activity Diagram for Dead Spot/Weak Signal

BlueworksLIVE

### Use Case Activity Diagram for Dead Spot/Weak Signal

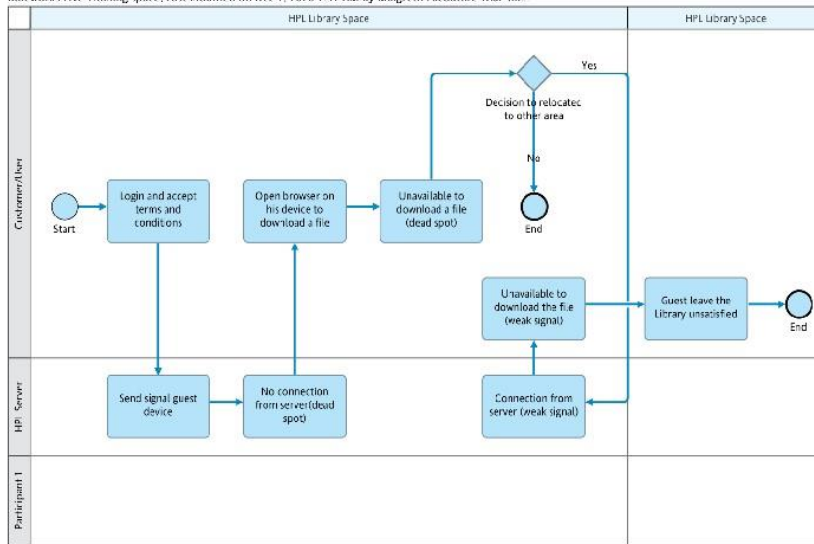
Blueworks Live Training space

<https://us006.blueworkslive.com/scr/processes/203715c4777>

Created on Dec 7, 2020 7:11 AM by Maigreth Lacouture-Diaz (maigreth.lacouture-diaz@mohawkcollege.ca)

Last modified on Dec 7, 2020 7:47 AM by Maigreth Lacouture-Diaz (maigreth.lacouture-di...)

Use Case Activity Diagram for Dead Spot/Weak Signal (ID: 203715c4777) <https://us006.blueworkslive.com/scr/processes/203715c4777>  
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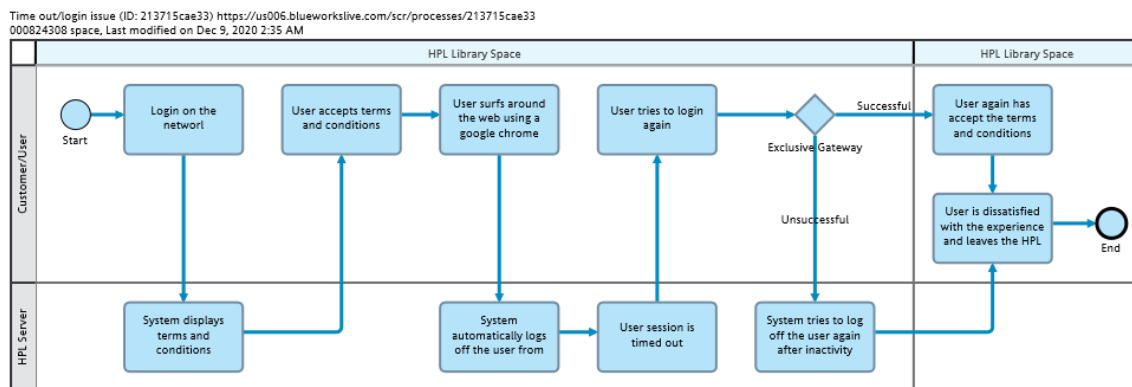


## Problem 2

## Use Case Brief

<b>Use case Name:</b>	Time out, Login issue and T&C agreement	
<b>Scenario:</b>	The guest/ customers are facing issues when trying to login in or connecting to a Wi-Fi network.	
<b>Triggering Event:</b>	The customer tries to login in and connect to the Hamilton Public Library Wi-Fi network. The customer accepts the terms and conditions and tries to surf around but is timed out after a specific period of time.	
<b>Brief Description:</b>	The customer are facing issues staying connected to the network as they automatically get timed out and cannot stay connected to the network for a longer period of time.	
<b>Actors:</b>	Library Guest/Customer, HPL WIFI Network, Automated servers.	
<b>Related use cases:</b>	Connection time out	
<b>Pre-condition</b>	<p>1) The user or the guest should be a member of HPL.</p> <p>2) The user should accept the terms and conditions before trying to connect to the network.</p> <p>3) To use the network the user should be around the HPL infrastructure .</p>	
<b>Post Conditions:</b>	The user gets timed off from the network after a while and has to login again to try and use the service.	
<b>Flow of Activities:</b>	<p>Library Guest</p> <ol style="list-style-type: none"> <li>1. The customer/guest visits the website and logs in on the network.</li> <li>2. The User accepts the terms and condition.</li> </ol>	<p>HPL WIFI Network</p> <ol style="list-style-type: none"> <li>1. The system verifies the credentials and displays terms and condition.</li> <li>3. The system automatically logs off the user from the network</li> </ol>

	<ol style="list-style-type: none"> <li>3. The user surfs around the web using a google chrome browser.</li> <li>4. The user tries to log in again on to the system.</li> <li>5. The user is dissatisfied with the experience and leaves the HPL premises.</li> </ol>	<p>system and his session is timed out.</p> <ol style="list-style-type: none"> <li>4. The system tries to log off the user again after inactivity.</li> </ol>
<p><b>Exception Conditions:</b></p>	<p>The guest successfully connects to the HPL Wi-Fi network by accepting their term and condition. The guest does not get timed out after a period of time. The guest is able to use the service as long as they want.</p>	



## Recommendations

After gathering requirements for the project through extensive environmental scan and document analysis, we went on to analyze the current Wi-Fi infrastructure across all 22 branches and also carried out data analysis on the Wi-Fi usage in these branches. The data analysis enabled us to gain a better understanding of Wi-Fi bandwidth, throughput and average session timing in all HPL branches. This helped us re-define the problem experienced at HPL regarding Wi-Fi and make some recommendations for each of the problems so identified.

After analyzing the current state and Wi-Fi infrastructure at HPL, certain findings were made regarding the Wi-Fi hardware, bandwidth and usage patterns. Further data analysis enabled a deeper understanding of issues that is persistent within different branches, and findings about the average session timings, average throughput and Wi-Fi capabilities at all branches were helpful in formulating the following recommendations:

1. The login component or authentication of a user's device can be extended for 8-24 hours on a single login to avoid the T&C Agreement screen every time.
2. Branches with high traffic and Wi-Fi usage may switch to updated Wi-Fi radio standards such as 802.11 a/c, enabling the full capability of Wi-Fi.
3. Increase the bandwidth from current limit of 100mbps.
4. More access points to the Wi-Fi network maybe added at branches were there are high number of customer visits.
5. Wi-Fi boosters, repeaters and extenders would help to widen the range of the Wi-Fi signal and improving the service throughout the facility and not just in the region near the router.
6. Router upgrade and repositioning maybe required in some branches after a thorough evaluation of dead spots across the area of each branch.
7. Physically wire the access points to dead spots in libraries to enable connectivity.
8. Control the Bandwidth: Some applications make download and upload speed slow down for people on the same Wi-Fi network, modern routers support QoS (quality of service) which can be used to prioritize certain application over the others and there will no longer be interruption on the Wi-Fi network.
9. Library Members should be allowed access to the Wi-Fi network directly, bypassing the T&C Agreement screen. This can be enabled by using an Authorization Software.

Below is a table indicating the user problems and solutions/recommendations to overcome the problem:

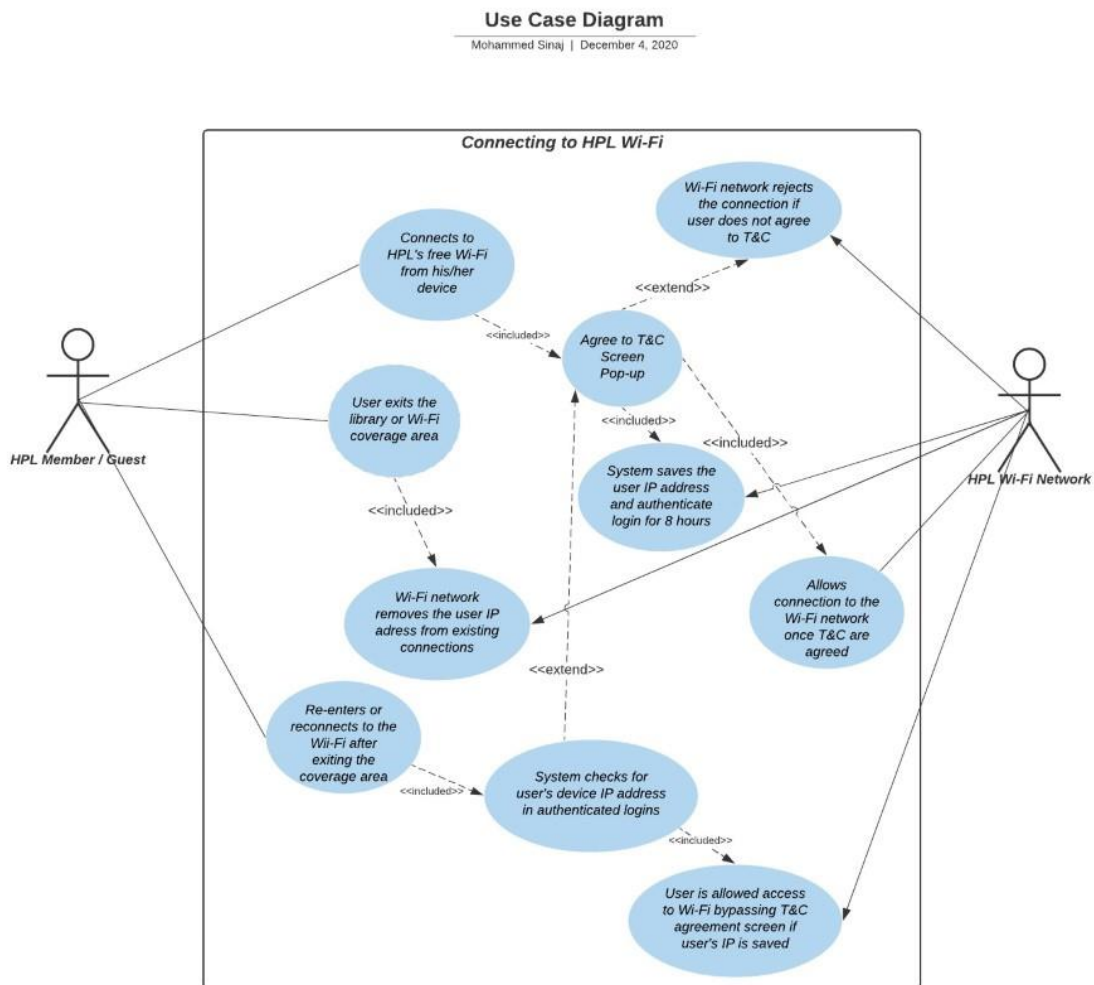
User Problem regarding Wi-Fi	Solution/Recommendation
User is asked to agree to T&C every time he/she reconnects to the HPL Wi-Fi.	The login component be modified to automatically save and authenticate a user's device IP address for 8 hours of access to HPL's Wi-Fi.
Dead spots in library where users cannot access Wi-Fi network.	Physically wire an access point to such areas after conducting a site survey and identifying those dead spots.
Connection time outs and slow signal strength.	Increase the bandwidth of the Wi-Fi channels from current limit of 100mbps.
Connection is lost when user moves out of a particular location in the library.	Analyze the user traffic and Wi-Fi usage in each branch and add more Wi-Fi access points in locations of high user demand for Wi-Fi.

The current hardware infrastructure analysis helped us identify some of the minor hardware upgrades or additions that could help HPL enable a seamless Wi-Fi experience for the guests. They are the use of the following hardware:



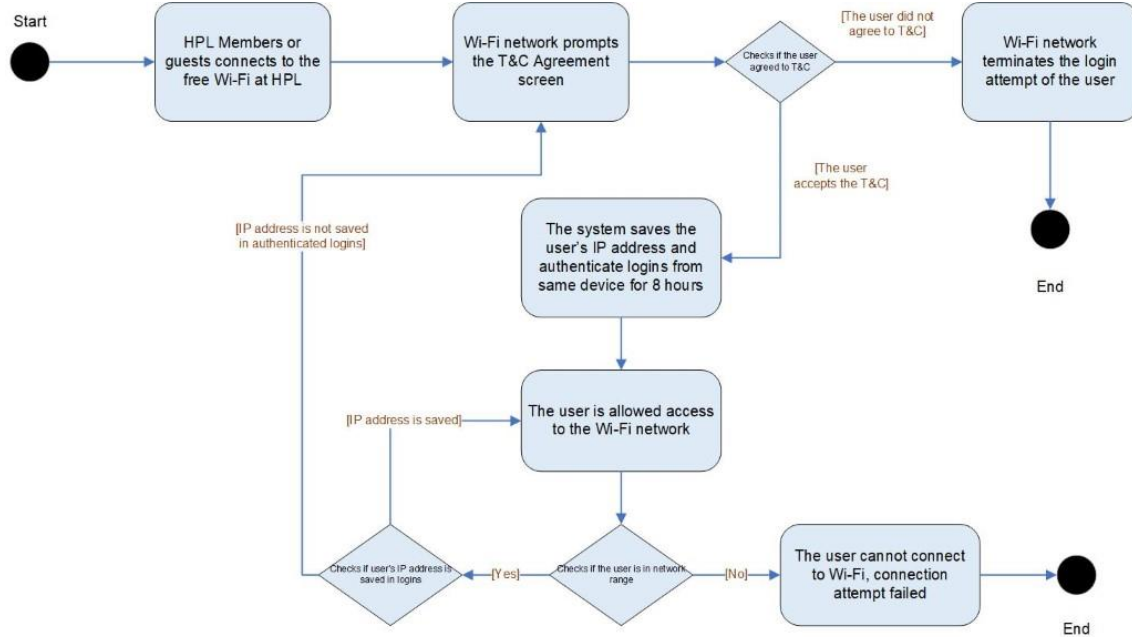


The changes to be made in the login component or the T&C Agreement screen was visualized in a Use Case Diagram and Use Case Activity Diagram as below:



Making the changes recommended in the above Use Case Diagram will bypass the T&C Agreement screen for guests after their first sign-in to the network. The system is asked to save the user's device IP address and authenticate access to Wi-Fi for 8 hours in a single sign-on to the network.

Below is the Use Case Activity Diagram showing the flow of activities for this process implementation:



We researched on techniques to increase the bandwidth of a Wi-Fi network (without actually upgrading to a better hardware), and came up with the following recommendations, depicted in the below diagram:

### Techniques to Increase Bandwidth of Wi-Fi



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