Computer Networking

Project Tuesday 9:15 NP Group 1

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Local area network project

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1 Introduction

1.1 Company Profile

1.1.1 General Information

The City Hall is a public institution whose main objective is to manage local community affairs, provide public services, and ensure residents have access to information and assistance in administrative matters. The institution employs 687 staff members who offer services in the areas of real estate, transportation, taxation, and vehicle registration, supporting residents in handling key matters.

1.1.2 Location and Buildings

The City Hall is located in Wrocław. The institution consists of two buildings. The first building has two floors, while the second building has three floors. The buildings are 100 meters apart. Communication between them is facilitated through a single-mode optical link.

2 Project Objective

The objective of this project is to design a local area network (LAN) for the City Hall in accordance with specified requirements. The design must be scalable and highly available. The project aims to improve the efficiency of IT systems while considering the diverse needs of different workgroups and ensuring adequate network bandwidth for both wired and wireless users. Additionally, the project includes providing connectivity between the two City Hall buildings.

3 Resource Inventory

3.1 Devices Used by the City Hall

The institution is equipped with three types of devices: printers, WiFi access points, and wireless devices. These devices will be used within the City Hall's local area network.

Number of Users (Computers)

Workgroup	B1 P1	B1 P2	B2 P1	B2 P2	B2 P3
Real Estate	30	44	36	15	25
Taxation	57	4	47	58	47
Vehicles	11	15	11	58	47
Transport	50	57	57	12	6

Table 1: Number of users (computers) in buildings

Number of Printers

B1 P1	B1 P2	B2 P1	B2 P2	B2 P3
1	1	1	1	3

Table 2: Number of printers in buildings

Number of WiFi Access Points

B1 P1	B1 P2	B2 P1	B2 P2	B2 P3
2	0	0	0	1

Table 3: Number of WiFi access points in buildings

Number of Wireless Devices

B1 P1	B1 P2	B2 P1	B2 P2	B2 P3
12	0	0	0	11

Table 4: Number of wireless devices in buildings

In total, the City Hall uses 687 computers, 7 printers, 3 access points, and 23 wireless devices.

3.2   Servers

The institution operates two key internet servers: a Web Server and an FTP Server. Their characteristics are as follows:

Servers	To the Internet	From the Internet	Simultaneous Sessions
Web Server	90	50	33
FTP Server	180	90	5

Table 5: Characteristics of the servers in use

3.3   Bandwidth

Workgroup / Server	Server 1	Server 2	Printer
Real Estate	450/300	700/550	10/170
Taxation	150/800	650/650	10/110
Vehicles	200/450	750/1000	10/180
Transport	500/800	600/950	10/200
WiFi	200/200	0/0	10/120

Table 6: Transfer rates to local servers and printers (down/up) [kb/s]

Workgroup / Application	Browser	Video Conference	VoIP
Real Estate	34/10	40/40	0/0
Taxation	0/0	0/0	20/20
Vehicles	59/10	40/40	20/20
Transport	0/0	40/40	20/20
WiFi	34/10	0/0	20/20

Table 7: Internet transfer rates (down/up) - Part 1

Workgroup / Application	FTP Client	Messenger	Cloud Services
Real Estate	61/12	15/15	60/28
Taxation	0/0	0/0	0/0
Vehicles	0/0	15/15	0/0
Transport	97/16	15/15	24/24
WiFi	72/18	0/0	0/0

Table 8: Internet transfer rates (down/up) - Part 2

4 Analysis of User Needs – Client Requirements

User needs analysis is essential to tailor the network's characteristics to the company's requirements. Based on the flow requirement tables (Tables 6, 7, and 8), the local and Internet flow will be estimated for representatives of each workgroup. Then, based on the number of employees on each floor (Table 1), the estimated required bandwidth will be determined. The company's cabling bandwidth can be calculated based on the most heavily loaded floor and distribution points.

4.1 Backbone Connections

Based on the data from Tables 6, 7, and 8, the download and upload requirements for both the local and Internet connections should be summed.

Employee Department: Real Estate

Description	Result
Data downloaded for local connection:	$450 + 700 + 10 = 1160$ [kb/s]
Data uploaded for local connection:	$300 + 550 + 170 = 1020$ [kb/s]
Data downloaded for Internet connection:	$34 + 40 + 0 + 61 + 15 + 60 = 210$ [kb/s]
Data uploaded for Internet connection:	$10 + 40 + 0 + 12 + 15 + 28 = 186$ [kb/s]
Total downloaded data:	$1160 + 210 = 1360$ [kb/s]
Total uploaded data:	$1020 + 186 = 1206$ [kb/s]

Employee Department: Taxes

Description	Result
Data downloaded for local connection:	$150 + 650 + 10 = 710$ [kb/s]
Data uploaded for local connection:	$800 + 650 + 110 = 1560$ [kb/s]
Data downloaded for Internet connection:	$0 + 0 + 20 + 0 + 0 + 0 = 20$ [kb/s]
Data uploaded for Internet connection:	$0 + 0 + 20 + 0 + 0 + 0 = 20$ [kb/s]
Total downloaded data:	$710 + 20 = 730$ [kb/s]
Total uploaded data:	$1560 + 20 = 1580$ [kb/s]

Employee Department: Vehicles

Description	Result
Data downloaded for local connection:	$200 + 750 + 10 = 760$ [kb/s]
Data uploaded for local connection:	$450 + 1000 + 180 = 1630$ [kb/s]
Data downloaded for Internet connection:	$59 + 40 + 20 + 0 + 15 + 0 = 134$ [kb/s]
Data uploaded for Internet connection:	$10 + 40 + 20 + 0 + 15 + 0 = 85$ [kb/s]
Total downloaded data:	$760 + 134 = 894$ [kb/s]
Total uploaded data:	$1630 + 85 = 1715$ [kb/s]

Employee Department: Transport

Description	Result
Data downloaded for local connection:	$500 + 600 + 10 = 1110$ [kb/s]
Data uploaded for local connection:	$800 + 950 + 200 = 1950$ [kb/s]
Data downloaded for Internet connection:	$0 + 40 + 20 + 97 + 15 + 24 = 196$ [kb/s]
Data uploaded for Internet connection:	$0 + 40 + 20 + 16 + 15 + 24 = 115$ [kb/s]
Total downloaded data:	$1110 + 196 = 1306$ [kb/s]
Total uploaded data:	$1650 + 115 = 1765$ [kb/s]

WiFi

Description	Result
Data downloaded for local connection:	$200 + 0 + 10 = 210$ [kb/s]
Data uploaded for local connection:	$200 + 0 + 120 = 320$ [kb/s]
Data downloaded for Internet connection:	$34 + 0 + 20 + 72 + 0 + 0 = 126$ [kb/s]
Data uploaded for Internet connection:	$10 + 0 + 20 + 18 + 0 + 0 = 48$ [kb/s]
Total downloaded data:	$210 + 126 = 336$ [kb/s]
Total uploaded data:	$320 + 48 = 368$ [kb/s]

Workgroup	Local Connection [kb/s]	Internet Connection [kb/s]	Total [kb/s]
Real Estate	Download: 1160 Upload: 1020	Download: 210 Upload: 186	Download: 1370 Upload: 1206
Taxes	Download: 710 Upload: 1560	Download: 20 Upload: 20	Download: 730 Upload: 1580
Vehicles	Download: 760 Upload: 1630	Download: 134 Upload: 85	Download: 894 Upload: 1715
Transport	Download: 1110 Upload: 1950	Download: 196 Upload: 115	Download: 1306 Upload: 1765
Wifi	Download: 210 Upload: 320	Download: 126 Upload: 48	Download: 336 Upload: 368

Table 9: Required bandwidth per employee in each workgroup

Table 9 summarizes the bandwidth requirements for one employee of each workgroup. For further analysis, we need to estimate the bandwidth for the individual floors of the two buildings. The data from Tables 1 and 9 will be used for the calculations.

Building 1, Floor 1

Department	Download [kb/s]	Upload [kb/s]
Real Estate	$1370 * 30 = 41100$	$1206 * 30 = 36180$
Taxes	$730 * 57 = 41610$	$1580 * 57 = 90060$
Vehicles	$894 * 11 = 9834$	$1715 * 11 = 18865$
Transport	$1306 * 50 = 65300$	$1765 * 50 = 88250$
Wifi	$336 * 12 = 4032$	$358 * 12 = 4296$

Building 1, Floor 2

Department	Download [kb/s]	Upload [kb/s]
Real Estate	$1370 * 44 = 60280$	$1206 * 44 = 53064$
Taxes	$730 * 4 = 2920$	$1580 * 4 = 6320$
Vehicles	$894 * 15 = 13410$	$1715 * 15 = 25725$
Transport	$1306 * 57 = 74442$	$1765 * 57 = 100605$
Wifi	$336 * 0 = 0$	$358 * 0 = 0$

Building 2, Floor 1

Department	Download [kb/s]	Upload [kb/s]
Real Estate	$1370 * 36 = 49320$	$1206 * 36 = 43416$
Taxes	$730 * 47 = 34310$	$1580 * 47 = 74260$
Vehicles	$894 * 11 = 9834$	$1715 * 11 = 18865$
Transport	$1306 * 57 = 74442$	$1765 * 57 = 100605$
Wifi	$336 * 0 = 0$	$358 * 0 = 0$

Building 2, Floor 2

Department	Download [kb/s]	Upload [kb/s]
Real Estate	$1370 * 15 = 20550$	$1206 * 15 = 18090$
Taxes	$730 * 58 = 42640$	$1580 * 58 = 91640$
Vehicles	$894 * 58 = 51852$	$1715 * 58 = 99470$
Transport	$1306 * 12 = 15672$	$1765 * 12 = 21180$
Wifi	$336 * 0 = 0$	$358 * 0 = 0$

Building 2, Floor 3

Department	Download [kb/s]	Upload [kb/s]
Real Estate	$1370 * 25 = 34250$	$1206 * 25 = 30150$
Taxes	$730 * 47 = 34310$	$1580 * 47 = 74260$
Vehicles	$894 * 47 = 42018$	$1715 * 47 = 80605$
Transport	$1306 * 6 = 7836$	$1765 * 6 = 10590$
Wifi	$336 * 11 = 3696$	$358 * 11 = 3938$

Workgroup	Transfer	B1 P1	B1 P2	B2 P1	B2 P2	B2 P3
Real Estate	Download [kb/s]	41100	60280	49320	20550	34250
	Upload [kb/s]	36180	53064	43416	18090	30150
Taxes	Download [kb/s]	41610	2920	34310	42640	34310
	Upload [kb/s]	90060	6320	74260	91640	74260
Vehicles	Download [kb/s]	9834	13410	9834	51852	42018
	Upload [kb/s]	18865	25725	18865	99470	80605
Transport	Download [kb/s]	65300	74442	74442	15672	7836
	Upload [kb/s]	88250	100605	100605	21180	10590
Wifi	Download [kb/s]	4032	0	0	0	3696
	Upload [kb/s]	4296	0	0	0	3938
FTP and WWW Server	Download [kb/s]	2100	2100	2100	2100	2100
	Upload [kb/s]	3870	3870	3870	3870	3870
Total	**Download [kb/s]**	**163976**	**153152**	**170006**	**132814**	**124210**
	Upload [kb/s]	**241521**	**189611**	**241016**	**234250**	**203413**

Table 10: Required bandwidth for each workgroup in different buildings and floors

The calculations for the FTP and WWW servers have been added to Table 10. The maximum number of users for the WWW server is 33, and for the FTP server, it is 5.

$$\text{Download} = 33 * 50 + 5 * 90 = 2100 \text{ kb/s}$$

$$\text{Upload} = 33 * 90 + 5 * 180 = 3870 \text{ kb/s}$$

(The server characteristics are provided in Table 5)

4.2   Connection to local servers and printers

Department: Real Estate

Description	Result
Group size:	$30 + 44 + 36 + 15 + 25 = 150$ [people]
Transfer to server 1 (download):	$450 * 150 = 67500$ [kb/s]
Transfer to server 1 (upload):	$300 * 150 = 45000$ [kb/s]
Transfer to server 2 (download):	$700 * 150 = 105000$ [kb/s]
Transfer to server 2 (upload):	$550 * 150 = 82500$ [kb/s]
Transfer to printers (download):	$10 * 150 = 1500$ [kb/s]
Transfer to printers (upload):	$170 * 150 = 25500$ [kb/s]

Department: Taxes

Description	Result
Group size:	$57 + 4 + 47 + 58 + 25 = 191$ [people]
Transfer to server 1 (download):	$150 * 191 = 28650$ [kb/s]
Transfer to server 1 (upload):	$800 * 191 = 152800$ [kb/s]
Transfer to server 2 (download):	$650 * 191 = 124150$ [kb/s]
Transfer to server 2 (upload):	$650 * 191 = 124150$ [kb/s]
Transfer to printers (download):	$10 * 191 = 1910$ [kb/s]
Transfer to printers (upload):	$110 * 191 = 21010$ [kb/s]

Department: Vehicles

Description	Result
Group size:	$11 + 15 + 11 + 58 + 47 = 142$ [people]
Transfer to server 1 (download):	$200 * 142 = 28400$ [kb/s]
Transfer to server 1 (upload):	$450 * 142 = 63900$ [kb/s]
Transfer to server 2 (download):	$750 * 142 = 106500$ [kb/s]
Transfer to server 2 (upload):	$1000 * 142 = 142000$ [kb/s]
Transfer to printers (download):	$10 * 142 = 1420$ [kb/s]
Transfer to printers (upload):	$180 * 142 = 25560$ [kb/s]

Department: Transport

Description	Result
Group size:	$50 + 57 + 57 + 12 + 6 = 182$ [people]
Transfer to server 1 (download):	$500 * 182 = 91000$ [kb/s]
Transfer to server 1 (upload):	$800 * 182 = 145600$ [kb/s]
Transfer to server 2 (download):	$600 * 182 = 109200$ [kb/s]
Transfer to server 2 (upload):	$950 * 182 = 172900$ [kb/s]
Transfer to printers (download):	$10 * 182 = 1820$ [kb/s]
Transfer to printers (upload):	$200 * 182 = 36400$ [kb/s]

WiFi

Description	Result
Group size:	$12 + 11 = 23$ [people]
Transfer to server 1 (download):	$200 * 23 = 4600$ [kb/s]
Transfer to server 1 (upload):	$200 * 23 = 4600$ [kb/s]
Transfer to server 2 (download):	$0 * 23 = 0$ [kb/s]
Transfer to server 2 (upload):	$0 * 23 = 0$ [kb/s]
Transfer to printers (download):	$10 * 23 = 230$ [kb/s]
Transfer to printers (upload):	$120 * 23 = 2760$ [kb/s]

Summary of data transfer for all departments

Department	Transfer [kb/s]	Server 1	Server 2	Printers
Real Estate	Download	67500	105000	1500
	Upload	45000	82500	25500
Taxes	Download	28650	124150	1910
	Upload	152800	124150	21010
Vehicles	Download	28400	106500	1420
	Upload	63900	142000	25560
Transport	Download	91000	109200	1820
	Upload	145600	172900	36400
WiFi	Download	4600	0	230
	Upload	4600	0	2760
Total	**Download**	**220150**	**444850**	**6880**
	Upload	**411900**	**522550**	**111230**

4.3 Internet Connection

Department: Real Estate

Description	Result
Group size:	$30 + 44 + 36 + 15 + 25 = 150$ [people]
Transfer from Internet (download):	$210 * 150 = 31500$ [kb/s]
Transfer to Internet (upload):	$186 * 150 = 27900$ [kb/s]

Department: Taxes

Description	Result
Group size:	$57 + 4 + 47 + 58 + 25 = 191$ [people]
Transfer from Internet (download):	$20 * 191 = 3820$ [kb/s]
Transfer to Internet (upload):	$20 * 191 = 3820$ [kb/s]

Department: Vehicles

Description	Result
Group size:	$11 + 15 + 11 + 58 + 47 = 142$ [people]
Transfer from Internet (download):	$134 * 142 = 19028$ [kb/s]
Transfer to Internet (upload):	$85 * 142 = 12070$ [kb/s]

Department: Transport

Description	Result
Group size:	$50 + 57 + 57 + 12 + 6 = 182$ [people]
Transfer from Internet (download):	$196 * 182 = 35672$ [kb/s]
Transfer to Internet (upload):	$115 * 182 = 20930$ [kb/s]

WiFi

Description	Result
Group size:	$12 + 11 = 23$ [people]
Transfer from Internet (download):	$126 * 23 = 2898$ [kb/s]
Transfer to Internet (upload):	$48 * 23 = 1104$ [kb/s]

WWW

Description	Result
Group size:	33 [people]
Transfer from Internet (download):	$50 * 33 = 1650$ [kb/s]
Transfer to Internet (upload):	$90 * 33 = 2970$ [kb/s]

FTP

Description	Result
Group size:	5 [people]
Transfer from Internet (download):	$90 * 5 = 450$ [kb/s]
Transfer to Internet (upload):	$180 * 5 = 900$ [kb/s]

Summary of Data Transfer for All Departments

Department	Transfer [kb/s]	Result
Real Estate	Download	31500
	Upload	27900
Taxes	Download	3820
	Upload	3820
Vehicles	Download	19028
	Upload	12070
Transport	Download	35672
	Upload	20930
WiFi	Download	2898
	Upload	1104
WWW	Download	1650
	Upload	2970
FTP	Download	450
	Upload	900
Total	**Download**	**93618**
	Upload	**64944**

4.4   Summary of Calculations

Building	Floor	Transfer [kb/s]	Distribution Point
Building 1	Floor 1	download 163976 upload 241521	IDF2
	Floor 2	download 153152 upload 189611	IDF2
Building 2	Floor 1	download 170006 upload 241016	MDF
	Floor 2	download 132814 upload 234250	MDF
	Floor 3	download 124210 upload 203413	IDF1

Table 11: Summary table of bandwidth requirements for each work group in various buildings and floors

Distribution Point	Transfer [kb/s]
IDF1	download 124210 upload 203413
IDF2	download 317128 upload 431132
MDF	download 302820 upload 475266

Table 12: Summary table of bandwidth requirements for distribution points

MDF-IDF1	Result
Download:	$124210 + 302820 = 427030$ [kb/s] ≈ 0.43 [Gb/s]
Upload:	$203413 + 475266 = 678679$ [kb/s] ≈ 0.68 [Gb/s]

MDF-IDF2	Result
Download:	$317128 + 302820 = 619948$ [kb/s] ≈ 0.62 [Gb/s]
Upload:	$431132 + 475266 = 906398$ [kb/s] ≈ 0.91 [Gb/s]

Transfer [kb/s]	Server 1	Server 2	Printers
Download	220150	444850	6880
Upload	411900	522550	111230

Table 13: Summary table of transfer for local link

Transfer [kb/s]	Result
Download	93618
Upload	64944

Table 14: Summary table of transfer to/from the Internet

5 Design Assumptions

- The company is located in the city of Wrocław.

- The company prefers Ethernet-based technologies.

- Wireless network access should be available on the specified floor of each building (necessary cable installations are prepared).

- Additional ports should be provided on the switches (at a rate of 20% of occupied ports).

- Traffic within workgroups should be separated using VLANs.

- Two internet connections should be provided: primary and backup, with bandwidth suitable for the company's needs.

- The primary internet connection should guarantee a minimum bandwidth of at least 40% of the expected average throughput on that link.

- The design should include an additional internet connection.

- The cost estimate should include the cost of all devices, internet connections, and the cost of using internet links over a 2-year period.

- The buildings are equipped with Category 6 twisted pair cabling.

- There is an optical fiber link (single-mode) between the buildings.

- To secure the network, it is proposed to implement multi-layer security, including a firewall at the gateway level and security measures at the application level.

- Implementation of an authorization system.

- Access to the server room is limited to authorized employees only.

- In Building 1, the required link bandwidth is 317128/431132[kb/s] (download/upload).

- In Building 2 (Floors 1 and 2), the required link bandwidth is 302820/475266[kb/s] (download/upload).

- In Building 2 (Floor 3), the required link bandwidth is 124210/203413[kb/s] (download/upload).

- The required bandwidth for the first server's link is 220150/411900[kb/s] (download/upload).

- The required bandwidth for the second server's link is 444850/522550[kb/s] (download/upload).

- The required bandwidth for the printer's link is 6880/111230[kb/s] (download/upload).

- The required bandwidth for the MDF to IDF1 link is 0.43/0.68[Gb/s] (download/upload).

- The required bandwidth for the MDF to IDF2 link is 0.62/0.91[Gb/s] (download/upload).

6 Network Design

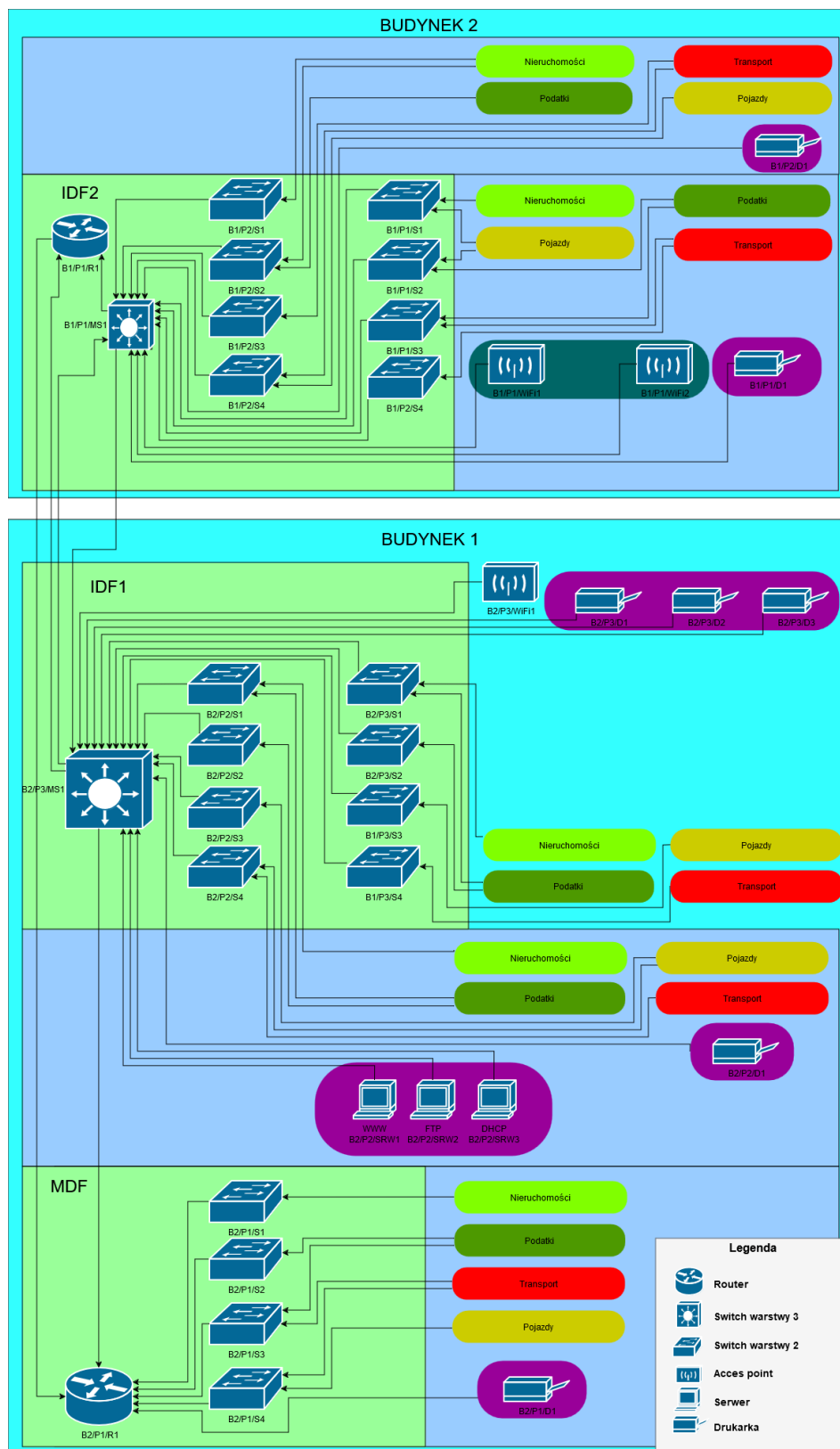## 6.1 Logical Network Design with Solution Concept Description

Figure 1: Logical Network Design

Solution Concept Description - The logical network design is based on a hierarchical topology that guarantees performance, security, and ease of management. The network is divided into access, distribution, and core layers, which allows for scalability and reliability in operation. Each building has logically separated distribution points (IDF) and a main distribution point (MDF) located in Building 2. Layer 2 switches are placed on each floor to minimize the distance between end devices and switches. By assigning workgroups to specific switches, better bandwidth management is possible. Each switch supports a certain number of users, preventing overload on any one device. The solution is designed to be flexible and adaptable to the changing needs of the organization. Each switch supports a set number of devices, with spare capacity for future expansions. This division ensures high performance and ease of management of the entire infrastructure.

6.2 Selection of Network Devices

- **Ubiquiti UniFi Dream Machine Pro (UDM-Pro) Router** is an advanced solution that combines the functions of a network controller and a gateway. This device was chosen for its versatility and high performance. With an 8-port Gigabit Ethernet switch, a 10G SFP+ WAN port, and a Quad-Core 1.7 GHz processor, the UDM-Pro performs excellently in both small and large network environments. Integration with the UniFi platform allows easy network management and configuration of advanced features such as VPN, QoS, and threat protection. Additionally, support for PoE enables powering other devices, increasing the flexibility of our infrastructure.

- **NETGEAR M4350 Layer 3 Switch** was chosen due to its reliability, scalability, and high performance, ideal for medium-sized companies. These models support PoE+ (Power over Ethernet) technology, allowing the powering of network devices such as access points and IP cameras without additional power cables. With 10GbE ports, they ensure fast data transfer, minimizing delays even in overloaded networks. They include advanced management features such as VLAN, QoS, and network security. Additionally, integration with the NETGEAR Insight system facilitates central network management via mobile app or browser, making it a convenient solution for monitoring infrastructure.

- **NETGEAR Smart Switch Series (XS748T) Layer 2 Switch** is a managed switch we selected due to its reliability and advanced features, ideal for demanding networks. With 48 Gigabit Ethernet ports and support for PoE+ (Power over Ethernet), the device allows powering network devices such as access points without the need for additional power cables. Integration with management tools, both via a web interface and SNMP protocols, facilitates precise monitoring and control of infrastructure by administrators.

- **Netgear Nighthawk M6 Pro (5G) Wi-Fi** is a mobile router we selected for its high speed and reliability. With support for 5G and Wi-Fi 6, the device offers download speeds up to 4.7 Gbps. The Nighthawk M6 Pro ensures stable connections even in crowded networks, making it ideal for environments with many devices. With Ethernet ports and PoE functionality, the router allows powering other network devices, further increasing its versatility. The Nighthawk app enables easy configuration, management, and monitoring of network status.

6.3 IP Addressing Plan

For all stations, the default gateway will be the LAN addresses of the B2/P1/MDF router corresponding to the respective VLAN networks. For standardization, these will be the last

addresses in the subnets. Address pools are allocated with significant surplus to allow for network expansion and simplify installation.

VLAN	Department	Required Number of Hosts	Number of Hosts	Subnet Address	Address Pool
1	Real Estate	150	254	192.168.0.0/24	192.168.0.1 - 192.168.0.254
2	Taxes	191	254	192.168.1.0/24	192.168.1.1 - 192.168.1.254
3	Vehicles	142	254	192.168.2.0/24	192.168.2.1 - 192.168.2.254
4	Transport	182	254	192.168.3.0/24	192.168.3.1 - 192.168.3.254
5	Wireless Devices	23	31	192.168.4.0/27	192.168.4.1 - 192.168.4.30
6	Local Servers, FTP, WWW	5	16	192.168.4.32/28	192.168.4.48 - 192.168.4.61

Table 15: VLAN Table with Workgroup Assignment, Number of Hosts, and Subnet Addresses.

The IP addresses of network devices will be statically assigned, which allows for their unique identification, facilitating troubleshooting, configuring routing, and managing devices. Employee computers in workgroups will use dynamically assigned addresses via a DHCP server. This allows for flexible management of the growing number of devices and minimizes the risk of IP address conflicts that may occur with manual assignment. Dynamic allocation enables quick connection of new devices and reduces the need for continuous monitoring of changes in the network.

6.4   Device Configuration Plan

Network Device	Port Numbers	VLAN	Connected Devices	Port Numbers
-	ISP1	-	B2/P1/R1	WAN1
-	ISP2	-	B1/P1/R1	WAN2

Network Device	Port Numbers	VLAN	Connected Devices	Port Numbers
B2/P1/R1	Gi1	-	B1/P1/MS1	Gi1
B2/P1/R1	Gi2	-	B2/P3/MS1	Gi1
B2/P1/R1	Gi3	1	B2/P1/S1	Gi1
B2/P1/R1	Gi4	2	B1/P1/S2	Gi1
B2/P1/R1	Gi5	2, 3	B1/P1/S3	Gi1
B2/P1/R1	Gi6	3, 4	B1/P1/S4	Gi1
B2/P1/R1	Gi7	5	B1/P1/D1	-
B2/P1/R2	Gi1	-	B2/P1/MS1	Gi19
B1/P1/R2	Gi2	-	B1/P1/MS1	Gi13

Network Device	Port Numbers	VLAN	Connected Devices	Port Numbers
B2/P3/MS1	Gi1	-	B1/P1/MS1	Gi1
B2/P3/MS1	Gi2	1, 2	B2/P3/S1	Gi1
B2/P3/MS1	Gi3	2	B2/P3/S2	Gi1
B2/P3/MS1	Gi4	3	B2/P3/S3	Gi1
B2/P3/MS1	Gi5	4	B2/P3/S4	Gi1
B2/P3/MS1	Gi6	1, 2	B2/P2/S1	Gi1
B2/P3/MS1	Gi7	2	B2/P2/S2	Gi1
B2/P3/MS1	Gi8	3	B2/P2/S3	Gi1
B2/P3/MS1	Gi9	3, 4	B2/P2/S4	Gi1
B2/P3/MS1	Gi10	6	B2/P2/WiFi1	Gi1
B2/P3/MS1	Gi11-14	6	B2/P3/D1-3	-
B2/P3/MS1	Gi15	5	B2/P2/D1	-
B2/P3/MS1	Gi16-18	5	WWW, FTP, DHCP	Gi1
B2/P3/MS1	Gi19	-	B1/P1/R1	Gi1
B2/P3/MS1	Gi20	-	B1/P1/MS1	-

Network Device	Port Numbers	VLAN	Connected Devices	Port Numbers
B2/P1/S1	Gi1	1	B2/P1/R1	Gi3
B1/P1/S2	Gi1	2	B2/P1/R1	Gi4
B1/P1/S3	Gi1	2, 3	B2/P1/R1	Gi5
B1/P1/S4	Gi1	3, 4	B2/P1/R1	Gi6
B2/P1/D1	Gi1	5	B2/P1/R1	Gi7

Network Device	Port Numbers	VLAN	Connected Devices	Port Numbers
B2/P3/S1	Gi1	1, 2	B2/P3/MS1	Gi2
B2/P3/S2	Gi1	2	B2/P3/MS1	Gi3
B2/P3/S3	Gi1	3	B2/P3/MS1	Gi4
B2/P3/S4	Gi1	4	B2/P3/MS1	Gi5

7 Catalog Sheets of Proposed Devices

7.1 Router

Test data - UniFi Application Suite	Full
UniFi Devices	200+
Client Devices	200+
WiFi	-
High Availability	Shadow Mode
Multi-WAN Load Balancing	Yes
Application-Aware Firewall	Yes

Mechanical

Dimensions	442.4 x 43.7 x 285.6 mm (17.4 x 1.7 x 11.2")
Weight	3.9 kg (8.6 lb)
Enclosure material	Aluminium CNC, SGCC steel
Mount material	SGCC steel

Hardware

Processor	Quad-core ARM® Cortex®-A57 at 1.7 GHz
System memory	4 GB DDR4
On-board storage	16 GB eMMC
Management interface	Ethernet Bluetooth
Networking interface	LAN: (8) GbE RJ45 ports (1) 10G SFP+ port WAN: (1) GbE RJ45 port

Gateway Features

Performance	Redundant WAN with failover and load balancing
	WiFi QoS with UniFi APs
	Application, domain, and country-based QoS
	Application and device type identification
	Additional internet failover with LTE Backup
	Internet quality and outage reporting
Next-generation security	Application-aware firewall rules
	Signature-based IPS/IDS threat detection
	Content, country, domain, and ad filtering
	VLAN/subnet-based traffic segmentation
	Full stateful firewall
Advanced networking	License-free SD-WAN
	WireGuard, L2TP and OpenVPN server
	OpenVPN client
	OpenVPN and IPsec site-to-site VPN
	One-click Teleport and Identity VPN
	Policy-based WAN and VPN routing
	DHCP relay
	Customizable DHCP server
	IGMP proxy
	IPv6 ISP support

7.2 Layer 3 Switch

M4350-44M4X4V
Fully Managed Switch

Ordering information
- Americas, Europe: MSM4352-100NES (NA, UK, EU)
- Americas, TAA Compliant: MSM4352-TAANES (NA, UK, EU)
- Asia Pacific: MSM4352-100AJS (JP, AU)
- China: MSM4352-100PRS
- Warranty: Lifetime ProSAFE Hardware Warranty

- 44 2.5G and 4 10G/Multi-gig PoE++ ports with 4 25GBASE-X SFP28 uplinks.
- 550W internal power supply providing 194W of PoE budget.
- 2 slots for modular power supplies (1+1 redundancy and/or EPS share).
- Any APS350W, APS600Wv2, APS920W, or APS2000W can be used.
- The PoE budget can reach 3,314W, the redundant PoE budget can reach 1,794W.
- Virtual Chassis stacking provides non-stop forwarding (NSF) and hitless failover.
- Layer 3 feature set includes static, policy-based, and dynamic routing.
- NETGEAR IGMP Plus™, AV User Interface, and Engage Controller speed up AV installations.
- NETGEAR ProSAFE® Limited Lifetime Hardware Warranty.
- Lifetime Next Business Day Hardware Replacement.
- Dimensions: 440x400x43.2 mm
- Weight: 7.34Kg (16.18 lb)

7.3   Layer 2 Switch

10-Gigabit copper ports : 44 10GBASE-T copper

SFP ports : 4 SFP+ 1000/10GBASE-X fiber ports (shared)

Buffer size : 3 MB

MAC address database size : 16K

VLAN (# supported) : 512

Number of LAGs & number of members : 24 LAGS with max 8 members in each LAG (LACP)

Number of priority queues : 8

Access Control Lists (ACLs) : 164 shared for MAC, IP and IPv6 ACLs

IPv4 Static routes : 64

IPV6 Static routes : 64

Power supply : Internal 100-240VAC 50-60Hz

Max power consumption (Watts) : 262.8 W

VLAN routing : Yes

Dynamic VLAN assignment : Yes

Dynamic VLAN assignment : Yes

MLD Snooping : Yes

Static route : Yes (32)

Host ARP table : 512 ARP

EEE : Yes

DoS Prevention : Yes

Internal/External : External DC 54V 1.25A

Max consumption (Watts) : 15.1W

FAN : 4

Acoustic Noise Level @25C (dBA) : 47.8 dBA

Operating Temperature : 0° to 50°C (32° to 122°F)

MTBF (@ 25° C) : 483,808 hours

Electromagnetic compliance (A or B) : Class A

7.4   Access Point

TECHNICAL DETAILS   ✕

Height	0.85in (21.5mm)
Width	4.14in (105mm)
Depth	4.14in (105mm)
Weight	0.56 lbs (256g) with battery
Requirements	N/A
WiFi	WiFi 6E
Speed	AXE3600 max throughput (PHY)
Bands	5GHz/6GHz: 2900Mbps 2.4GHz: 700Mbps
Technology Bands	5G Sub6(3CC), mmWave(8CC), NR-CA, and NR-DC support 4G LTE CAT20(5CC) 3G: B1/B2/B5/B8 4G LTE: B1/B2/B3/B4/B5/B7/B12/B13/B14/B25/B26/B29/B30/B40/B41/B46/B48/B66/B71 5G Sub6: n2/n5/n7/n12/n14/n25/n29/n30/n38/n41/n48/n66/n71/n77/n78 5G mmwave: n260/n261 IPV6 Support
Touch Screen	2.8" touch LCD panel
Battery	Removable 5040mAh Li-ion battery
Ports	One (1) USB Type-C One (1) 2.5Gbps Ethernet Two (2) TS9 RF ports