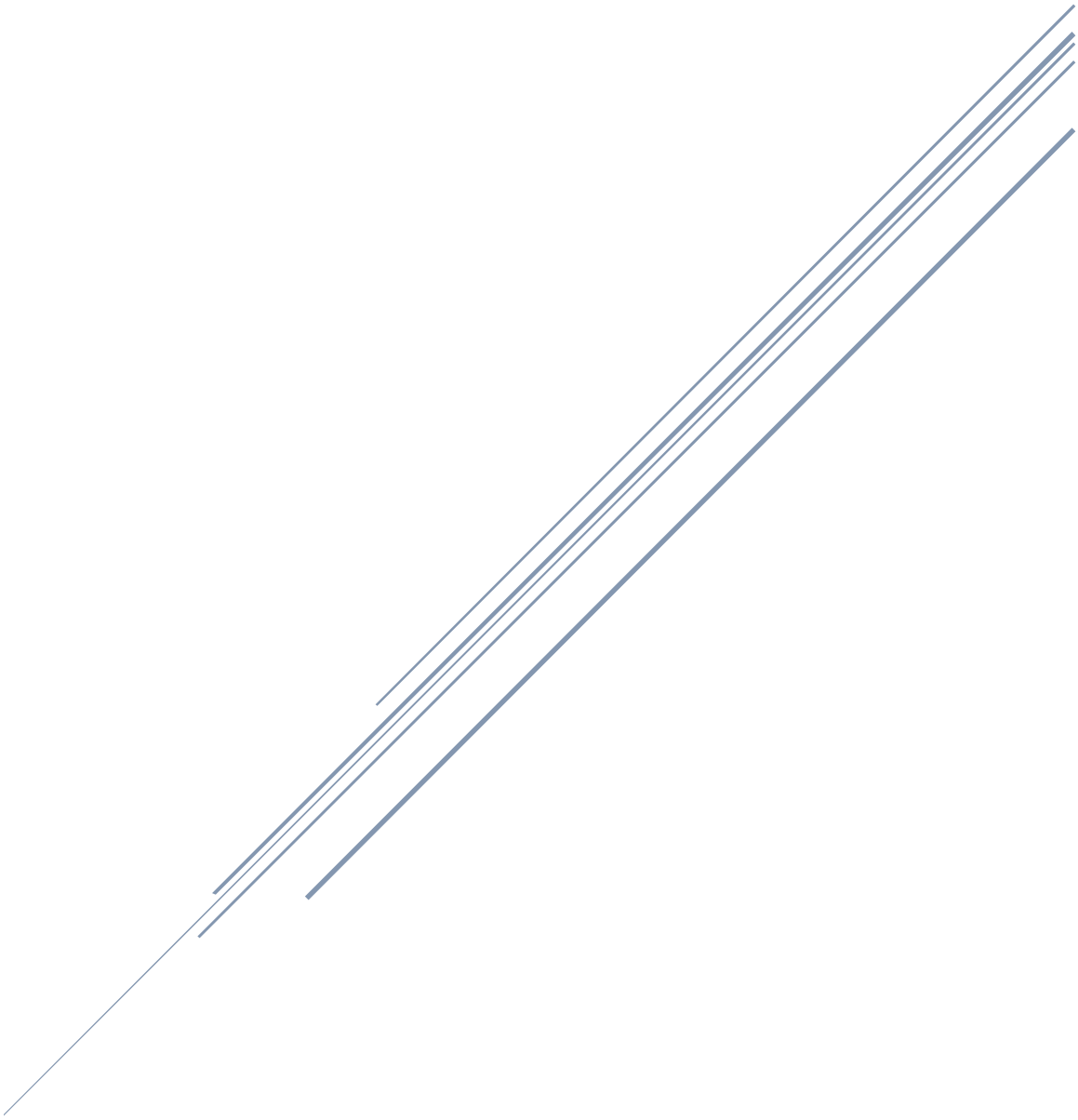
VISOIL – DRILLING DATA GRAPHICAL DISPLAY APPLICATION

Functional Specification



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1. Executive Summary

VisOil is a web application to automatically generate live drilling data graphical displays. This functional specification is a complete and comprehensive description of the project context, its scope, budget, general assumptions and functional requirements and component analysis

The main components of this document are:

1) Business Case
2) Scope
3) Methodology
4) Assumptions and Constraints
5) Functional Specification:
    a) Work Breakdown Structure
    b) Detailed Budget
    c) Component Overview
    d) Systems Requirements

The business case describes the need for the project, and gives a complete analysis of the problem that the final product will solves and how it will help the client achieve their business goals. The business case also offers a comparison of 5 different choices, and makes a recommendation on which choice would be the most viable to implement.

The scope outlines the major components and features of the final product and gives a brief overview of the budget for implementing this project. The scope also describes what will not be included in the final product and describes any limitations or constraints that will change the deliverable.

The methodology section of this document presents a typical use-case of the VisOil web application, and represents how a user would interact with the different features that will be present in the final product.

The assumptions and constraints outline the assumptions or constraints that are associated with each user-based task that is performed while interacting with the system.

The functional specification gives a high-level breakdown of the tasks needed to complete this project, along with the resources that they have been assigned to. A detailed and itemized budget of each component is given, along with an overview of how all the components fit together to make the final product. Lastly, the functional spec illustrates how each sub-component of the product works, and their logical design.

2. Business Case

2.1. Report Making Process is Time Consuming

The Client's current process of making graphical reports manually is inefficient and incurs heavy labor costs the Client's company. This process also introduces unnecessary risks to the security of the data being manipulated, and minimizes the value of the final reports that are produced.

2.2. Process and Task Automation is Essential

The process of making graphical reports needs to be automated in order to help the company reduce costs and maintain a competitive edge in the exploration and production market. This solution can be implemented through the use of an application that would make the reports, which would drastically reduce the time it takes to generate reports, as well as increase the integrity and availability of the data used in the reports.

2.3. Needs Assessment

2.3.1. Organizational Overview

The Client works for petroleum exploration and production company that provides detailed graphical reports of the wells that they are drilling. These data for these logs are generated by gamma ray sensors on the drilling rig, that measure rock formations as it is drilling. This information is sent wirelessly to a third-party database, where the Client logs in and downloads the data as a spreadsheet of raw data points. This data is then translated manually into a line graph utilizing custom made excel spreadsheets. Currently it takes up to 4 hours to download new data and translate it into a graph.

This graph is then used to relay information to the drilling operators to provide guidance on which direction to steer the drill, in order to avoid 'bad' sectors that could damage the drill. These graphs are generated periodically during the drilling, and the Client must choose when to log in to the database to get updated information, and the entire process must be repeated.

Sometimes a request is made from the drilling site to get an update on the data, and must wait for the graph process to be completed before they can receive a response

After drilling is completed, the accumulated data is formatted into a final report that is printed to paper and presented to engineers who will use the information for fracking operations.

2.3.2. Business Need

The process of manually creating well logs is time consuming and inefficient. This can be overcome by implementing a tool to generate these graphs automatically from the raw data that is produced by the drill.

2.4. Analysis

2.4.1. The Problem

In the current situation, the Client generates reports by manually downloading and formatting the raw data sent from the drilling site. This is a tedious and time-consuming process for the Client, who needs to re-download and translate the data every time an updated is needed. The time spent by the Client on this process could be better spent on other tasks that are more critical to the business' operations, and this process also introduces risks to the data's integrity and availability. Data can be lost or corrupted during the copying and pasting process, and any mistakes or errors must be manually corrected every time the data is updated. Updates to the information do not occur on a regular schedule, but relies on the Client being available to download it from the third party's website at any time. This is not practical, as often updates are needed while the Client is not scheduled to work or is busy with a different task. The operations team at the drill site are affected by this process because it increases the time it takes to provide drilling guidance, which could result in extra costs due to drill damage. Lastly, the reports generated at the end of the drilling operations are static, and completions engineers are unable to interact with the data or manipulate it in order to provide customized feedback to suit their needs.

2.4.2. The Solution

The Client's problem can be solved by providing a software application that can automatically download, format, and present the wellsite data as graphs.

2.4.3. Business Outcomes

Given the business need, the following outcomes are expected as a result of implementing an automated solution

Outcome	Method
Increased Efficiency	- Reduce the time it takes to make graphs - Reduce the complexity of the graph making process - Reduce the response time needed for field updates and drill guidance
Increased Data Security	- Increased data integrity - Increased data availability
Competitive Edge	- Give added-value features to the final graphs that are produced - Reduce human error by eliminating the need to do manual data entries - Create instant access to well logs and generate reports quicker than competitors
Technology	- Give the company a proprietary software that will give it an innovative edge over competitors
Ecological	- Reduce the number of printed reports produced

2.4.4. Strategic Fit

This project will streamline the process of generating reports and allow them to put more resources towards gaining additional wellsites at an increased rate. Given the business strategy of furthering the development of crude oil and natural gas in Alberta, this project aligns closely with the business' goals.

2.4.5. Key Requirements

In order to be successful, this application must meet the following requirements:

Functional Requirement No.	Description
FR 1	The application must be able to generate graphs without manual data entry.
FR 2	The application must be accessible from the internet.
FR 3	The application must download data automatically on a pre-set interval, without the need for manual scheduling.
FR 4	The graphs generated by the application must match the current format being used by the Client, or a format that the client approves.
FR 5	The application must translate the data accurately
FR 6	The application must be secure from data loss
FR 7	The application must be secure from unauthorized access

2.4.6. Desired Functionality

The application provided will include the following added-value features to some degree, depending on the option chosen:

Data Interaction
The ability to configure or modify the data represented as needed

Friendly User Interface
Simple and friendly web design to give employees a fluid viewing experience

High Availability
Quick access to the data, and the ability to access it from remote locations

2.5. Available Options

2.5.1. Option 1 – Status Quo

Description

This option maintains the current system and does not implement an automated solution for generating graphs.

Benefits
No implementation costs

Costs
Continued current cost of labor, with no additional savings

Major Risks

Description	Likelihood	Impact	Mitigating Actions
Reduced market shares due to inefficiencies	Likely	High	Increase marketing budget for better exposure to clients
Reduced employee work satisfaction	Likely	High	Outsource manual data entry tasks

2.5.2. Option 2 – Buy Professional Application

Pay outright for commercial software that is used by exploration companies, and adapt the business process and report standards to fit the software's parameters. This option offers the least customization, and would require the business to adapt their reports and processes to fit the application's parameters. Chance of not being fully able to translate the data from its raw format without manual manipulation.

Benefits
Low risk of major software bugs
Professional user interface
More added-value features
Highly secure data through the use of professional software
Transfer of liability to software company

Costs
High cost for purchasing professionally built application
Possibility of subscription or maintenance fees

Feasibility
Costs likely to exceed savings

Major Risks

Description	Likelihood	Impact	Mitigating Actions
Software not compatible with data format	Possible	High	- Purchase insurance or return policy to cover the losses of buying incompatible software - Implement rigorous testing phase to ensure product can meet business' needs
Cost of purchasing software exceeds savings	Likely	High	- Explore leasing or subscription options to reduce costs

2.5.3. Option 3 – Build or Outsource Custom Application

Description
Build a completely working application from the ground up, to maximize customization and flexibility. Longest time to implement, largest risk critical software-breaking bugs.

Benefits
Highly customizable
Full control and rights to software
Ability to sell or licence software for profits

Costs
Hiring new software specialists or training staff in software development
High cost for professional contractors (if outsourcing)
Ongoing maintenance, troubleshooting and update costs
Training staff on how to use custom software
Purchasing computer hardware for developing software
Purchasing computer hardware to host and maintain software

Feasibility
Costs likely to exceed savings
Development time likely to exceed project deadline

Major Risks

Description	Likelihood	Impact	Mitigating Actions
Security / Data breaches, including: Virus, Malware, Crypto Locking, Ransomware, etc.	Possible	High	- Add firewall rules to protect against intrusion - Ensure all contractor and client computers have antivirus installed and activated - Implement OS hardening scheme - Implement backup and recovery protocols
Critical software bugs or errors that break application	Likely	High	- Outsource software testing to professional contractor to find and eliminate bugs or error
Software development time exceeds project due date	Likely	High	- Implement phased delivery for application features - Extend project due date
Data loss due to network connectivity issues	Possible	High	- Implement backup solution for all computers and servers holding data. - Plan server updates or changes ahead of time to prevent network outages during application usage
Reduced internet speed due to increasing local traffic	Possible	Medium	- Implement separate network sections (subnets) to isolate high-traffic areas

2.5.4. Option 4 – Hybrid – Build/Outsource Application

Description
Use a mix of custom made and already developed software. Maximizes software flexibility while minimizes development costs. Suggest using free or open source software where possible to further reduce costs.

Benefits
Fast delivery time with lowered cost of development
High customization level without needing to create basic software platforms from scratch
Maintain ownership over finished product with ability to sell or license finished product

Forecast cost
Software development costs for application components that must be custom built
Costs for hosting web application – locally or through cloud service

Feasibility
This option provides the most added-value for the cost to implement

Risks and solutions

Description	Likelihood	Impact	Mitigating Actions
Security / Data breaches, including: Virus, Malware,	Possible	High	- Add firewall rules to protect against intrusion - Ensure all contractor and client computers have antivirus installed and activated

Crypto Locking, Ransomware, etc.			- Implement OS hardening scheme - Implement backup and recovery protocols
Data loss due to network connectivity issues	Possible	High	- Implement backup solution for all computers and servers holding data. - Plan server updates or changes ahead of time to prevent network outages during application usage
Reduced internet speed due to increasing local traffic	Possible	Medium	- Implement separate network sections (subnets) to isolate high-traffic areas
Major Software bugs or errors	Possible	High	- Increase testing regime for application features
Project Failure due to complexity	Possible	High	- Provide scalable solution to deliver product in phases - Control scope-creep with clearly defined added-value features

2.6. Recommendation

2.6.1. Preferred Option

Given the business need for a more efficient system of creating well logs, and after an evaluation of the viable options, it is recommended that **Option 4 – Hybrid - Build Application** be implemented. This option is the most cost-effective solution which will drastically reduce the time needed to create graphs while increasing the value of the final product. Building a hybrid application with a mix of open source software and custom-made scripts will ensure that the final product is flexible enough to meet the business' needs while not exceeding budget or schedule limits. This option also has the benefit of being able to incorporate several added-value features such as: providing high-availability to the data with frequent live updates, network infrastructure security, and an interactive interface for multiple stakeholders. The current business operations and infrastructure will not face any major changes, and yet efficiency, employee satisfaction and profits will increase.

With the implementation of the new application, the drill site team will not need to wait on graphs being manually generated, and it will provide users with real-time data for drilling guidance, saving them time to react to any drilling errors that could cause the equipment to break down or worse, cause an environmental catastrophe. The leadership team will be able to translate the productivity of the drilling site almost on real time and be able to increase or decrease productivity based on demand. This option will grant access to reports securely and in real time by multiple parties, freeing up human resources to perform other more profitable tasks. The application will prevent human error while translating it into readable reports, increasing the accuracy and history of the reports for forecasting purposes. These benefits well supersede the costs associated with the software and hardware implementation to automate these reports.

2.6.2. Implementation

The current process of manually downloading raw data and generating reports from it will not be interrupted during the implementation of the project., scope of work, preparation of the reporting software builds and installation of the firewall security hardware. Therefore, we will take our time to make build, test and roll out our suggested solution in multiple phases, until we test everything and feel like we are ready to cut over the manual reporting. As the raw data will be saved in our database, it will be accessible in case of any issues with front end reporting, so the success rate of this project is very good and easily measurable by the organization.

2.6.3. Project Assumptions, Constraints, Dependencies and Risks

Assumptions

It is assumed that all data samples needed to build a compatible application will be supplied by the Client, and that at no time will the unfinished application be tested in a live environment where it could cause damage. It is also assumed that the project team posses the technical skills and knowledge necessary for working on the project, and that enough time has been given to complete the project. The final application will only be able to translate data given in the specific format that is used in the current environment. Any changes to the data format will result in a need to re-design the application. The application will be presented to the Client as a proof of concept, to be implemented at the Client's own discretion and risk.

Constraints

There is a strict time-constraint on the project, as it must be delivered by August 2020, and the project team will be working with limited human and financial resources. Therefore, the scope of the project must be kept strictly within the constraints of the schedule and budget, which will reduce the number of added-value features that can be included in the final product.

Dependencies

The project will not be able to proceed until the current form of generated data is supplied to the project team, along with the desired outcomes for graph formatting.

Risks

The risks associated with implementing this solution are manageable, given the mitigation strategies that have been provided. Its access to cloud/web will bring some security risks that we will need to mitigate through a user registration interface, where only certain people can access it. Also, additional firewall hardware and software will be built that will keep any data breaches away from the general public or hackers. A backup solution will be implemented to protect against data loss, and all major bugs will be worked out of the final product before completion.

2.6.4. Evaluation

Success measures

The project will be continually monitored to ensure that it stays within its scope, remains on budget, and is on schedule. The key functionalities will be measured with the following criteria:

- Reduce the time it takes to make graphs by 75%
- Reduce the complexity of the graph making process by eliminating the need for manual data entries
- Change the deliverable format to interactive graphs with the ability to Turn individual values on and off, and add comments or notations to the graphs
- Give the company a proprietary software that will give it an innovative edge over competitors
- Reduce the number of printed reports needed by 50%

3. Product Scope

3.1. Major Components

The following major components will be included in the final product.

Major Component	Description
Website	A website that is accessible from the internet, and will serve as the user interface to the graphical display
Graphical Display	The actual interactive display of data, as distinct from the general website it is hosted in
System Infrastructure	The back end of the application that is not visible to the user, including hardware, software, networking, services, and security

3.2. Individual Component Features

The following features will be included in each major component

3.2.1. Website Application

The website component will contain the following features

Feature	Description
Login Page	A login page that authenticates the user and creates a session on the webserver
Wellsite Selection Page	A wellsite selection page that allows the user to select which wellsite data to view
Graphical Display Page	The live display of the selected drilling data
Logout Confirmation Page	A page to confirm when a user has successfully logged out of the application

3.2.2. Graphical Display

The graphical display application will include the following features:

Feature	Description
Automatic Updates ("Live Data")	- A live display of the drilling data pertaining to the site that was selected, which is updated automatically on 30minute intervals (1800s)
Line Graph	- This data represented as a colored line graph of subsea elevation (y-axis) vs measured depth (x-axis), and will include the following data points: o ROP (Rate of penetration) o Gamma o Gas o Wetness ratio o Balance ratio
Layer Toggles	- Toggle switches to turn data layers on or off
Annotation Tools	- Annotation tools to add textual notes, flags, and tags to the graph
Printing Option	- Print to pdf option that will print either the entire graph or a selected area of the graph to pdf
Email Option	- Option to email the printed pdf using the client's installed email application

3.2.3. System Infrastructure

Feature	Description
Hardware	Servers, monitors, keyboard/mouse, cables, routers, switches
Software	Operating systems, licensing, development software, productivity applications, Databases, Scripts, 3rd party software.
Security	Firewalls, Intrusion Detection Systems, Anti Malware, Encryption, Secure Connections
Networking	WANs, LANs, VPNs, network connections, network configurations
Services	Web Service, Backup/Restore, DNS, DHCP, Email

3.3. Not Included in Product Scope

The following features are not included in the project scope

- Displaying data that is not in the same format as the test data
- Displaying data or values that are not specified in section **3.2.2. Graphical Display**
- Non-website applications

3.4. Project Scope

3.4.1. Project Design

PROJECT DESIGN				
Task	**Labor Hours**	**Labor Cost**	**Material Cost**	**Subtotal**
Business Requirements Analysis	20	$60	$0	$1,200
Develop Functional Specification	20	$60	$0	$1,200
Develop System Architecture	20	$60	$0	$1,200
			TOTAL	**$3,600**

3.4.2. Project Development

PROJECT DEVELOPMENT				
Task	**Labor Hours**	**Labor Cost**	**Material Cost**	**Subtotal**
Procurement	40	$60	$0	$2,400
Hardware	240	$60	$6,017	$20,417
Software	240	$60	$5,316	$19,716
Network/Security/Services	240	$60	$0	$14,400
			TOTAL	**$56,933**

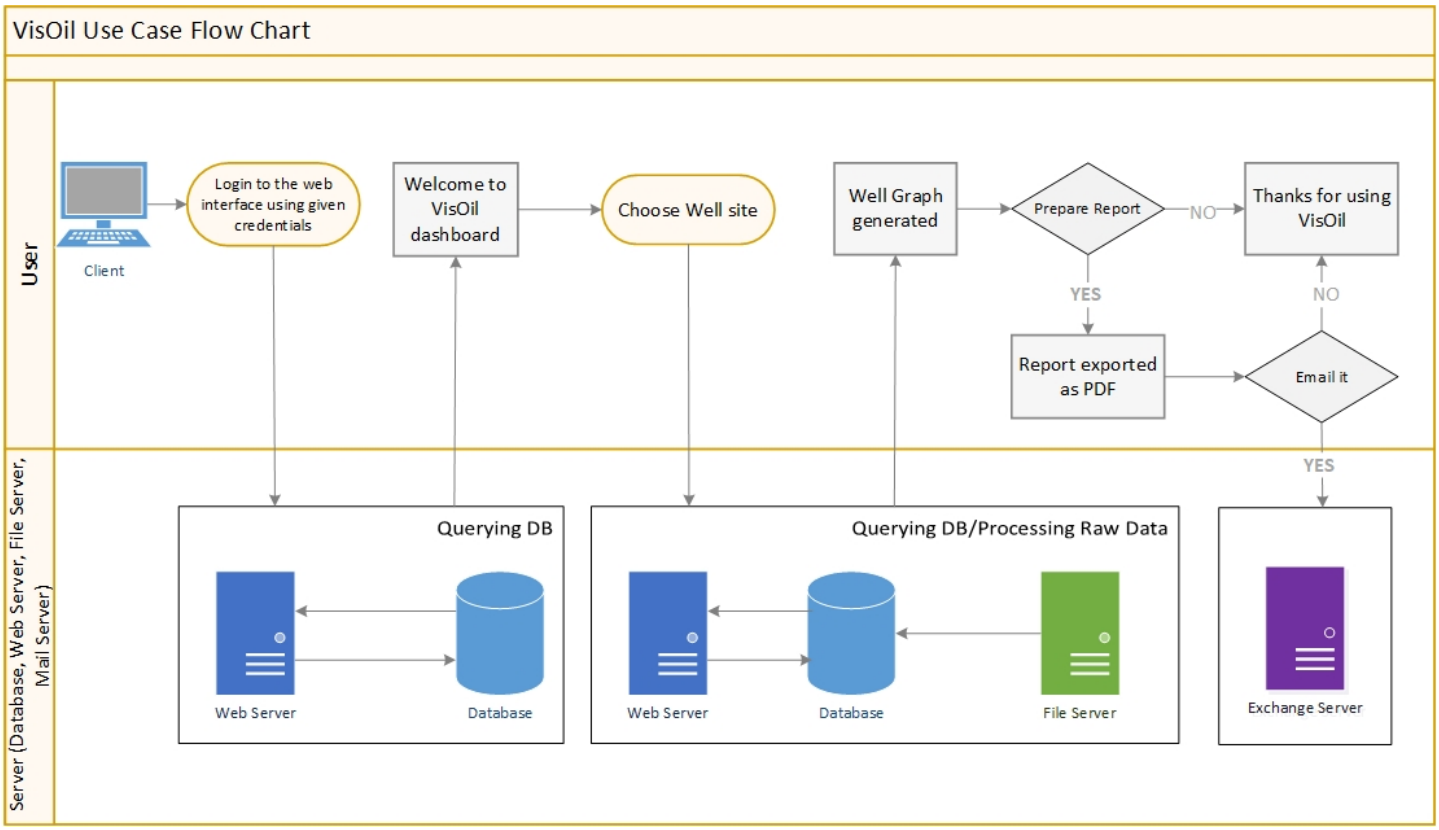
3.4.3. Project Delivery

PROJECT DELIVERY				
Task	**Labor Hours**	**Labor Cost**	**Material Cost**	**Subtotal**
Customer Training	8	$60	$0	$480
Final System Testing	20	$60	$0	$1,200
			TOTAL	**$1,680**

4. Methodology

4.1. Use Case

The following diagram outlines a typical use case of the VisOil web application.



5. Assumptions and Constraints

5.1. Task Level Assumptions and Constraints

Task	Assumptions	Constraints

User browses to website	- User has basic knowledge of computers and web browsers	- Compatible internet browser
		  o JavaScript
		  o HTTPS
		- user has internet connection
		- user is connected to application network via VPN

User logs in with credentials	- Connection to webserver and database are secure and stable - Correct login information entered	- User account database is available
User enters/selects wellsite data to load	- User knows which wellsite they want to monitor	- Wellsite database is available
Wellsite Data dashboard is loaded	- Graphical display scripts are functioning -	- Will only display data types that have been supplied as test data
User chooses interactive actions (print report, turn on/off layers, add notations to graph)	- User has basic knowledge of computers - User has been trained by the product provider on how to use application features	- Graphical application scripts are working properly
User clicks “logout” link when finished	- User has completed desired tasks, and session is ended	- (none)

5.2. Design and Implementation Constraints

Due to a lack of equipment availability, the project will be implemented virtually, with all hardware and networking components being deployed as virtual machines.

The functionality of the product will not change, and each virtual component will be built and configured to match a real-world physical implementation as closely as possible.

All security, service, and software components will remain unaffected by virtualization, and will be developed as described in this document.

6. Functional Specification

6.1. Work Breakdown Structure

WBS	Task Name
1	**Initiation**
1.1	**Business Case**
2	**Planning**
2.1	**Project Management Plan**
2.2	**Project Design Plan**
2.3	**Component Architecture**
3	**Execution**
3.1	**Setup/Install/Configuration**
3.1.1	**Software**
3.1.2	**Hardware**
3.1.3	**Network**
3.1.4	**Security**
3.1.5	**Service (Server)**
3.2	**Deployment**
3.2.1	**Software**
3.2.2	**Hardware**
3.2.3	**Network**
3.2.4	**Security**
3.2.5	**Services**
3.3	**Integration/Testing**
3.3.1	**Software**
3.3.2	**Hardware**
3.3.3	**Network**
3.3.4	**Security**
3.3.5	**Services**
3.4	**Implementation**
3.4.1	Debugging
3.4.2	Trouble shooting
4	**Completion**

6.2. Budget

6.2.1. Hardware

HARDWARE			
Item	**Qty.**	**Cost/Item**	**Subtotal**
HPE Proliant DL385 G7 (Server A)	1	$2,350.00	$2,350.00
HPE Proliant DL385 G7 (Server B)	1	$2,600.00	$2,600.00
LG 15-inch LCD Monitor	2	$120.00	$240.00
USB Keyboard/Mouse Combo	2	$30.00	$60.00
RJ45/Ethernet Cable	6	$10.99	$65.94
		TOTAL	**$5,315.94**

6.2.2. Software

SOFTWARE				
Item	**Type/Edition**	**Qty.**	**Cost/Item**	**Subtotal**
Windows Server 2016	Standard	2	$399.99	$799.98
Windows 10 Professional	Standard	1	$186.90	$186.90
ESXi	Enterprise	1	$4,350.00	$4,350.00
Exchange Server 2016 CU	Standard	1	$449.00	$449.00
Microsoft Excel 2019	Open	1	$231.00	$231.00
			TOTAL	**$6,016.88**

6.2.3. Labor

LABOR				
Task	**Assigned Resource**	**Hours**	**Rate**	**Subtotal**
Business Requirement Analysis	Shkumbin Muli	20	$60	$1,200.00
Develop Functional Specification	Thomas Llewellyn	20	$60	$1,200.00
Develop System Architecture	Jeong Seok Kim	20	$60	$1,200.00
Network/security/services Procurement	Jeong Seok Kim	20	$60	$1,200.00
Network/security/services Installation	Jeong Seok Kim	100	$60	$6,000.00
Network/security/services Configuration/ Development	Jeong Seok Kim	100	$60	$6,000.00
Network/security/services Maintenance/Testing	Jeong Seok Kim	40	$60	$2,400.00
Software Development	Thomas Llewellyn	100	$60	$6,000.00
Software Implementation	Thomas Llewellyn	100	$60	$6,000.00
Software Testing	Thomas Llewellyn	40	$60	$2,400.00
Hardware Procurement	Shkumbin Muli	20	$60	$1,200.00
Hardware Installation	Shkumbin Muli	100	$60	$6,000.00
Hardware Configuration	Shkumbin Muli	100	$60	$6,000.00
Hardware Testing	Shkumbin Muli	40	$60	$2,400.00
Final System Testing	Thomas Llewellyn	20	$60	$1,200.00
Training	Thomas Llewellyn	8	$60	$480.00
			TOTAL	**$50,880.00**

GRAND TOTAL $62,212.82

6.3. Components

6.3.1. Security

Components	Description	Remarks
IDS/Snort	Capturing suspicious packets from inside and outside traffic	NIDS, HIDS, Firewall rules on virtual routers or each machine are required
OS hardening	Checking all possibilities of vulnerable points of using OSes	Consideration of various OS environment
SSL/TLS	Encrypting all packets between machines	Using a public key and certificates
VPN	Making a safe route to transfer data via tunneling technique	Deploying VPN tunneling between all WAN connection
Anti-virus application	Scanning malware and preventing data corruption	Applying on important machines like a backup server and web server

6.3.2. Networking

Components	Description	Remarks
Host-only (LAN) connection	Internal network to transfer data for machines in a same subnet	A subnet has its unique IP class and mask, also it should be configured on each machine and a virtual router
WAN connection	External network to transfer date to cloud via a virtual router	Using VPN and virtual routers to enhance security

6.3.3. Hardware

Components	Description	Remarks
(2) HPE Proliant DL385 G7 2U rack servers	(1) server A is used for backup, file, and storage services (1) server B is used for web, mail, DNS/DHCP, and Active Directory services	Server A should need minimum 8GB RAM and more than 500GB disk capacity to backup data from server B Server B is required for minimum 32GB RAM and CPUs with high performance to execute multiple services which use lots of resources
	Servers	**Required specification [1]**
	Server A	(1) AMD Opteron™ 6136 (2.0GHz/8-core/12MB/80W) Processor (2) 4GB PC3-10600R (DDR3-1333) Registered DIMMs (2) HP NC382i Dual Port Multifunction Gigabit Server Adapters (four ports total) HP Smart Array P410i/Zero Memory Controller (6) 140GB 7.2K SAS 2.5" Hard Drive (1) 460W Common Slot Gold Hot Plug Power Supply (4) hot plug redundant fans
	Server B	(2) AMD Opteron™ 6274 (2.2GHz/16-core/16MB/115W) Processor (4) 8GB PC3-10600R (DDR3-1333) Registered DIMMs (2) HP NC382i Dual Port Multifunction Gigabit Server Adapters (four ports total) HP Smart Array P410i/Zero Memory Controller (6) 140GB 7.2K SAS 2.5" Hard Drive (1) 460W Common Slot Gold Hot Plug Power Supply (6) hot plug redundant fans
(2) 15-inch LCD monitors	Necessary device to deploy the project plan and monitor resources	Using one monitor for each server. LCD monitors supports light weight for easily moving and prevents eyestrain
(2) USB keyboards	Necessary device to enter input	Using one keyboard for each server. PS/2 keyboard could be acceptable
(2) USB mice	Necessary device to move a cursor for GUI environment of OSes	Using one mouse for each server. PS/2 mouse could be acceptable
(6) RJ cables	Connecting to each server and WAN	Applying on important machines like a backup server and web server

6.3.4. Software

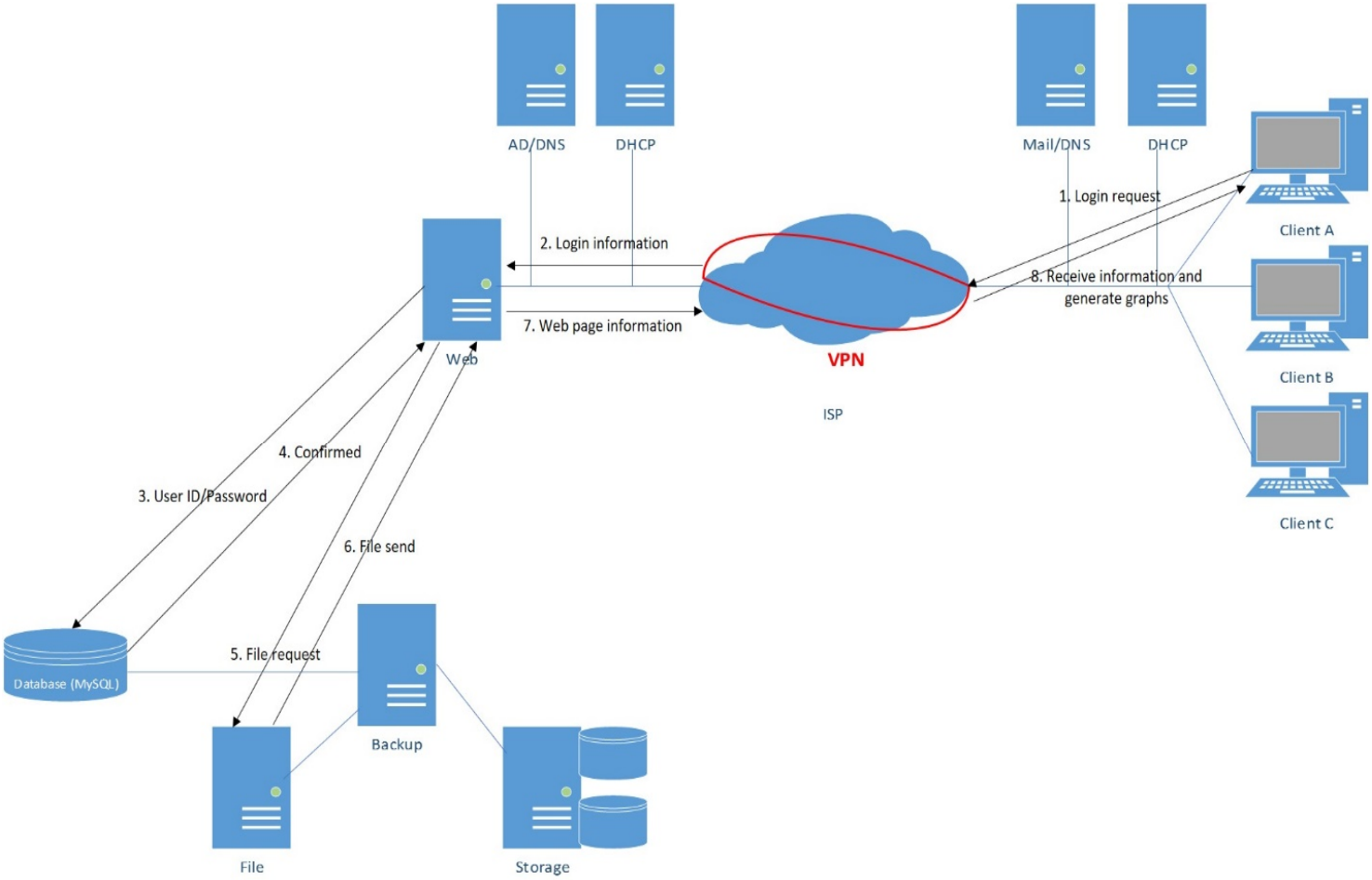
Components	Description	Remarks
MySQL 8.0.19	Catalogs for input files(.CSV) and backup server's records	Backup server's database and input files' database should be separated
HTML 5.2/ CSS 3/ PHP 7.4/ Java script ES9 (jQuery, AJAX)	Scripts to implement web site's client and server	All web-based scripts are located in one web server
ESXI 6.7U3b	Providing virtualization environment for multiple OSes and virtual routers	Applying on only server B
Windows Server 2016 build: 14393	Supporting server services with GUI and very compatible with Windows clients and applications	Active Directory could provide users' accounts for its member servers or clients
Windows 10 Professional build: 1909	Representing general clients who use Windows 10 which is the most popular OS	All Windows 10 clients should be in the Active Directory's forest
CentOS Linux 7 1810	One of Linux distribution, and being compatible with Red Hat Enterprise Linux (RHEL)	All server services except services on Windows server will run on CentOS 7
Kali Linux 2020.1a	Debian-based Linux distribution for security tasks	IDS and snort are running on Kali Linux 2020.1a
Bacula 9.4.4, or equivalent	Open-sourced enterprise backup system	Backup and restore system would be configured based on Bacula 9.4.4
MS Exchange Server 2016 CU 14	Mail and calendar server for Windows server environment	MS Exchange Server should be a member server under the Active Directory (DC)
Chrome browser 80.0.3987.122 (for windows & Linux)	A web browser which has been developed by Google	Every result from web scripting will show up on Chrome browser
MS Excel 2019 16.0.6742.2048	A spreadsheet application developed by Microsoft	CSV files will be monitored and modified on this application
Pfsense 2.4.4-p3	Open-sourced virtual firewall/router	Core virtual component to connect with LAN and WAN and configure firewall rules
.NET Framework 4.8.0 Build 3928	Framework software which help some Microsoft application run	Necessary application to run MS Exchange 2016 CU 14
Apache httpd 2.4.41	Providing web server feature on Linux	Every web site will be configured as virtual hosts using this application
Visual Studio Code 1.42.1	Multi-platform IDE for multiple programming languages including scripts	All scripting tasks will be worked on Visual Studio Code 1.42.1
Python 3.8.2	High-level and interpreted script language	It will be used for auto-generated random numbers in CSV files to display graphs in real-time

6.3.5. Services

Components	Description	Remarks
Web service	Providing web sites for clients to access to graphical data	All scripts should be worked or placed on this web server except Python
Backup/restore service	Supporting scheduled backup system and restoring features for clients	Initial CSV files and auto-generated CSV data files are stored in backup server
Active Directory/DNS service	Management of employees using object-oriented service on Windows server	Active directory service should contain DNS service to resolve IP addresses under the designated domain name
DHCP service	Distribution of automatically generated IP addresses and resolved name via the addresses	IP addresses in this project's subnet should be considered by all devices including printer, tablet, or phones
Mail service	Easily finding receivers and sending messages through Exchange and Active Directory	Exchange should be a member server of the Active Directory to get all users' accounts

6.4. Component Overview

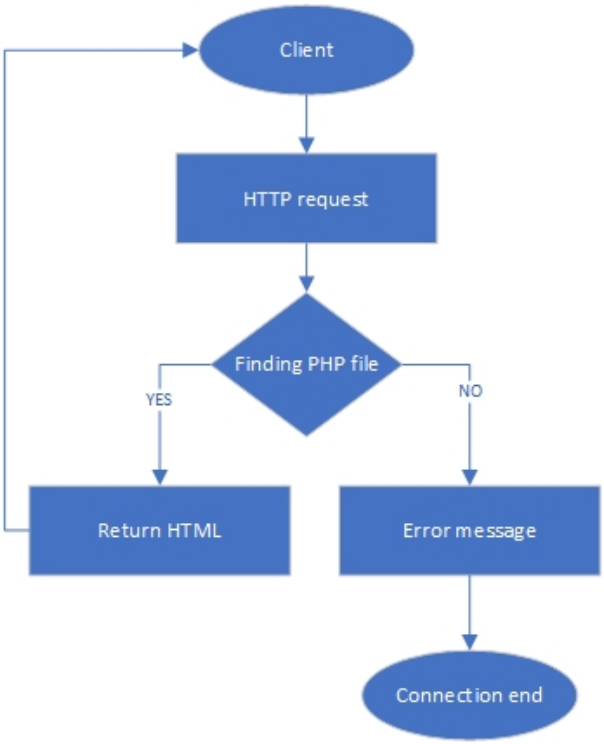
6.4.1. Analysis/Flow chart



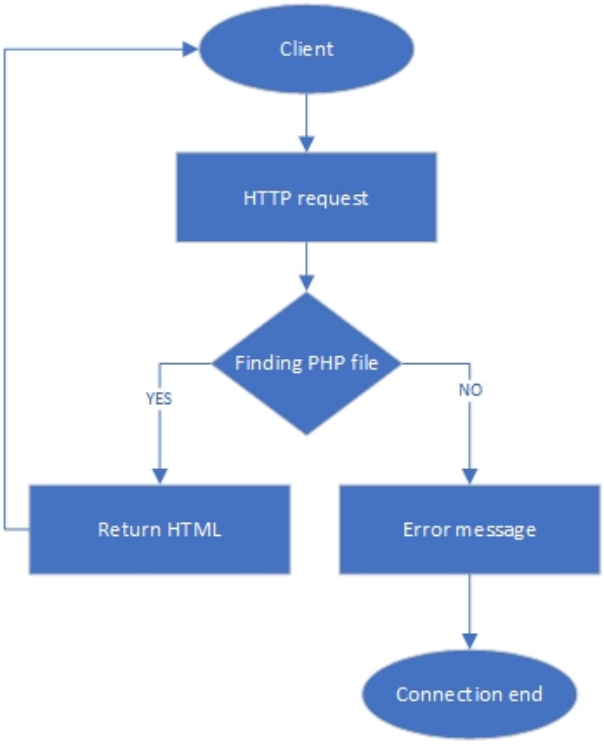
Step	Description
1	A client fills a login form and submit it.
2	Login information is transferred via ISP.
3	The user's ID and password are checked with the data of database.
4	If the data is validated, the web server gets a 'validation confirmed' message.
5	The web server requests the raw file from the file server.
6	The file server sends the requested file to the web server.
7	The web server sends web page and file information.
8	A client's web browser generates the code to graphs.

6.5. System Requirements

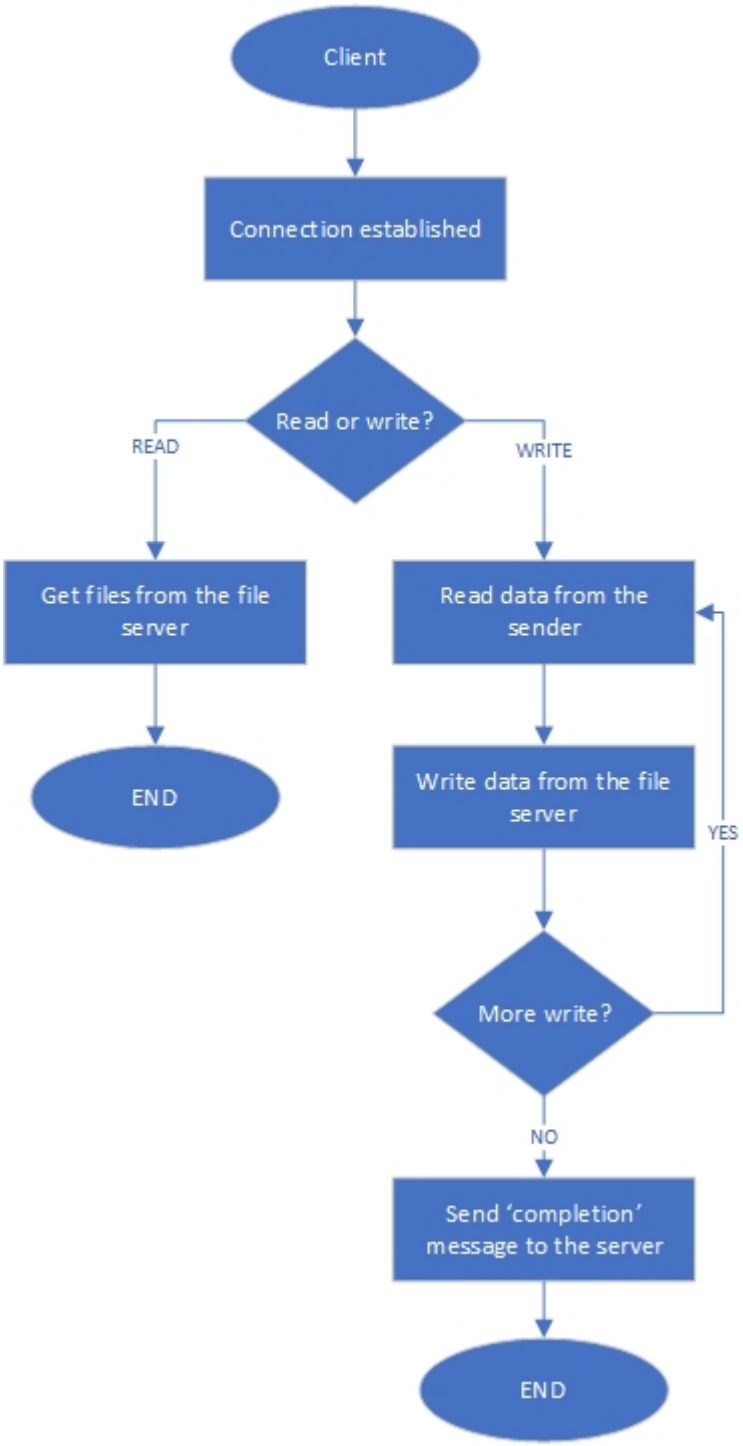
6.5.1. Web Server



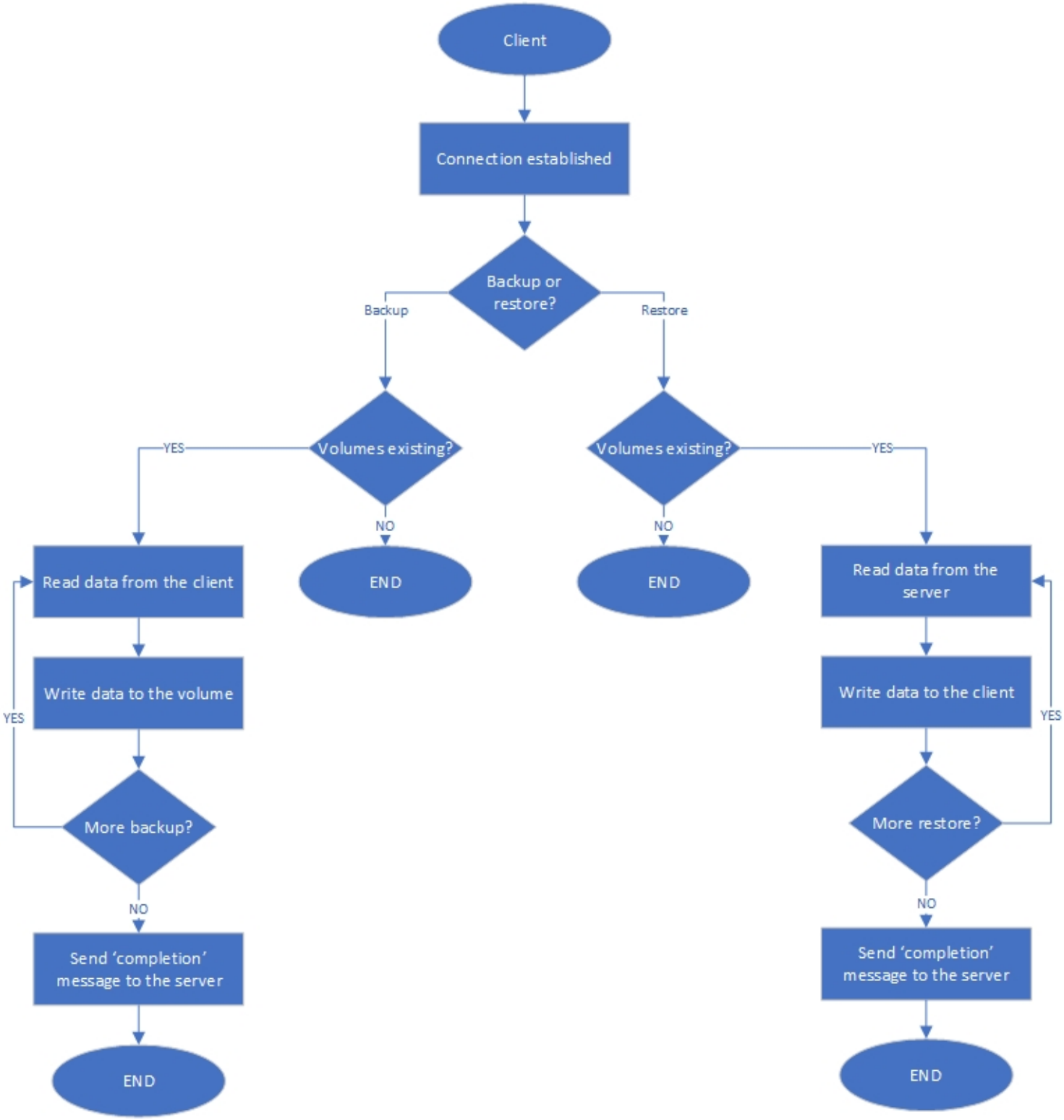
6.5.2. Database Server



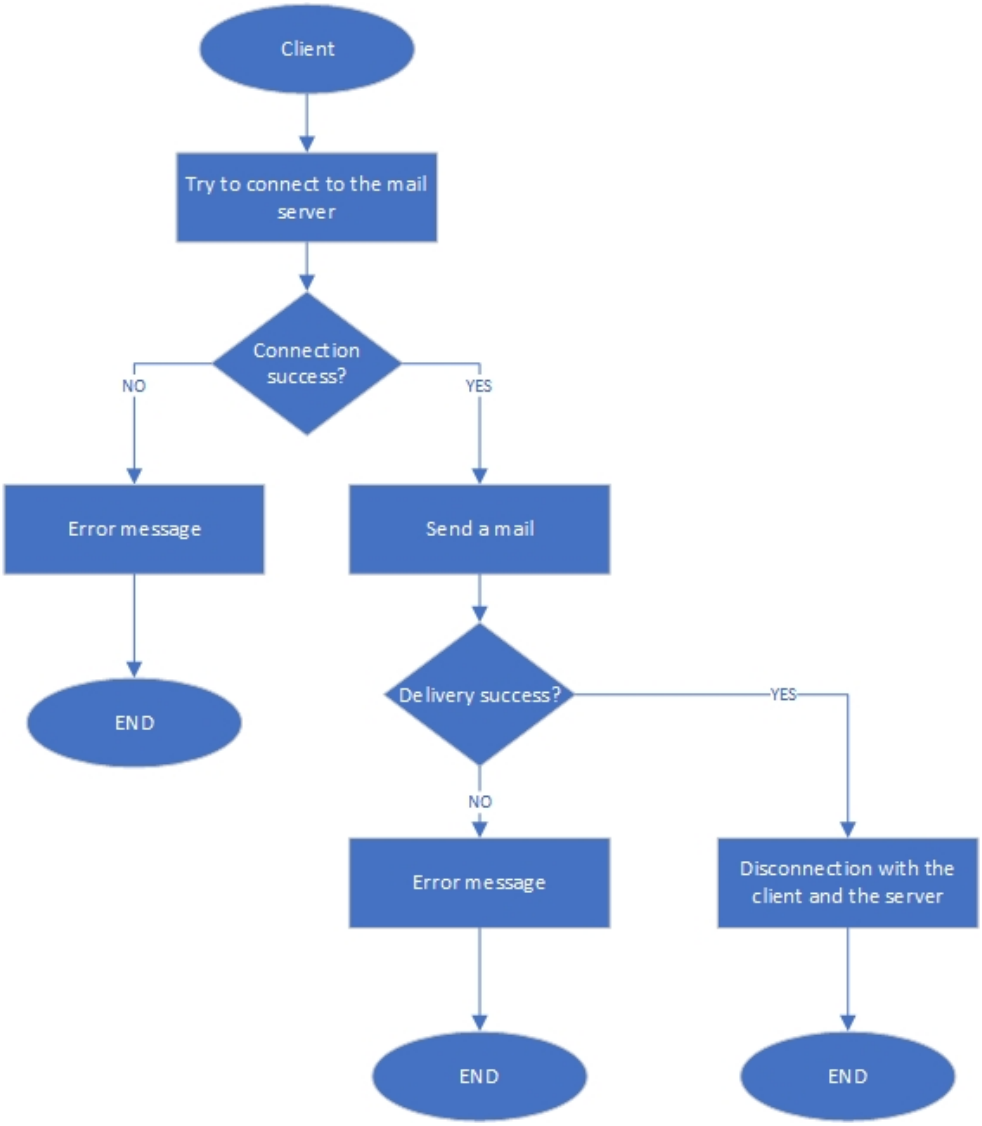
6.5.3. File Server



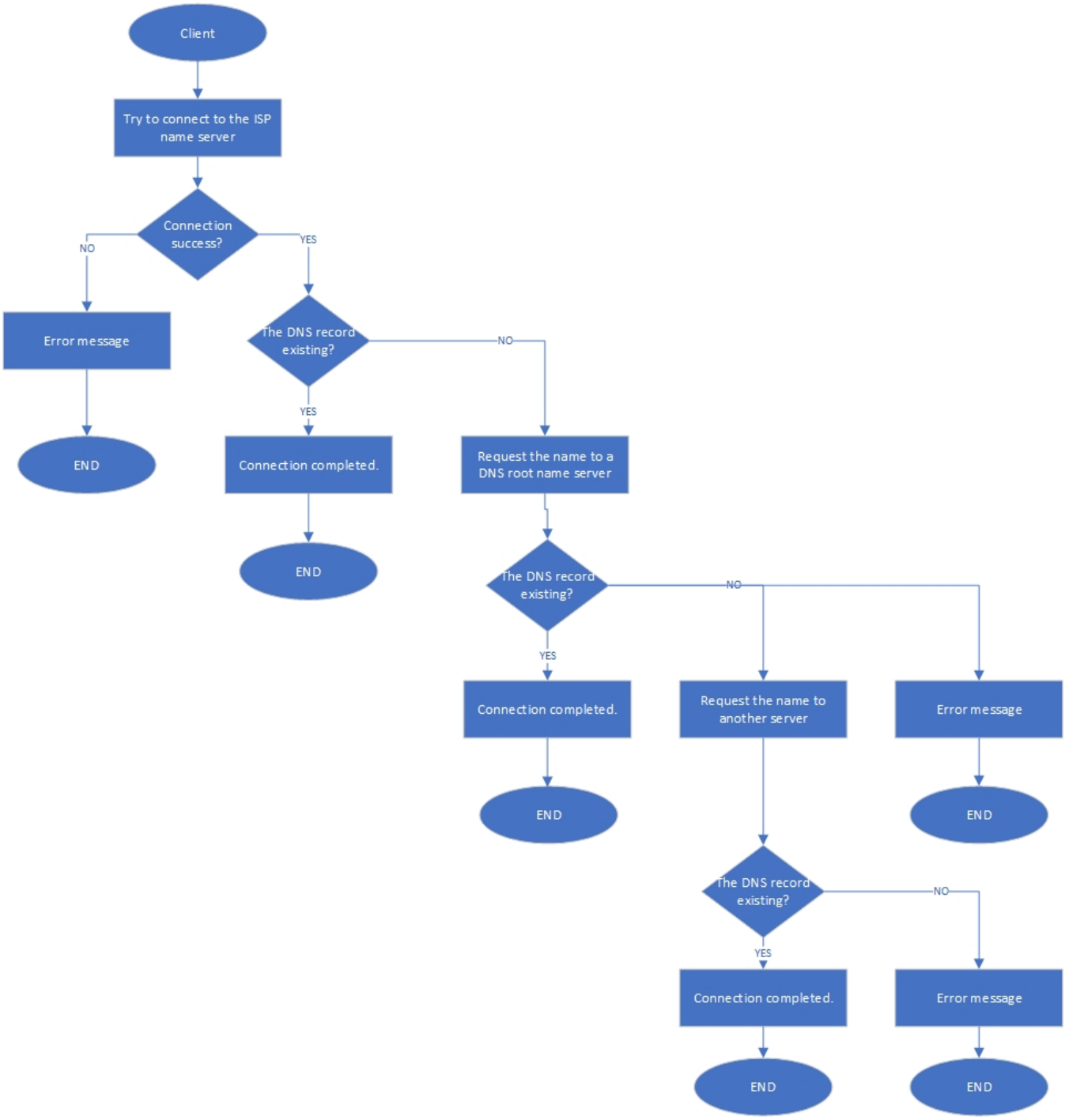
6.5.4. Backup Server



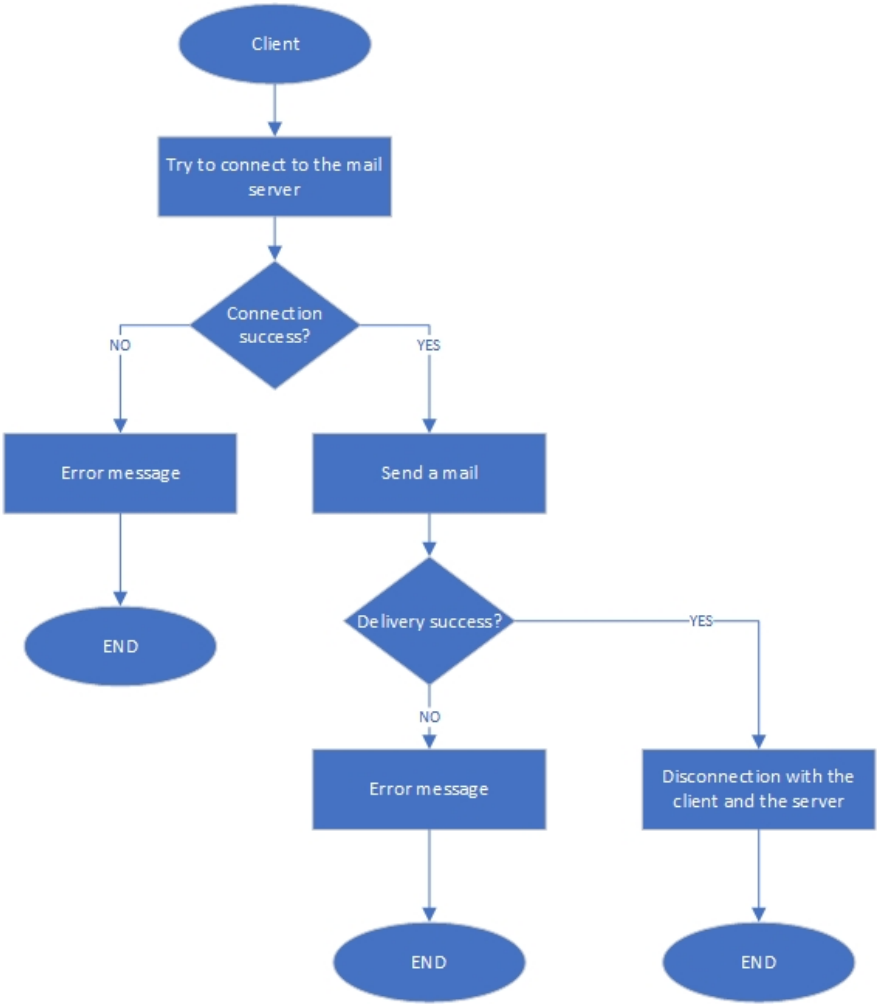
6.5.5. Mail Server



6.5.6. DNS Server



6.5.7. DHCP Server



7. Glossary

7.1. Acronyms

DB	Database
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System.
HTTP	Hypertext Transfer Protocol. The
ISP	Internet Service Provider
PHP	Personal Home Page
LAN	Local Area Network
VPN	Virtual Private Network
WAN	Wide Area Network

7.2. Terms

Anti-Virus	A computer program designed to detect and remove computer viruses. [1]
Crypto Locking	(See “Ransomware”)
Encryption	A means of encoding data so that only authorized parties can access it. [2]
Firewalls	A network security system that monitors and controls incoming an outgoing network traffic, based on predetermined rules. [3]
Intrusion Detection Systems	A device or software application that monitors a network or systems for malicious activity or policy violations. [4]
Malware	Any software intentionally designed to cause damage to a computer or network. [5]
Ransomware	A type of malware that threatens to permanently block access to a victim’s data unless a ransom is paid. It may use encryption which is difficult to reverse. [6]
Virus	A type of malware that, when executed, replicates itself by modifying other computer programs and inserting its own code. [7]
Virtual Machine	An emulation of a computer system. [8]

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[1] Wikipedia, "Antivirus Software," [Online]. Available: https://en.wikipedia.org/wiki/Antivirus_software.

[2] Wikipedia, "Encryption," [Online]. Available: https://en.wikipedia.org/wiki/Encryption.

[3] Wikipedia, "Firewall (computing)," [Online]. Available: https://en.wikipedia.org/wiki/Firewall_(computing).

[4] Wikipedia, "Intrusion detection system," [Online]. Available: https://en.wikipedia.org/wiki/Intrusion_detection_system.

[5] Wikipedia, "Malware," [Online]. Available: https://en.wikipedia.org/wiki/Malware.

[6] Wikipedia, "Ransomware," [Online]. Available: https://en.wikipedia.org/wiki/Ransomware.

[7] Wikipedia, "Computer Virus," [Online]. Available: https://en.wikipedia.org/wiki/Computer_virus.

[8] Wikipedia, "Virtual Machine," [Online]. Available: https://en.wikipedia.org/wiki/Virtual_machine.