



The 2nd International Conference on Applied Information and Communication Technology



ICo-ApICT 2015

2nd International Conference On Applied
Information and Communication Technology



*Improving Welfare through
Information and Communication Technology*



FACULTY OF ENGINEERING & COMPUTER SCIENCE
UNIVERSITAS KOMPUTER INDONESIA
BANDUNG, November 10, 2015





**The 2nd International Conference on
Applied Information and Computer Technology
UNIVERSITAS KOMPUTER INDONESIA**
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PROCEEDING

**2nd international conference on
applied Information and Computer Technology**

**ICo-ApICT 2015
UNIVERSITAS KOMPUTER INDONESIA
October 10, 2015**



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PROCEEDINGS

International Conference

2nd International Conference on Applied Information and Communication Technology
"Improving Welfare Through Information and Communication Technology"

Bandung, October 10, 2015

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Foreword

ICo-ApICT is an international conference held by the Faculty of Engineering and Computer Science, Universitas Komputer Indonesia. The 2015 conference is the second one, following the successful first one on October 2013. The 2015 ICo-ApICT theme "Improving Welfare through Information Technology" is emphasizing the use of the information technology in everyday life to enhance common welfare.

Therefore, the ICo-ApICT is inviting all the reseachers from academic institution as well as research institute, industry, professional, goverment officer from Indonesia and abroad to share the research, the knowledge and all the creative ideas in relation to the conference theme.

The conference is about to discuss the newest issues regarding the ICT application that hopefully will strengthen the international relationship between researchers, as well as to become a sharing media for those who involved in creating and using of ICT application.

Contents

Credit title i

Contents ii

Invited Speakers

Pham Ngoc Nam 1

Zulkhairi Md Dahalin 6

Plenary Panels I

CREATIVE INDUSTRY ASSET MANAGEMENT MODEL WITH SM@RT ASSET BSC IN BANDUNG RAYA I.1 - 10
Deden A. Wahab Sya'roni, Supriyati, Hery Dwi Yulianto, Apriani Puti Purfini

FLASH FLIP BOOK APPLICATIONS TO MEASURE THE LEVEL OF NATIONALISM ON PRIMARY SCHOOL STUDENTS I.11 – 18
Yessy Asri, Yessy Fitriani

RW-NET IN BANDUNG CITY, AN INNOVATION TOWARDS A COMMUNICATIVE CITY BY PROMOTING COMMUNITY MONITORING AT THE NEIGHBORHOOD LEVEL I.19 – 24
Ridwan Sutriadi, Tatang Suheri, Rifiati Safariah

IMPLEMENTATION OBJECT ORIENTED PROGRAMMING (OOP) FOR INFORMATION SYSTEM MONITORING PROMOTIONAL ACTIVITY I.25 -36
Gregorius Hendita

DESIGN AND DEVELOPMENT NETWORK ATTACHED STORAGE FOR ELEMENTARY SCHOOL ACADEMIC DATA CENTER (CASE STUDY: GUGUS 45 BANDUNG) I.37 – 44
Gilby Benaya Lesar, Irawan Afrianto

DEVELOPMENT OF ARCHERY TOOLS SIMULATION MODEL BASED ON EMBEDDED SYSTEM I.45 – 50
Darma Rusjdi, Dian Hartanti

ACCOUNTING INFORMATION SYSTEMS AT THE ORGANIZATION OF NATIONAL ZAKAT MANAGEMENT I.51 – 54
Adeh Ratna Komala

DESIGN OF MULTI-TENANCY ARCHITECTURE SOFTWARE AS A SERVICE (SAAS) QUALITY ASSESSMENT TOOL I.55 – 66
Alif Finandhita

DESIGNING INFORMATION TECHNOLOGY SERVICE GOVERNANCE IN PT X USING COBIT 4.1 AND ITIL V.3 I.67 – 76
Gentisya Tri Mardiani

Plenary Panels II

WEB BASED INTEGRATED SMARTHOME APPLICATIONS: CONTROL, MONITORING AND SECURITY Susmini Indriani Lestaringati	II.1 – 6
THE APPLIED COMPARISON MODELING BETWEEN ALGORITHM C4.5 AND C4.5 BAGGING-BASED ALGORITHM TO CLASIFY AND ANALYSE PILGRIMS IN CIREBON 2014 – 2025 Dadang Sudarajat, Tri Ginanjar Laksana	II.7 – 16
SECURITY ATTACK ALGORITHMS IN WIRELESS SENSOR NETWORK Sri Supatmi, Irfan Dwiguna Sumitra	II.17 – 22
THE STUDY OF C4.5 (DECISION TREE MODEL) CLASSIFICATION ALGORITHM TO ANALYSE AND PREDICT THE ECONOMIC BASED EFFECTIVE CONTRACEPTIVES Tri Ginanjar Laksana, Dadang Sudarajat	II.23 – 34
ANALYSIS OF ACCEPTANCE KULIAHONLINE UNIKOM SERVICES USING TECHNOLOGY ACCEPTANCE MODEL (TAM) Sufa'atin	II.35 – 42
AUDIT IT GOVERNANCE IN PDAM TIRTAWENING KOTA BANDUNG USING COBIT 5 Anna Dara Andriana	II.43 – 50
SMART INTERACTIVE CAMPUS MAP FOR UNIVERSITAS KOMPUTER INDONESIA Muhammad Aria, Agus Mulyana, Deni Albar	II.51 – 56
PROTOTYPE APPLICATION DISTRO CLOUD INVENTORY Citra Noviyasari	II.57 – 62
MANAGEMENT SYSTEM DESIGN OF THE COMPUTER LABORATORY AS OPTIMIZATION ELECTRICAL POWER Rizqia Cahyaningtyas, Efy Yostira, Wisnu Hendro Martono, Rifky Raymond	II.63 – 68

Plenary Panels III

SPECIAL CALCULATOR FOR THE BLIND WITH INPUT BRAILLE CODE BASED ON MICROCONTROLLER Hidayat, Sono Istiana	III.1 – 6
BIOINFORMATICS IMPLEMENTATION AT THE ANDROID-BASED EMBEDDED SYSTEMS : A CASE STUDY IMPLEMENTATION OF HMM -BASED CONTROLLER EXON ON ARM926T PROCESSOR Binti Solihah, Suhartati Agoes, Alfred Pakpahan	III.7 – 12
PROSTHETIC ROBOTIC ARM CONTROL SYSTEM USING EMG SIGNAL DETECTION Jana Utama, Abdul Barry Husein	III.13 - 18
EMBEDDED SYSTEM PRACTICUM MODULE DESIGN TO INCREASE STUDENT COMPREHENSION OF MICROCONTROLLER-BASED EMBEDDED SYSTEM TECHNOLOGY AND COURSE Indrianto, Meilia Nur Indah Susanti	III.19 – 24
SNAPPER FISH DISEASES DIAGNOSIS USING ANDROID BASED APPLICATION Sri Nurhayati	III.25 – 30

EARLY DETECTION ON DIABETIC RETINOPATHY STAGE LEVEL BASED ON KNOWLEDGE BASE USING EXTREME LEARNING MACHINE METHOD Desti Fitriati	III.31 – 38
MULTI-PRECISION INTERVAL ARITHMETIC UNIT FOR REAL TIME SYSTEM Agus Mulyana, Yusrila Yeka Kerlooza	III.39 – 44
SECONDARY SURVEILLANCE RADAR (SSR) INTERROGATOR ANALYSIS ON TRANSMISSION FREQUENCY OF 1030 MHZ Dimas Widyasastrena	III.45 – 48
DESIGN TRAINER MIKROKONTROLER ARDUINO BOARD AS MEDIA LEARNING IN VOCATIONAL HIGH SCHOOL (SMK) Sutono	III.49 – 60

Plenary Panels IV

ACCOUNTING INFORMATION SYSTEM DESIGN RECEIVABLE AT SANTO BORROMEUS HOSPITAL BANDUNG USING SOFTWARE MICROSOFT VISUAL BASIC.NET AND DATABASE MYSQL Dony Waluya Firdaus, Uus Rusmana	IV.1 – 10
MOBILIZING THE PARTNERSHIPS MODELS AS A STEP FOR SUSTAINABILITY IN GREEN OPEN SPACES PROCUREMENT IN BANDUNG, INDONESIA Dhini Dewiyanti, Dewi Kurniasih	IV.11 - 20
ANALYSIS OF THE PRODUCTION PROCESS QUALITY CONTROL OF AIRBUS A-380 USING THE CONCEPT OF LEAN SIX SIGMA APPROACH AT PT DIRGANTARA INDONESIA BANDUNG Giri Hardyantoro Aziz, Julian Rebecca	IV.21 – 28
IMPROVING SERANG-BANTEN FARMERS WELFARE THROUGH AGROPOLITAN BUSINESS PARK Salmon Priaji Martana	IV.29 - IV.32
QUALITY CONTROL PROPOSAL USING SEVEN TOOL OF STATISTICAL PROCESSING CONTROL ON THE TRANSFORMER PRODUCT AT PT NIKKATSU ELECTRICS WORKS Tegar Mahardika, Iyan Andriana	IV.33 – 42
THE IMPACT OF INFORMATION TECHNOLOGY INFRASTRUCTURE ROLE TO E-SPT IMPLEMENTATION Ony Widilestariningtyas	IV.43 – 46
DESIGN OF ACCOUNTING INFORMATION SYSTEM SHOPPING OPERATING AND MAINTENANCE FACILITIES AND INFRASTRUCTURE WITH MICROSOFT VISUAL BASIC 2008 AND MYSQL SERVER Hery Dwi Yulianto, Asty Astuty Permana	IV.47 – 64
PROPOSED AUTONOMOUS MAINTENANCE OF PREFORM MANUFACTURING AT PT. COCA-COLA BOTTLING INDONESIA, BEKASI Andi	IV.65 – 74

DESIGN OF MANAGEMENT INFORMATION SYSTEM COST OF GOOD SOLD AND
PROFIT ESTIMATE BASED ON THE RELEVANT COST AND BENEFITS METHOD IN
JOINT PRODUCT ON UMKM CREATIVE INDUSTRIES IN THE CITY OF BANDUNG
USING PHP AND MYSQL
Supriyati, Leni Novianti

IV.75 - 84

Preface

ICT technology has developed rapidly in various scientific fields. This is an opportunity and a challenge for developing countries like Indonesia to be able to pursue the utilization of ICT technology to improve the welfare of the Indonesian people.

The 2015 International Conference on Applied Information and Communication Technology or known as ICo ApICT 2015 is the second event to discuss the newest issues regarding the ICT application that hopefully will strengthen the international relationship between researchers, as well as to become a sharing media for those who involved in creating and using of ICT application. The 2015 Ico ApICT theme “**Improving Welfare through Information Technology**” is emphasizing the use of the information technology in everyday life to enhance common welfare.

Muhammad Aria

DESIGN AND DEVELOPMENT NETWORK ATTACHED STORAGE FOR ELEMENTARY SCHOOL ACADEMIC DATA CENTER (CASE STUDY: GUGUS 45 BANDUNG)

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Abstract

Network Attached Storage is a technology development from the file server. NAS is a server with an operating system that is devoted to serving the needs of the data file. While the School Cluster is an institution / organization as a center for the development of the surrounding primary schools which have the purpose of improving the quality of education. Cluster School 45 Bandung is one of the School Cluster in Bandung, which has eleven elementary impact and one that is in essence SD Cijerah, District Kulon Bandung, Bandung. Cluster School 45 Bandung has a problem in the distribution of data, data collection and data storage with Elementary Schools. Data distribution and data collection is still done manually using a flashdrive or CD and Gugus 45 also does not have a special storage.

Therefore created a system that can help in terms of storage, distribution and collection of data that is building Data Center-based NAS (Network Attached Storage) using PPDIIO as system development method. This must be supported with minimum infrastructure that has been done in the analysis phase.

With the construction of this NAS-based data center, its help supervisors, operators, the principal and KKG in Gugus 45 and the elementary schools in managing data that is done. And of course this makes data management in the cluster and its 45 elementary schools to be efficient outcome in terms of time and data centers are built to ensure the availability of data for the users.

Keywords: *NAS (Network Attached Storage), PPDIIO, School Cluster (Gugus), Data Center*

1. Introduction

School cluster (Gugus) is an institution / organization as a center for the development of elementary schools in the surrounding areas that have the goal of improving the quality of education.

Cluster schools usually handle five to eight elementary schools in the region. School groups also have the task of overseeing any good elementary school teacher performance, employees and principals as well as a data center for elementary schools academic handled.

The Gugus 45 Bandung is one of a cluster of schools in Bandung, which has eleven Elementary Schools swept up and one SD core residing in Cijerah Subdistrict, Bandung Kulon, Bandung. Elementary School core that handled the cluster school is Budding Hope Elementary School, while Elementary School outbreak handled i.e. SDN Cijerah 1-4, SDN Sayuran 1-5, SDS, SDS Andir Mukti, Bandung Raya. Basically every time period, elementary school academic data to Cluster schools for review by the watchdog group comes from the Office of education and in the forward to the Office of education of Bandung city.

In this case the cluster School 45 Bandung frequently experience problems in distributing data, data collection and data storage was done manually, and user involved in the management of such data is a supervisor, the operator, the operator of cluster school, principal with KKG (Working Group on teacher).

With the construction of this NAS-based data center, its help supervisors, operators, the principal and KKG in Gugus 45 and the elementary schools in managing data that is done. And of course this makes data management in the cluster and its 45 elementary schools to be efficient outcome in terms of time and data centers are built to ensure the availability of data for the users.

2. Purpose of Research

The purpose of research is:

1. Helps make it easier for the Operator and the operator school Cluster along with KKG in doing data management in the Gugus 45.
2. Build a specialized data storage to ensure the availability of data on primary school academic computer networks.

3. Give the ease of update data that is maintained for the efficiency of the time.

3. Literature Review

a. Network Attached Storage (NAS)

Over time the development of the technology, then the file server has been developed by experts, for example the development of a file server is a Network Attached Storage (NAS). (Sean K, 2011) Network Attached Storage (NAS) is an operating system with a server devoted to serving the needs of data files. NAS can be accessed directly via a local area network with TCP/IP protocols.

(T Akbar, 2013) NAS would own the benefits there are in the system recoverynya, that is, at the time one of the broken host can be backed up. NAS not am committed with just one server only, have a high transfer rate speed with the gigabite ethernet, and storage capacity of hard disk has 2 or more. NAS himself different from the server in General, i.e. NAS can be used only for storage (data storage) only.

b. Data Center

(Fauzi and Ekko, 2015) The data center or often known as data center is a facility that is used to place computer systems and associated components such as telecommunications and data storage system Based on its functions, the data center is divided into two general categories, namely:

1. The Internet Data Center, only support applications related to the internet, usually built and operated by the service provider or a company that has a business model based on Internet Commerce.
2. Corporate/Enterprise Data Center, supports all functions that allow various business models running on internet services, interanet and both.

A data center design criteria generally include:

1. Availability, data center was created to be able to provide continuous operation and continuous for an enterprise well under normal circumstances as well as in case of the occurrence of a malfunction which means or not. The data center must be built as much as possible approached zero-failure for all of its components.
2. Scalability & Flexibility, data centers must be able to adapt to the fast growing needs or when the presence of new services to be provided by the data center without making any appreciable changes mean for overall data center.
3. Security, data centers storing valuable company assets, hence the security system created as tightly

as possible good safeguards physical or non-physical.

c. CIFS (Common Internet File System)

(Noprianto, 2015) CIFS or Common Internet File System is an implementation of the Protocol file sharing/file-sharing Server Message Block (SMB) using UDP ports 137 and 138, and TCP 139 and 445, which has been suggested to be the standard of the Internet, so it can be retrieved easily . This protocol allows a group of users to be able to collaborate and share files over the internet or interanet company. CIFS has been seen as a possible replacement for Protocol File Transfer Protocol (FTP) and Network File System (NFS) Protocol file sharing and file management system. CIFS support the use of encrypted passwords, as well as the name of the file with a Unicode encoding. In addition CIFS can also be used to associate (mount) a remote file system as a directory or drive in a local machine, as if the remote file system is a file system.

Advantages compared to CIFS protocols FTP and HTTP file sharing protocol is that CIFS support read and write access to a file simultaneously; While HTTP and FTP supports only simple file transfer only. While, if compared with NFS, CIFS protocol offers some advantage improved performance with the features of read-ahead, write-behind and opportunistic locks .

d. Prepare, Plan, Design, Implement, Operate, and Optimize (PPDIOO) Network Lifecycle

(Odon and Wendell, 2004) A system development method is performed using the method Prepare, Plan, Design, Implement, Operate, and Optimize (PPDIOO) Network Lifecycle. Method and architecture was created by Cisco to support the goals of the business conducted. PPDIOO method has a sustained phase of circle, and each converted have measures to make the network planning, design, implementation and operation. And this method is owned by phase there are 6, Prepare, Plan, Design, Implement, Operate, and Optimize where we know with PPDIOO. The PPDIOO method is shown in **figure 1**.

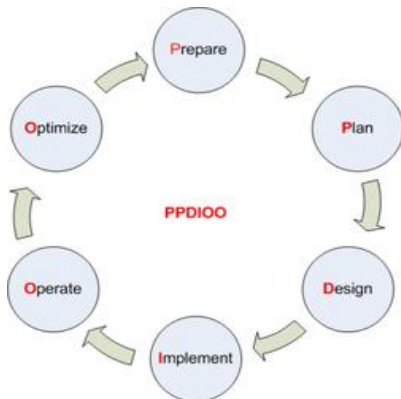


Figure 1. PPDIIO Method (Prepare, Plan, Design, Implement, Operate, Optimize) Network Lifecycle (Odon and Wendell, 2004)

4. Result and Discussion

a. Network Analysis

Network analysis carried out in Bandung and its cluster of 45 all SD swept up with 7 different locations (Gugus 45, SDN Sayuran 1,4,5, SDN Sayuran 2,3, SDN Cijerah 1,2, and SD Tunas Harapan, SDN Cijerah 3,4, SD Bandung Raya, SDS Andir Mukti) are modelled with topology. With the exception of the SD Andir Mukti is not modeled in the topology because there is only a laptop and internet connection using a USB modem.

1. Gugus 45 Bandung Topology

Network analysis performed in the Gugus 45 Bandung that is as follows in **figure 2**:

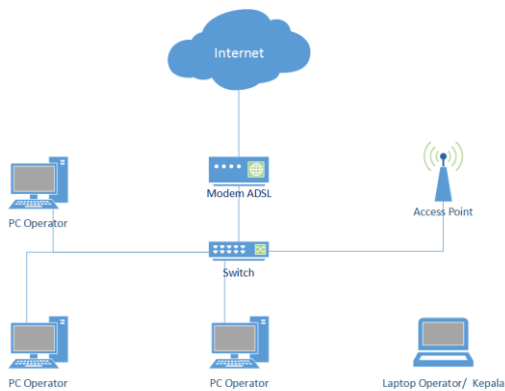


Figure 2. Computer Network Topology of Gugus 45

And network resource in the Gugus 45 can be seen in **table 1** below.

Table 1. Network Resources in Gugus 45

Description	
Range IP Address	192.168.1.1 – 192.168.1.255
Subnet	255.255.255.0
Hosts	3-5 units
Provider	Indischool (Speedy)
Bandwidth	Up to 10 Mbps
PC/Laptop User	4 units
Access Point	1 unit
Switch	8 port / 1 unit (<i>unmanage</i>)
Modem ADSL	1 unit

2. Elementary Schools Network Topology

As for the network topology and the availability of the hardware in the environment of SD Induced represented with 1 design topology (SDN Sayuran 1-5, Cijerah 1-4, SD Tunas Harapan) as follows in **figure 3**.

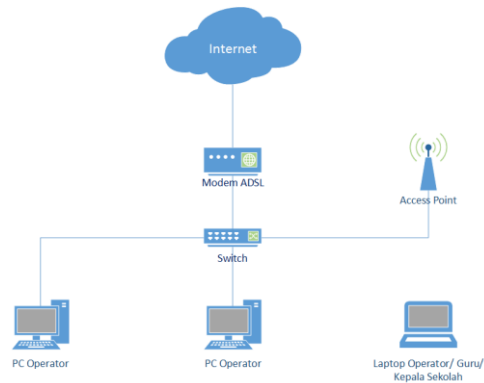


Figure 3. Computer Network Topology of SD Imbas (SDN Sayuran 1-5, SDN Cijerah 1-4, SD Tunas Harapan)

Table 2 Network Resources in SD Imbas (SDN Sayuran 1-5, SDN Cijerah 1-4, SD Tunas Harapan)

Description	
Range Alamat IP	192.168.1.1 – 192.168.1.255
Subnet	255.255.255.0
Jumlah Host	3-5 unit
Provider	Indischool (Speedy)
Bandwidth	Up to 10 Mbps
PC/Laptop User	4 units
Access Point	1 unit
Switch	8 port / 1 unit (<i>unmanage</i>)
Modem ADSL	1 unit

3. Topologi Jaringan SD Bandung Raya

Network analysis in SD Bandung Raya as follows in **figure 4**:

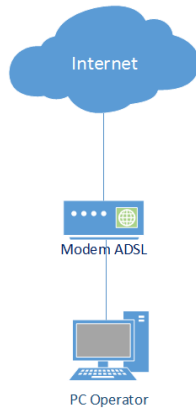


Figure 4. Computer Network Topology of SD Bandung Raya

Table 3. Network Resources in SD Bandung Raya

Keterangan	
Range Alamat IP	192.168.1.1 – 192.168.1.255
Subnet	255.255.255.0
Jumlah Host	1 unit
Provider	Speedy
Bandwidth	2 Mbps
PC/Laptop User	1 unit
Modem ADSL	1 unit

b. Users Analysis

In the operation of a File Server-based NAS (Network Attached Storage), its need basic knowledge and ability in the operation of the computer, internet and file sharing. As for the users in Gugus 45 SD and swept up basically to operate the computer. Here are the details of the ability of the users in the cluster School 45 Bandung with SD Imbas based on observations and interviews, can be seen in **table 4**.

c. Software Analysis

Software is a device used in operating the computer. **Table 5** is the operating system used on the client computers and laptops on the research of Cluster School in Bandung and SD 45-induced:

d. Hardware Analysis

Gugus 45 Bandung with SD Imbas has a total of 13 PCs Client, 7 Laptops Client, 5 Switchs, 6 ADSL, 5 Access Points, 1 USB Modem which is located around the site. Hardware analysis is shown in **table 6**.

e. Capacity Planning Analysis

As for the capacity planning analysis is conducted to find out the needs of capacity Gugus 45 in a certain time period. It can be seen in **table 7**.

Table 4. User Knowledge Analysis

User	Knowledge
Operators	<ol style="list-style-type: none"> Has the basic capabilities in the field of computer (Copy, Move, Edit, Explorer, Save, Exit, Login, etc.) Run the operating system Windows Xp or Windows 7, Microsoft Office (Word, Excel) Can use network applications related to internet (upload, download, etc.). Know the basics of LAN network (set up IP Address, File Sharing)
Operator Gugus	<ol style="list-style-type: none"> Has the basic capabilities in the field of computers (Copy, Move, Edit, Explorer, Save, Exit, Login, etc.) Run the operating system Windows Xp or Windows 7, Microsoft Office (Word, Excel). Can use network applications related to internet (upload, download, etc.). Know the basics of LAN network (set up IP Address, File Sharing).
Teachers	<ol style="list-style-type: none"> Has the basic capabilities in the field of computers (Copy, Move, Edit, Explorer, Save, Exit, Login, etc.) Run the operating system Windows Xp or Windows 7, Microsoft Office (Word, Excel)

Table 5. Operation System Client Analysis

Type	Operation System
PC/laptop Client	Windows XP, Windows 7, 8

Table 6. Hardware Analysis in Gugus 45 and SD Imbas

Type	Total
PC Client	13 units
Laptop Client	7 units
Switch	5 units
Modem ADSL	6 units
Access Point	5 units
Modem USB	1 units

Table 7. Capacity Planning Analysis

No	Name	Total	Min. Req.	Recommendation Req.
1	Fix Data	27,6 GB	41,4 GB	55,2 GB
2	Not Fix Data	82,8 GB	165,6 GB	182,6 GB
TOTAL			207	237

f. System Design

Once the analysis is complete, the next step is the design of the system. The design of the NAS system in the Gugus 45 is as follows

1. Description of The System to be Built

On network topology designed in fact does not have much change because the network used is the network WAN, as well as access to the server via the internet, connected through the VPN network making the task of designing only dotted at 2 point, namely:

1. Local Network (End Point/Client) to the Internet
2. Server network to the Internet

Changes that occur on the local network client physically is no because to access the server only needed an Internet connection that basically has been there before. As for the increased physical server is a network of FreeNAS. The following is the description of the network topology of the system being designed.

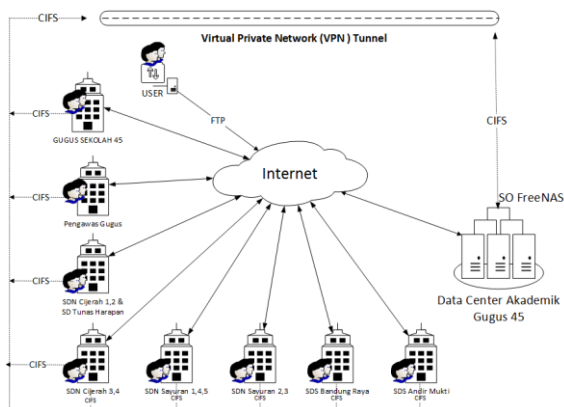


Figure 5. Description of Connectify System from Instance to NAS Server

Network architecture to be constructed as shown in **Figure 5**, where each user will be grouped based on establishments. Every user that has grouped the data center can access academic Cluster 45 through the internet network. However, every user who accesses the data center using the CIFS service is required to use a VPN network. VPN on this

system is useful for simplifying the network, so as to make as if every user who connected to the data center into a single segment or one Network ID. Beside that, the user is given a different access rights in accordance with the position as in table 8. For file sharing academic data center service uses CIFS, where this service supports file sharing simultaneously.

2. Users Permission

Each user will have different permission tailored to the Office and duty of each, can be seen in **table 8**.

Table 8. Users Permission on System

Position	The Authority
Gugus Supervisor	Reserves the right to access, monitoring, verification and validation of the entire academic data that is handled by Gugus 45, besides supervisor cluster can give instructions to all members of the cluster to store/collecting/distribute data.
Gugus Chairman	Reserves the right to access all data handled by the academic Gugus 45. And also has the right to berkordinasi with school-related data in
Headmaster	Reserves the right to access all data at the academic school respectively.
KKG Coordinator	Reserves the right to access the data that is managed by the teachers.
Gugus Operator	Reserves the right to access and manage data elementary school and academic data maintained in Gugus 45 for recapitulation.
School Operator	Reserves the right to access and manage data elementary school and academic data from each school
Teacher	-

g. System Implementation

After this stage of the analysis and the design is done, then the system has been designed will be implemented. As for the stage of installation and configuration is done against the server NAS and is hosted on a computer network in Gugus 45 Bandung, namely:

1. Hardware Implementation of NAS Server

Here are the specifications of dedicated-server NAS that has been installed, including:

Table 9. Dedicated-server NAS Spesification

No.	Device	Total	Spesification
1.	CPU	1 unit	Intel(R) Xeon(R) CPU E5504 @2.00GHz
2.	RAM	1 unit	2 GB
3.	Harddisk	1 unit	500 GB
4.	Flashdisk	1 unit	8 GB
5.	Bandwidth	-	10 Mbps Local, 2 Mbps International
6.	IP Public	1 unit	-

2. Software Implementation of NAS Server

Software on the NAS server are used namely FreeNAS 9.3 STABLE Operating System.

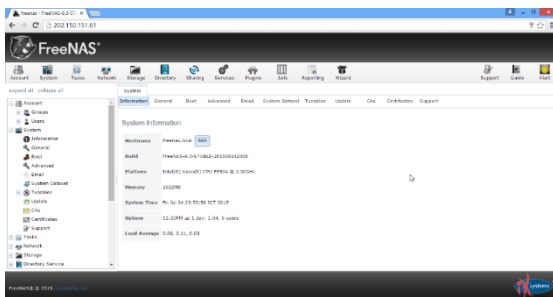


Figure 5. Web Interface FreeNAS 9.3

3. Create Users and Groups

Creation of user and group are conducted in accordance with the conditions in the field. Each school complex will be made into 1 group and will be filled with the user that exists in the schools. Users and groups that are created can be seen in table 10.

Table 10. Description of Groups and Users

No	Group	Member
1	Pengawas	1. Pengawas01 2. Pengawas02
2	KKG	1. (Seluruh Guru & Kepala Sekolah) 2. pengawas01 3. ops_gugus01
3	Gugus	1. Ops_gugus01 2. Ketua_gugus 3. pengawas01
4	KSD_Sayuran_1_4_5	1. guru_sayuran1 (sample) 2. ks_sayuran1 3. ops_sayuran1 4. guru_sayuran4 (sample) 5. ks_sayuran4

		6. ops_sayuran4 7. guru_sayuran5 (sample) 8. ks_sayuran5 9. ops_sayuran5
5	KSD_Sayuran_2_3	1. guru_sayuran2 (sample) 2. ks_sayuran2 3. ops_sayuran2 4. guru_sayuran3 (sample) 5. ks_sayuran3 6. ops_sayuran3
6	KSD_Cijerah_1_2	1. guru_Cijerah1 (sample) 2. ks_Cijerah1 3. ops_Cijerah1 4. guru_Cijerah2 (sample) 5. ks_Cijerah2 6. ops_Cijerah2
7	KSD_Cijerah_3_4	1. guru_Cijerah3 (sample) 2. ks_Cijerah3 3. ops_Cijerah3 4. guru_Cijerah4 (sample) 5. ks_Cijerah4 6. ops_Cijerah4
8	KSD_TunasHarapan	1. guru_TunasHarapan (sample) 2. ks_TunasHarapan 3. ops_TunasHarapan
9	KSD_AndiMukti	1. guru_andirmukti (sample) 2. ks_andirmukti 3. ops_andirmukti
10	KSD_Bandung Raya	1. guru_bandungraya (sample) 2. ks_bandungraya 3. ops_bandungraya

4. Design of Storage and Datasets

Configuration must also be done in the settings storage and dataset that will be used in this system. For the storage used is 500 GB.

Next create a dataset to split the volumes on the storage available. As for the dataset that is created is as much as 5 datasets, namely Data_Gugus, Data_Sekolah, Data_KKG, Data_Umum, Data_Pengawas.

After you created the dataset, then activate the CIFS service for distributing datasets in accordance with the permissions that have been designed.

Path	Name	Comm	Export	Read Only	Browsable to Network
/mnt/DATA	Data		false		true
/mnt/DATA/Data Gugus	Data Gugus		false		true
/mnt/DATA/Data KKG	Data KKG		false		true
/mnt/DATA/Data Pengawas	Data Pengawas		false		true
/mnt/DATA/Data Sekolah	Data Sekolah		false		true
/mnt/DATA/Data Umum	Data Umum		false		true

Figure 6. Datasets List

h. System Testing

After the stage of design and construction is done, the next is testing against WAN and computer network server NAS built on Gugus 45. The test is done to find out how efficient use of time in data transmission and data security.

1. Testing Availability of Data

The tests were carried out, to determine how well the NAS server to ensure availability of data in computer networks at 45 school clusters during business hours (9 hours) from Monday to Friday. The formula used to measure the availability of data is [27]:

$$AV (\%) = (AST-DT)/AST \times 100\%$$

Description:

AST = Agreed Service Time

DT = Down Time

Table 11 are the results of observations of the availability on the NAS server is done in 5 days and statistic of NAS server is shown in figure 7.

Table 11. Availability of Data Table

Days	Down Time (Hour)	Availability (%)
1	0	100
2	1	89
3	0	100
4	0	100
5	0	100

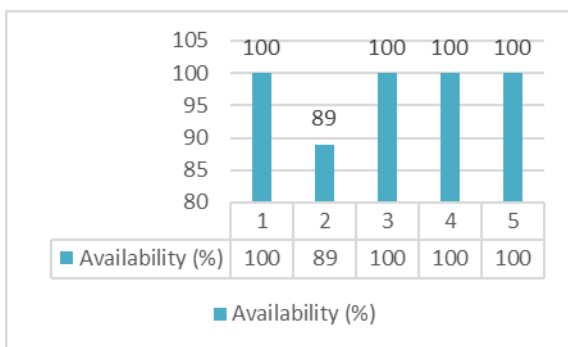


Figure 7. Statistic of NAS Server Availability Testing

2. Security Testing

As for security testing is done in the system to be built, such as authentication, permission and VPN.

Authentication of User Testing

The system is built using user authentication security upon log in. In this case the test will be performed if the user will try to log in with an incorrect password, then the notification will come out "Access is denied" as in Figure 8.

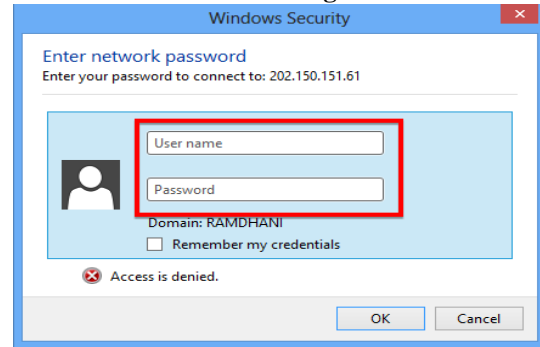


Figure 8. Authentication User Security

Permission Testing

Each dataset that was created for the sharing of security have each in terms of permissions or access rights. In testing this time will try to break the access rights are granted. For example a teacher with user guru_sayuran1 try to access to the folder the dataset Trustees, then the result is as shown in Figure 9.

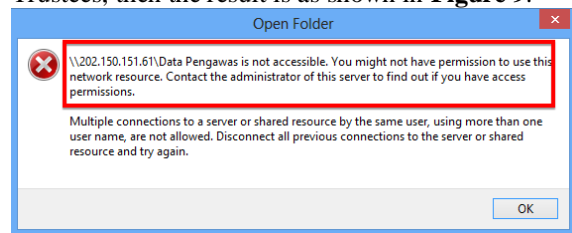


Figure 9. Permission Folder Security

Testing of VPN Security

Any user who does not connect with a VPN server, then the user will not be able to access the share folder given by the CIFS service. Can be seen in Figure 10.

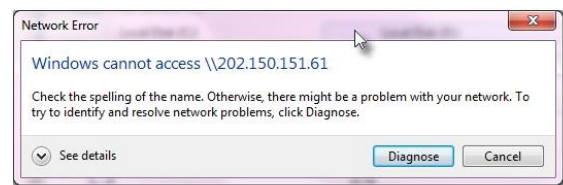


Figure 10. Network Error

1. Testing of Data Transfer

Based on the results of the testing of data transfer to perform upload and download to the server NAS and file size under 30 MB is 1-2

minutes. While based on the results of the interview about file transfer size is 10-30 MB using a flash drive or CD media into Gugus 45 to every operator-induced primary school get an average of 15 minutes, this calculation is derived from long time copy to flashdrive then calculated long travel time from SD to the cluster after it calculated the length of time the transfer to a computer Cluster, total estimates of the time required by manual can be seen in table 12.

Table 12. Data Transfer Comparison Chart

Agency	File Size	Time	
		Manual	NAS Server
SD Tunas Harapan	10 - 30 MB	5 minutes	2 minutes
SD Cijerah 1 & 2		12 minutes	
SD Cijerah 3 & 4		5 minutes	
SD Sayuran 1, 4, 5		15 minutes	
SD Sayuran 2 & 3		15 minutes	
SD Andir Mukti		20 minutes	
SD Bandung Raya		15 minutes	
Average		12,42 minutes	

It can be inferred that the faster data transfer is done using server NAS is 1-2 minutes compared with manual way using a flashdrive or CD media with average time 12,42 minutes, can be seen in **Figure 11**

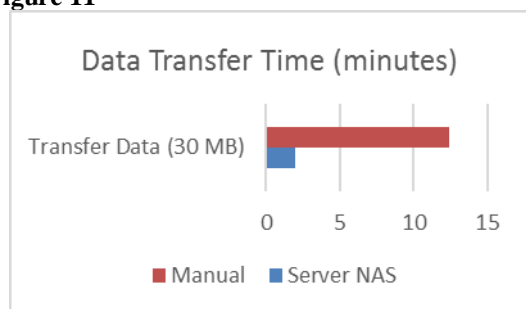


Figure 11. Comparison of Data Transfer

i. Conclusion

From the implementation and testing in the previous chapters, it brings some of the conclusions of the results the results of this research. As for some of the conclusions are as follows:

1. Data center built to provide data availability during the 23 hours or 93,8% and 78,03% sport results score questionnaire about the availability of data,

compared to manual systems which only cover at work.

2. From the results of the refined questionnaire, procedures of data storage, data distribution and data collection in the cluster School 45 with SD Flash by using data center built a great help the performance of the employees of the school and primary Cluster Induced by a score of 78,03% (strongly agree).
3. Data Transfer using media NAS server that is supported by the VPN network can be more efficient in terms of time to 2 minutes compared to using media flashdrive or the CD takes about 12 minutes.

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