



**Pilot Project: Academic Cloud System for the  
nationwide computer universities in Myanmar for  
ICT capacity building including countermeasures  
for Cybersecurity (Category-II)**

**Final Report**

July 27, 2018

University of Information Technology (UIT)

Tokyo University of Technology

Okayama Prefectural University

KDDI foundation

Fujitsu Limited



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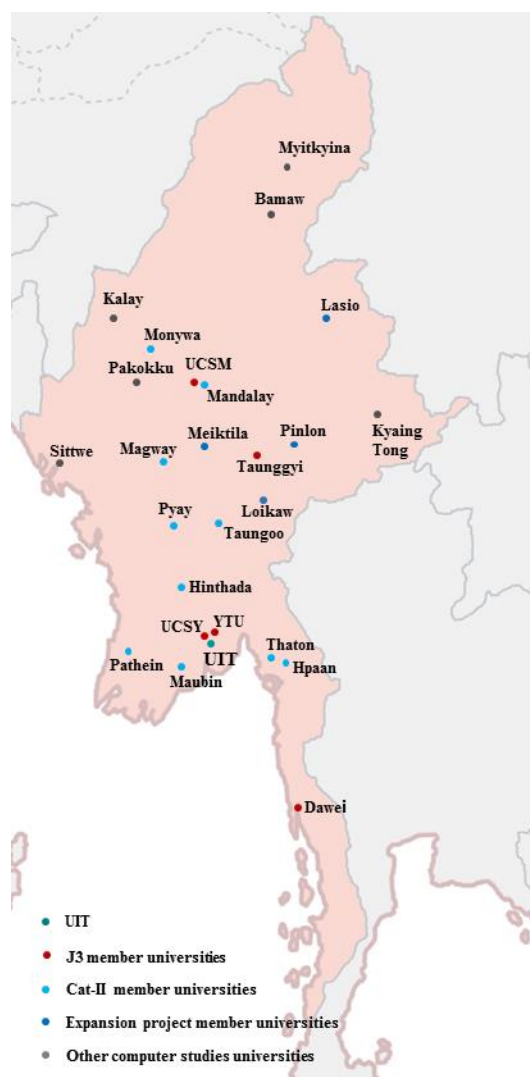
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## 1. EXECUTIVE SUMMARY

In the past half-decade, Myanmar took the helm to the open democratic policy and then is completing forward to reorganization of the government. After transformation of the policy, our APT J2 project introduced private cloud at University of Information Technology (UIT) which its former name is University of Computer Studies, Yangon (Bahan Campus). And we did start next step with support from the program of APT J3 project “PILOT PROJECT DEPLOYING NETWORKING PUBLIC CLOUD SYSTEM NATIONWIDE IN MYANMAR, EXTENDING FROM THE PRIVATE CLOUD SYSTEM AT UIT, FOR BOTTOM UP ICT SKILL AND ACADEMIC VALIDATION” that was experimentally implementing the public cloud system connected from UIT to 5 member universities who has capabilities and enthusiasts to join this project. This project included installation of cloud system and transferring skills and technologies to 5 universities to access the cloud platform. Based on these past APT projects’ achievement and our current advantageous position of sharing network in Myanmar, this Category-II project includes following activities;

1. Networking with additional 10 universities on our APT cloud network with support of Myanmar government
2. Coordination of utilization for cloud system and discussion on the revision for the rules and contents to share on the cloud
3. Skill up and knowledge transfer of cloud computing technology and its usage, coordination of sharing contents and teaching resources in various faculties
4. Implementation and operation training of required and indispensable cyber security technology into our APT cloud system and universities’ network

Through the activities in this project, we have conducted technology transfer not only for technical knowhow but also for skills and best practices with some hands-on practices with the cloud environment established in UIT which is now accessible from 15 other universities (plus 4



in expansion project) via Virtual Private Network (VPN), and have already started to provide the cloud services of the file sharing, Learning Management System (LMS) and e-learning to those universities with the aims of narrowing the digital divide in the ICT human resource development in collaboration with Japan. And we have also carried out an expansion project with financial support from KDDI foundation to prepare the replica cloud in University of Computer Studies Taunggyi, one of the J3 project member universities and to add 4 more universities to be connected. As future plan, we would like to connect all 27 ICT related universities and all higher education institutes in Myanmar step by step, to provide a good practice for Myanmar Research and Education Network (mmREN) project and to promote the teaching resource sharing and collaborative research among the universities.

## **2. BACKGROUND**

In view of the current globalization and ASEAN Economic Community (AEC) establishment in 2015, mitigation of digital divide and ICT capacity building are the key issues for the sustainable social and economic development. Along with that, cybersecurity has become the key factor for the safe, secure and sustainable use of ICT system since cyberattack is the significant threats to the digital economy. This is also the significant milestone from the regional economic integration point of view. Huge integrated market, USD 2.6 trillion and over 622 million people, is encouraging the expansion of economies of the region but the gaps among each country will become the big issue and the increasing cyberattacks will be the serious risks.

Myanmar deserves special consideration because of the urgent needs for higher education institutes' infrastructure improvement and the critical requirement of resolution of digital divide. ICT capacity building in Myanmar, not only for urban but also rural area, is one of the prime requisites for continuous and sustainable development of the country and also the Asia-pacific region.

There are 27 ICT related universities throughout the country. Most of the universities in remote areas are facing the lack of sufficient teaching materials, tools, equipment and human resources for producing the qualified ICT human resources. They need the computing resources for not only academic learning and teaching, but also for research and management purpose in their universities.

Therefore, this project aims for sharing cloud based virtual learning and administration services to fulfill those insufficiencies by establishing an academic cloud infrastructure.

On the other hand, mmREN project has been conducted to establish national network infrastructure dedicated to research and education since 5 years ago by University of Computer Studies Yangon (UCSY) and several universities including UIT. However, it hasn't yet been established because of very expensive connectivity cost. We would like to continue to discuss with the ministries based on

the achievement of this APT project. Besides, through this experience we could confirm the effectiveness and discuss on the actual usage and operation of mmREN. We believe that this would be helpful for not only fostering the research and innovative works collaboration with international universities but also the development of Myanmar.

In 2014, by APT J2 project, “THE PROJECT FOR DEPLOYING PRIVATE CLOUD SYSTEM FOR VIRTUALIZED LABORATORIES FOR ICT HIGHER EDUCATION”, the private cloud system was practically installed at UIT for education and human resource development. The project proposed a model for private cloud system design to deploy an academic cloud system to support virtualized laboratories in UIT. It was deployed with utilizing open source software such as CloudStack, Hadoop and Moodle. It also contributed several types of Virtual Machines (VMs) such as Linux based VM and Windows based VM. Asterisk and Moodle servers were deployed into private cloud to support learning management system and VoIP services on the private cloud infrastructure.

The university students in UIT could get the chance to deploy VMs, access Moodle course management system, to use digital library, and to process machine translation demonstrated by National Institute of Information and Communications Technology (NICT), on the private cloud configured in UIT through this J2 project. Moreover most of members who were the professors of UIT acquired experiences, and the achievement encouraged other higher education institutes as well. It suggested the main goal to not only UIT but also other universities; to manage effectively to fulfill the technological needs of universities such as delivery of software, providing of development platform, storage of data, and computing resources.

In 2016, as the second step of our project in UIT, five universities which were selected based on their existing internet connectivity, were connected via VPN to the cloud in UIT. We determined the system design and configuration process in the meetings. Members from Japan transferred practical skills through the actual configuration work to UIT technical members and gave lectures and On-the-Job Training for other universities to share knowhow to access and use the cloud system together with UIT as service administrator. These skill transferring and knowledge sharing among all the members were the key factors not only for the configuration work itself but also for the sustainable use of the cloud services and discussion on the future expansion. As a result, technical members of UIT successfully configured the OpenStack based cloud system and introduced it to the members from other universities as the cloud service users.

As the third step in 2017, we extended these cloud-based services to the 10 additional universities in the remote areas. Since we planned to set the larger infrastructure, the security issues would be more important and the cyber security has become the key factor for the safe, secure and sustainable use of cloud services. Therefore we determined to adopt the cyber security capabilities and

countermeasures for UIT cloud services.

### **3. PURPOSES OF THE PROJECT**

Purposes of this Category-II project are:

- 1) To build up an advanced ICT educational environment that enables universities in remote areas to utilize educational contents and tools, without geographical constraints, through the cloud platform, so that the universities in rural area can achieve the learning and administration qualities in the same manner as urban area.
- 2) To transfer the advanced cloud technology from Japan to Myanmar, including system configuration skills and operation knowhow along with the On-the Job Training for system configuration, maintenance and operation. It encourages speed and timely manner deployment of new ICT technologies in Myanmar nationwide.
- 3) To strengthen cybersecurity capability of educational staff and students in order for the continuous and safety utilization of ICT system in Myanmar nationwide. Increasing number of cyberattack incidents has been causing shortage of cybersecurity experts all over the world. Myanmar is not the exception. Cybersecurity capacity building is essential factor for stable and sustainable development of society and economics. Timely and appropriate introduction of the new cybersecurity technologies has significant meanings to build up Smart Digital Economy by eliminating the harmful ICT risks in Myanmar.
- 4) To create and propose the ideas what ICT network for higher ICT educational institutes in Myanmar should be, through utilizing the broadband network for the cloud based learning and administration services, for the purpose of sustainable ICT development, not only in the educational field but also in various fields, in Myanmar .
- 5) To offer and set-up an academic workshop and a community platform for exchanging good practices, making educational resources available and training of digital tools usage. It mitigates the digital educational divide in the field of ICT human resource development.

This project in 2017-2018 is a step to build-up the Myanmar nationwide academic cloud environment, based on the project in 2016, among the ICT related universities, in a step-by-step manner, depending on the each university's requirements and circumstances and to evaluate the

effectiveness and challenges of the use of cloud system for minimizing the gap of digital divide between the urban and rural areas. Our aims also includes other advanced ICT deployment activities and the human resources development, such as the advanced cloud technology transfer from Japan to Myanmar, the strengthen cybersecurity capability, the initiative for ICT network for educational institutes and the academic workshop/community platform forming.

#### **4. PROJECT OVERVIEW AND TIMELINE**

We plan to enhance the cloud system to provide the learning and administration services to all 15 universities including additional 10 new member universities.

Timeline: In the period from February 2017 to January 2018, the following project activities have been conducted. (7)-(11) was delayed according to the relocation of the project site. :

<b>Item</b>	<b>Activities</b>	<b>Term</b>
(1) Preparation to start the Project	To re-establish the project team and to fix the kick-off meeting schedule and agenda. To plan the study the site survey schedule and actions.	Started in February 2017
(2) Kick-off meeting in Myanmar	To agree with the objectives, milestones and role for each Party and other members in Myanmar. To discuss the site survey with local main persons and to research the sites.	April 2017
(3) Study and preparation of research	To fix the detailed schedule and action items. To share the design and idea of technology and its system design and configuration and the related training.	April-July 2017
(4) Interim report	To summarize activities including next phase plan and to report the up-to-date activities and financial results.	October 2017
(5) Research, study and discussion in Japan	Researchers from Myanmar will visit relevant enterprises, government and organizations. Site visits to particular environments for Parties' project reference. To discuss on the practical system configuration and design, procurement and shipping.	October 2017
(6) Preparation and development for practical experiment	To design system and testing environment. To fix the system configuration and development. To procure and to ship.	June-September 2017

	To fix the schedule and to prepare for installation and tools/installments.	
(7) Installation, practical experiment and evaluation	To discuss on experimental system by each site To operate and to evaluate.	March 2018
(8) OJT for the cloud usage and cyber security	To conduct hands-on training for usage of VMs on the cloud and lecture for the best practice of the system in the viewpoint of cyber security	March 2018
(9) Evaluation and final discussion	To discuss finally about the results of practice of operation as well as installation, future plan and policy/strategy	March-May 2018
(10) Final Workshop and Completion Ceremony	To make presentation to report the achievement to all the members and related organizations	May 2018
(11) Preparation of Final Report and submission	To submit the Final Report and the Accounting Report.	May-June 2018

## 5. PROJECT MEMBERS AND KEY ROLES

Myanmar (Main organization of the Myanmar team)

1) University of Information Technology (UIT) :

- Dr. Saw Sanda Aye
- Dr. Myat Thida Mon (Project Coordinator)
- Dr. Ei Chaw Htoon
- Dr. K Zin Lin
- Dr. Aye Myat Myat Paing (UCS(Thaton))
- Mr. Zaw Myint Naing Oo
- Dr. Tin Tin Yee
- Dr. Thant Zin Tun
- Dr. Swe Zin Hlaing

2) Ministry of Education

- Mr. Kyaw Zwa Soe (Chief of the project)

3) University of Computer Studies (Taunggyi)

- Dr. Thinn Thu Naing

JAPAN (Main organization of the Japanese team)

1) KDDI foundation

*ICT Pilot Project for Rural Areas:  
Pilot Project : Academic Cloud System for the nationwide computer universities in Myanmar for ICT capacity building including countermeasures for Cybersecurity (Category-II)*

- Mr. Yosuke Uchiyama (Accounting Coordinator)  
Mr. Yoshihiro Nakayama
- 2) Okayama Prefectural University  
Dr. Ye Kyaw Thu
- 3) Tokyo University of Technology  
Dr. Hidehiro Kanemitsu
- 4) Fujitsu Limited (Fujitsu group companies are involved)  
Ms. Maho Nakagawa  
Mr. Nobuyuki Komatsu

Role of the Parties and other members for the Project will be as below:

UIT	<ul style="list-style-type: none"> <li>- To be responsible for coordination with Myanmar side, procurement and administration of whole this Project, including installation, networking, configuration and operation/maintenance.</li> <li>- To provide the facilities and spaces for the Project, including the electricity and internet connection to the pilot project system.</li> <li>- To manage the machine room and its security for the Project.</li> </ul>
J3 member universities (UCSY, UCSM, YTU, University of Computer Studies (Taunggyi and Dawei)	<ul style="list-style-type: none"> <li>- To participate in the trainings and workshops to learn the knowhow and to share their knowledge to the new member universities</li> </ul>
New member universities (University of Computer Studies in Thaton, Taungoo, Mandalay, Maubin, Pyay, Hinthada, Pathein, Magway, Monywa, Hpaan)	<ul style="list-style-type: none"> <li>- To participate in the trainings and workshops to learn knowledge about cloud system and its function and capability.</li> <li>- To prepare the environment to access the cloud system and set up networks in collaboration with KDDI foundation</li> </ul>
Tokyo University of Technology and Okayama Prefectural University	<ul style="list-style-type: none"> <li>- To provide the expertise and know-how of ICT, especially cloud and applications on the cloud</li> <li>- To support and give academic advices on the discussion for the further expansion of the cloud network in Myanmar</li> </ul>

KDDI Foundation	<ul style="list-style-type: none"> <li>- To be responsible for accounting management as Accounting Coordinator and any general administrative works for the Project.</li> <li>- To provide the expertise and know-how of ICT, especially networking.</li> </ul>
Fujitsu Limited	<ul style="list-style-type: none"> <li>- To be responsible for ICT human resource development using cloud environment. (i.e. visit, training and material)</li> <li>- To provide the expertise and know-how for the system configuration and installation of cloud service platform.</li> </ul>

## 6. PROGRESS REPORT

### 6-1. KICKOFF MEETING (Date: 27<sup>th</sup>-28<sup>th</sup>, April, 2017. Place: UIT)

Firstly, the team members reviewed, discussed and confirmed the project schedule, tried to define the scope and the requirement for the enhanced system with consideration of the expectations from other universities and budget limitation, collected the information about the environment and requirement of new member universities and confirmed the schedule and contents for Japan visit and other items.

#### 1) The contact person lists of 15 member universities

No.	Status	Name of University	Contact Person
1	New	UCS (Thaton)	Dr. Win Htay
2	New	UCS (Taungoo)	Dr. Thet Thet Khin
3	New	UCS (Mandalay)	Dr. Zami San
4	New	UCS (Maubin)	Dr. Khin Mya Mya Thet
5	New	UCS (Pyay)	Dr. Sandi Win Aye
6	New	UCS (Hinthada)	Dr. Ei Ei Mon
7	New	UCS (Pathein)	Ms. Moe Moe San
8	New	UCS (Magway)	Dr. Zarchi Su Su Haling
9	New	UCS (Monywa)	Dr. Win Thanda Aung
10	New	UCS (Hpaan)	Dr. Aye Sandar Win
11	J3 member	UCS (Dawei)	Dr. Zin Mar Win
12	J3 member	UCSY	Dr. Ei Phyu Zaw
13	J3 member	YTU	Dr. Win Zaw
14	J3 member	UCSM	Mr. Hlaing Myo Zaw
15	J3 member	UCS (Taunggyi)	Dr. Thin Thu Naing

*ICT Pilot Project for Rural Areas:  
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2) Confirmed status of member universities was as below;

No.	Status	University Name	Line	Bandwidth	Faculty	Students	Machine Room (with internet)	No of PC with Internet	Campus Wifi
1	New	<b>UCS (Thaton)</b>	Fiber	10 MB	45+	600++	3	150	Available
2	New	<b>UCS (Taungoo)</b>	Fiber	10 MB	150	600	2	240	Available
3	New	<b>UCS (Mandalay)</b>	Fiber	10 MB		1000	Dept 10 + 2 MR	135	Available
4	New	<b>UCS (Maubin)</b>	Fiber	2.5 MB + 2.5 MB (2 lines)	55	400	2	80	Available
5	New	<b>UCS (Pyay)</b>	Fiber	10 MB		400++	1	40	Available
6	New	<b>UCS (Hinthada)</b>	Fiber	2 MB	60	300	Only Department & Office		Available
7	New	<b>UCS (Patheingyi)</b>	Fiber	4 MB	50	400++		33++	Available (half area of campus/only for faculties)
8	New	<b>UCS (Magway)</b>	Fiber	4 MB	60	460	3	150	Available
9	New	<b>UCS (Monywa)</b>	Fiber	10 MB	100++	1450++		25	Available
10	New	<b>UCS (Hpaan)</b>	ipstar, skynet	256k, 512k			Office		Available
11	J3member	<b>UCS (Dawei)</b>	Fiber	10 MB	50	250++	4		Available
12	J3member	<b>UCSY</b>	Fiber	100 MB	300	2500++	8 + 5Lab		Available
13	J3member	<b>YTU</b>	Fiber	40 MB	500	2500			Available (20MB for wifi)
14	J3member	<b>UCSM</b>	Fiber	50MB	70++	700			Available
15	J3member	<b>UCS (Taunggyi)</b>	Fiber	4MB	50++	400++			Available

3) Requirement from member universities

Member universities' expectations were shown in the following items, but in summary their main interest and motivation was to get the knowledge and experience from this project in making infrastructure, using VMs, sharing electronic and learning resources and the contents, events and projects of UIT students.

- a. Moodle Service: Users can download and install Moodle on a web server, such as Apache HTTP server, and a number of database management systems, such as PostgreSQL, are supported. Certified Moodle partners provide other Moodle services, including hosting, training, customization and content development. This service was designed by educators and is extremely customizable, allowing the platform to be configured to meet the individual needs of each universities, both in terms of the available functionality, the visual design of the software and its integration with other systems. UIT have already installed the Moodle and therefore can share the services of Moodle to each Member University.
- b. Lecture slide from Expert Teachers: Each member university wants to get the lecture slide from expert teachers who are local and international. The students can learn from these slides and they can share knowledge to each other.
- c. Research Collaboration: Universities are increasingly relying on external sources to fund their staff member's research activities. Where once institutional support would have been forthcoming for research trips and larger scale projects, now many of these are funded by research councils. So each university want to collaborate with others organization to get the following opportunities;
  - To access foreign or joint facilities and equipment.
  - To share/access techniques and skills
  - To increase knowledge capacity
  - To encourage further or additional links and enhance future funding opportunities
- d. E-library Service: An expected digital library is a special library with a collection of digital objects that can include text, visual material, audio material, video material. So each member university want to access to the UIT's library and they want to make their own library also.
- e. Network Infrastructure Sharing: Skill up and technology transfer of cloud computer and

its usage, coordination of sharing contents and resources in various faculties. They expect to create their own VM and use VM services from UIT cloud.

4) Result and Summary of Requirement for the APT Cat-II cloud:

# of university	# of users	# of concurrent access	# of virtual instance
16	600	125 (UIT40 + others)	125

- Configuration work (configuration to testing) supposed to be within 2 weeks
- What should be realized by Cat-II cloud:
  - ✓ Data sharing (e-learning/ file server) - video file, available on mobile
  - ✓ Resource sharing (Application Development/Running)

According to the discussion above, we decided Required spec for Cat-II as below :

- ◆ CPU
  - Shortage compared to J3 Cloud System = 93vCPU  
→ Need to add more CPU on Compute node
- ◆ Memory
  - No shortage according to minimum requirement but to match with additional CPU, it is preferable to add memory on Compute node
- ◆ Disk
  - Shortage = for OS segment, 700GB  
→ Need to add more Disk on Storage node
- ◆ Concurrent access
  - It is preferable to add Network node to keep networking function..  
→ need to decide considering cost and configuration work load.

(Condition) :

Item	CPU	Memory	Disk
per 1 instance	1vCPU	1GB	20GB
Resource of existing environment(J3)	32vCPU	128GB	1800GB
Required resource for Cat-II	125vCPU	125GB	2500GB

**April 27<sup>th</sup>, 2018: Discussion in the Kickoff Meeting**

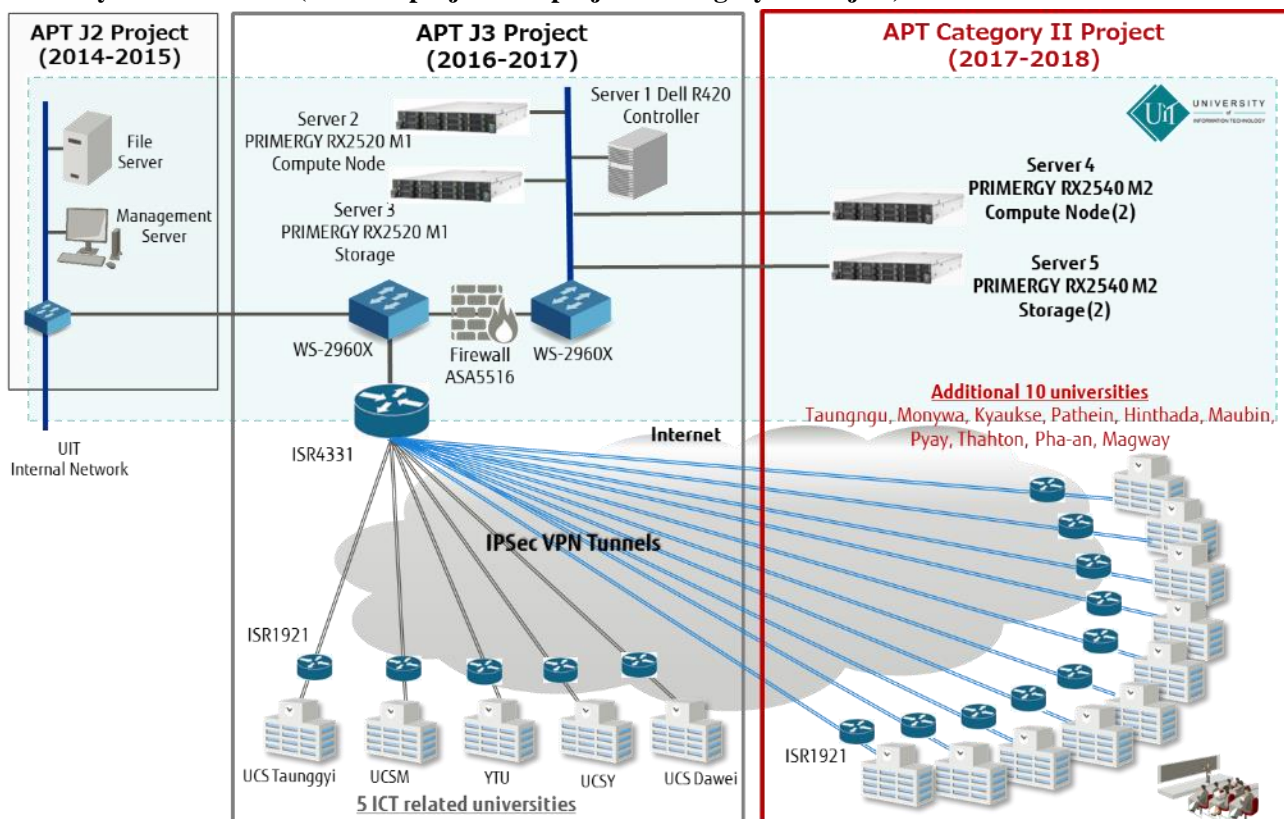


**6-2. SYSTEM DESIGN**

1) SYSTEM OVERVIEW

The overview of the Cloud system is as follows. The inside of the red square indicate the existing cloud of UIT and the connection to other universities as users which were established in J3 Project in 2016. We built in J3 cloud infrastructure with 3 servers (Controller Node, Compute Node, and Storage) and Server1 was provided by UIT. In 2017, we added 2 servers in J3 cloud infrastructure and a router for each new member universities to enhance the infrastructure and network to support cloud services for 10 additional users.

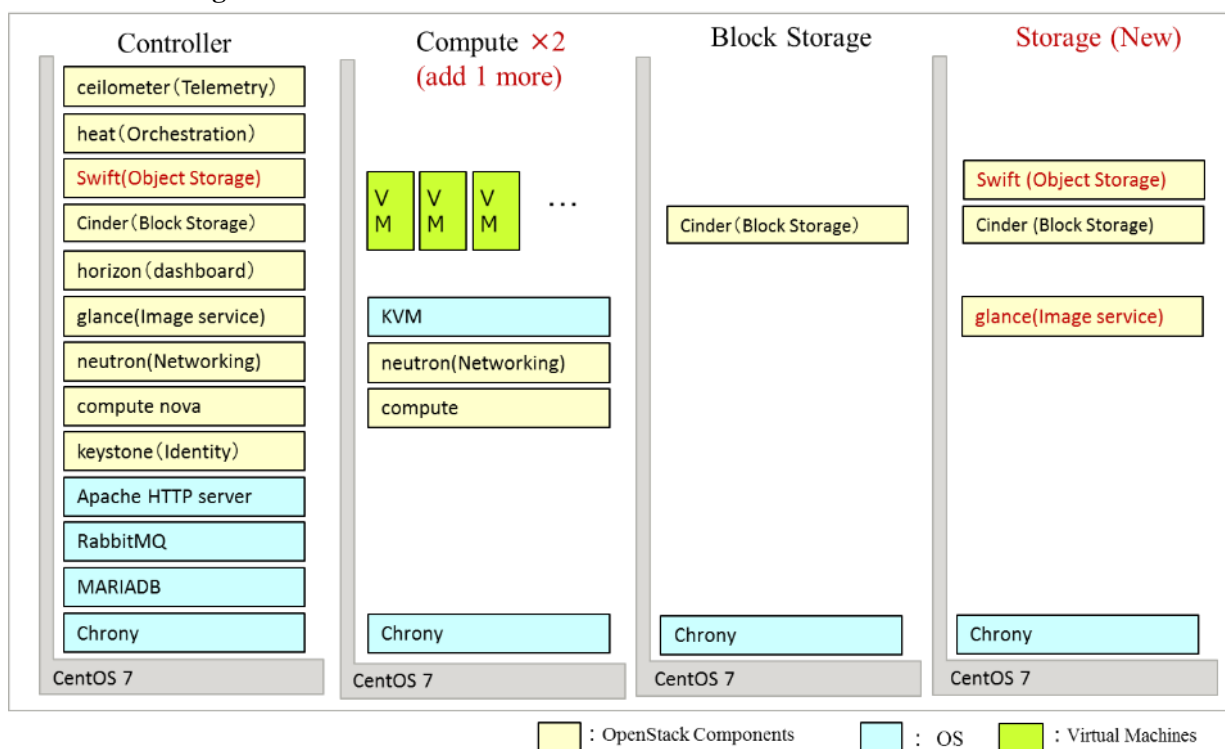
**System Overview ( APT J2 project / J3 project / Category-II Project)**



## 2) SOFTWARE SELECTION

We had chosen Open Source Software such as CentOS and OpenStack again because this system was enhanced from the J3 cloud system which was OpenStack based. Actually we found that it was difficult to configure because of some features of Open Source Software. However we have an experience and needless to say, OpenStack has huge community and progress day by day with so many contributors from all over the world.

### Software configuration for Cat-II Cloud



### 6-3. LECTURE AND WORKSHOP FOR ALL THE MEMBER UNIVERSITIES (Date: July 4th to 7th, 2017, Place: UIT, Assembly Hall)

4-days cloud lecture/training for 37 participants from all 16 universities was organized by the lecturer dispatched from Fujitsu Limited. The participants could learn actual VM creation with the J3 cloud environment. Agenda was as below;

- 1) OpenStack structure, security settings for the VMs and Practical tools for OpenStack operation
  - a. Security settings for Virtual Machines on the cloud system
  - b. As we configured settings tentatively for the demonstration in the final presentation,

so we will introduce more secure and appropriate security settings by demonstrating with some of VMs on the cloud.

- c. To explain about some tools for OpenStack operation. E.g. Turnkey Linux
- 2) Stress Testing of APT J3 Cloud
- a. To test the feasibility of the current cloud system: we deploy around 40 virtual instances at the same time, and it took so long time to downloading and installing the security software. E.g. To conduct Yum update, it took 30-40 minutes to just obtain the list, then took over 1 hour after entering “y”
  - b. To consider the rules based on the maximum number of concurrent access: UIT and other member universities determined that UIT will create the updated templates and distribute it to other universities according to above network status.
- 3) Support for the Cloud Operation
- a. To make detailed rules for the operation and process of switch on/shut down the system: UIT technical members confirmed the place where previous shell script was written and will try to check.

**July 4th to 7th, 2017: On-the-Job Training on the settings for Virtual Machines**



**6-4. STUDY TRIP TO JAPAN** (Date: from October 22nd to October 28th, 2018)

For the preparation of the cloud configuration and further discussion, we have conducted study trip to Japan consisted of OJT section and Sites visit as follows. 5 members from UIT, UCSM, and UCS (Thaton) joined this trip.

**1. Schedule and Agenda**

Date	day	Place	Activity	Remarks
1	22 Oct	SUN PM	Yangon	Departure NH 814 RGNRT 2145
2	23 Oct	MON AM	Tokyo Narita	Arrival NH 814 RGNRT 0650 23OCT
		PM	Washington Hotel Shinjuku	Bus from Airport to Hotel
3	24 Oct	TUE AM	9:30 Hotel Lobby	Mr. Nakayama
			10:30-12:00 Fujitsu Security Initiative Center	Cybersecurity In Toranomom
		PM	15:00-16:00 National Institute of Informatics	Meeting Garden Air Tower, Iidabashi
			16:30-17:30 KDDI	Meeting 14:00-18:00 Room 270
4	25 Oct	WED AM	10:00-12:00 Fujitsu	Training - Lecture
		PM	13:00-16:00 Fujitsu	Tradepia Odaiba on 21nd Floor (room 219)
5	26 Oct	THU AM	10:00-12:00 Fujitsu	Training - Practice
		PM	13:00-16:00 Fujitsu	
6	27 Oct	FRI AM	10:00-12:00 KDDI Otemachi (Research and Educatin Network)	Meeting and Data Center Tour At KDDI Otemachi Bldg., Otemachi
		PM	Free	Free
			18:00-20:00 Dinner	Dinner
7	28 Oct	SAT AM	Washington Hotel Shinjuku	Bus from Hotel to Aiport
		PM	Tokyo Narita to Yangon	Departure/Arrival NH 813 NRTRGN 1350 1830

- 1) Site Visit for learning and discussion on further expansion plan and secure operation.
  - a. Fujitsu Security Initiative Center
  - b. National Institute of Informatics
  - c. KDDI, KDDI Data Center
  
- 2) Training of Cloud configuration
  - a. To reconfirm the requirement for Cat-II project and the difference from J3 cloud.
  - b. New component (Swift) and its function
  - c. Training for configuration with test environment

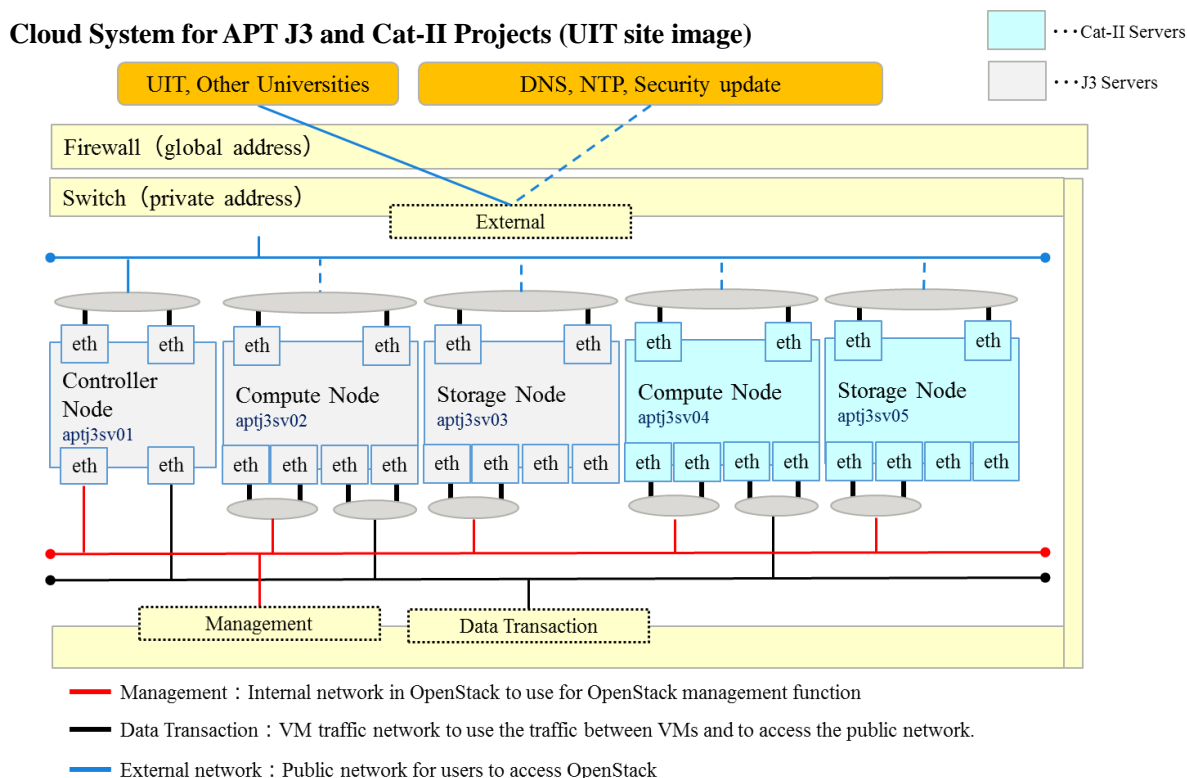


## 6-5. CLOUD AND NETWORK CONFIGURATION

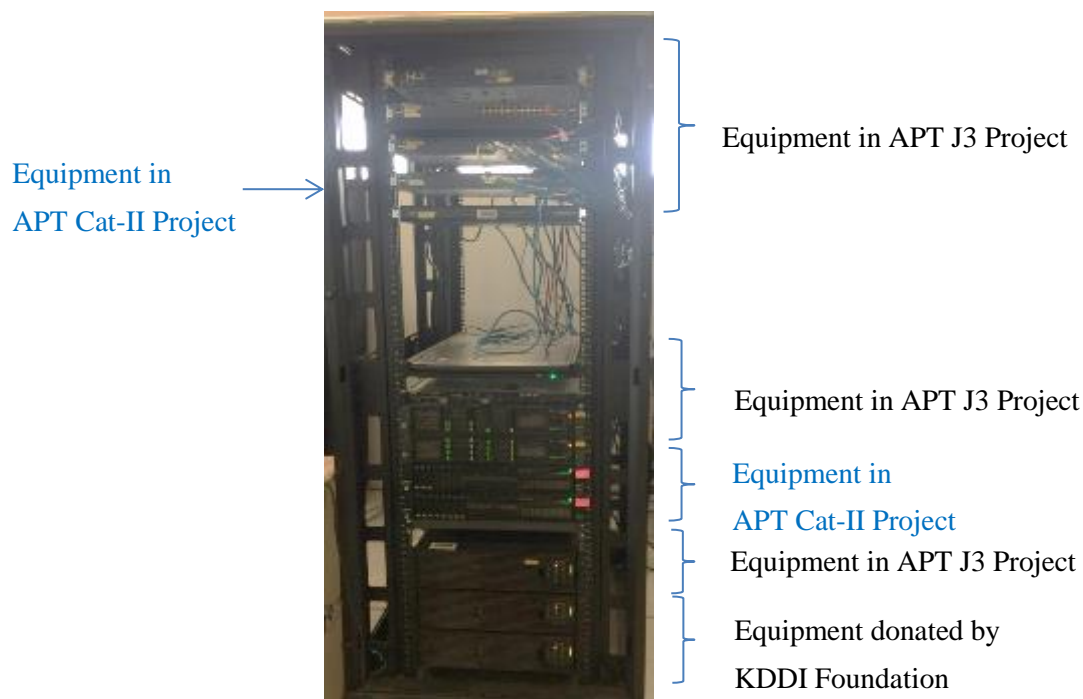
Cloud configuration is the process of setting hardware and software details for elements of a cloud environment to ensure that they can interoperate and communicate. The complexities of a cloud environment, and a hybrid cloud environment in particular, make configuration more challenging than the case in a single-location, homogenous network. A cloud provider has to enable service for users in various locations, using all different kinds of hardware and software. Just like the administrator of a single-premises network, the provider has to ensure that the service is reliable, performance is acceptable and communications are secure. In Myanmar, UIT established the Pilot Cloud Platform for next 10 other IT universities in order to create network for higher ICT educational institutes for cloud-based learning and administration services and also research collaboration,

Firstly, configuration schedule was postponed to mid of March because of the relocation of the UIT Campus. After settlement of our university, the implementation and re-configuration of cloud and VPN connectivity for additional 10 member universities took 2 weeks by UIT Technical team, other member universities, Fujitsu Limited, KDDI foundation, and KDDI Myanmar.

Based on the experience of previous APT J3 project and new knowledge gained from OJT in advance, we, UIT implemented the platform using OpenStack for cloud services and conducted trials of broadband connectivity to 10 new areas and deployed the cloud services for education, administration and applications (Samba: file sharing and Moodle: LMS) on Virtual Machines, infrastructure sharing and E-learning lecture implementation. Detailed system information are as follows:



**Equipment in UIT site for APT J3 and Cat-II Projects**



**Equipment Specification in CAT-II Project**

**For UIT**

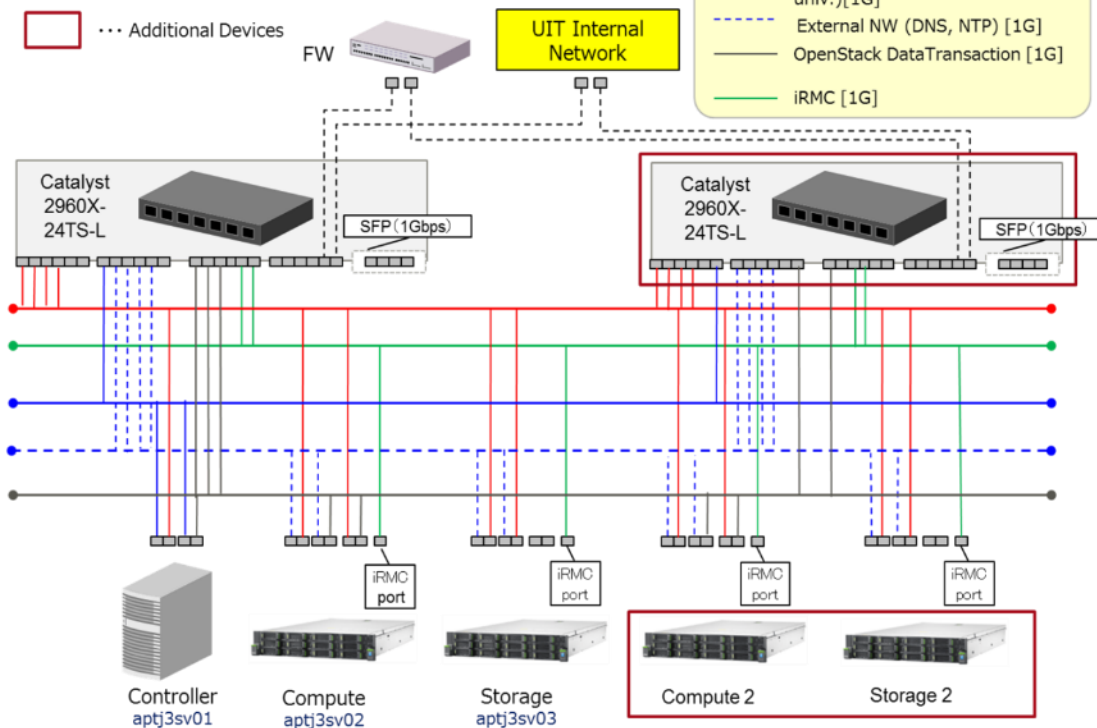
No.	Description	Type & Specification
1.	Compute Node	PRIMERGY RX2520 M1 CPU: 2 (8 core), RAM: 128GB, HDD: 1.8TB , (SAS600GBx3)
2.	Storage Node	PRIMERGY RX2520 M1 CPU: 2 (8 core), RAM: 48GB, HDD: 1.8TB, (SAS600GBx3)
3.	Network Switch	Catalyst 2960X-24TS-L
4.	Firepower Subscription	IPS L-S-ASA5516-TA-1Y (SVP Cisco ASA5516 FirePOWER IPS 1 YR Subscription)
5.	Others	PDU: AP9565 , VGA-VGA/USB Cable

**For 10 member universities,**

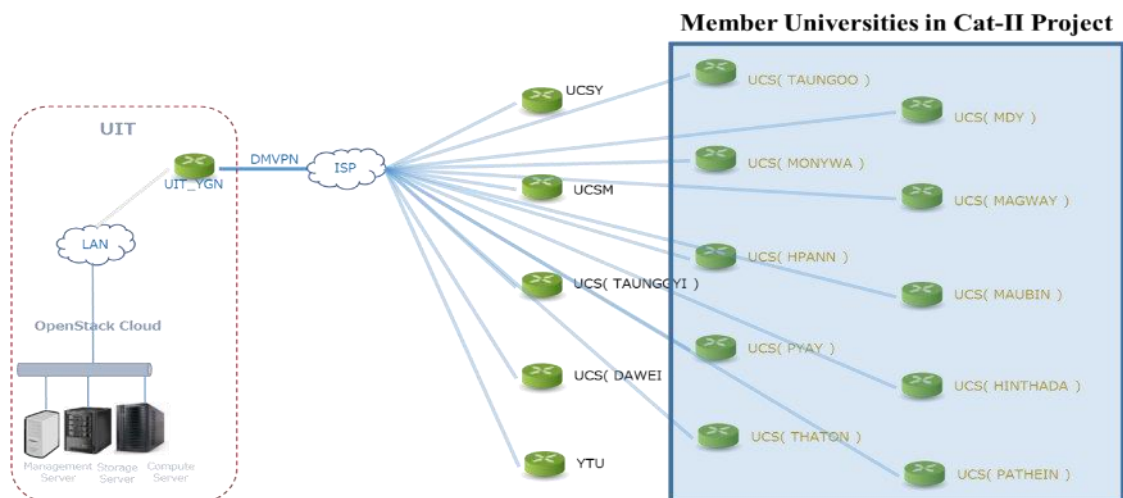
No.	Description	Type & Specification
1.	Router for VPN connection	Cisco 1921-Sec/K9 with 2GE, SEC License PAK, 512MD DRAM, 256MB), CON-SNT-1921SEC (SNTC-8x5xNBD Cisco 1921/K9 with 2GE, SEC License PAK)

**Network Design in Cloud Infrastructure**

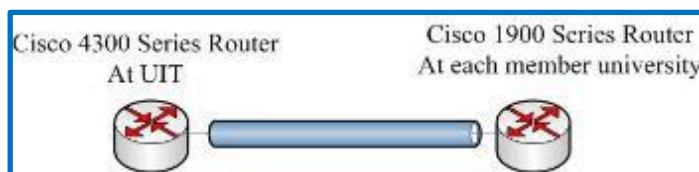
**■ Cat- II Network Design**



## VPN Connectivity Overview

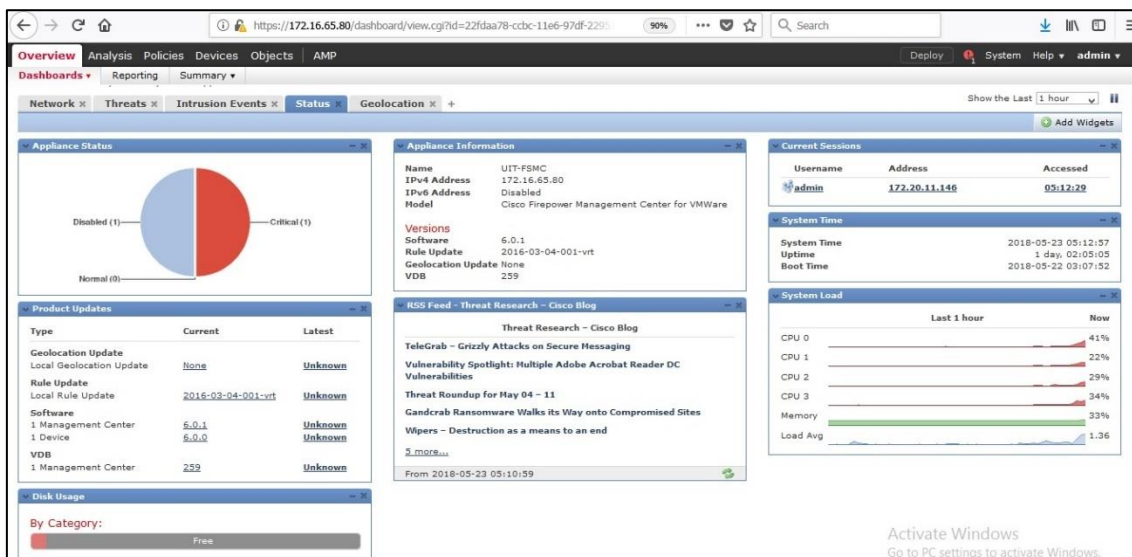


“Site-to-site” VPN tunnel was setup between UIT and each member university



## Countermeasures for Security

For countermeasure for security, Cisco Firepower Management Center was configured at UIT.



**6-6. OJT FOR THE CLOUD USAGE AND CYBER SECURITY** (Date: from March 19th to 20th, 2018)

2-days lecture and OJT for 39 participants from all 16 universities was organized by UIT and the lecturer from Fujitsu Limited. UIT technical team explained the enhanced system design and how to access. And the lecturer facilitated OJT to learn the actual usage for VMs on the Cat-II Cloud system. The agenda was as below;



1) Lecture topics:

- Introduction to the best practice for the system according to a viewpoint of cyber security
- How to scan and check the system configuration; actual vs the best practice
- How to modify the configuration
- Hardening : how to search for the vulnerability

2) Training to conduct the actual process above:

- [CentOS] on Virtual Instance : Participants joined the practice with the virtual environment on APT Cat-II Cloud
- [OpenStack] UIT technical leader conducted the process with the instruction. Each process was shown to all other participants on the screen

**6-7. CLOUD SERVICE DEPLOYMENT**

UIT deployed the Cloud Infrastructure for member universities for the following functions and member universities became able to access shared materials which UIT and every university uploaded to the cloud.

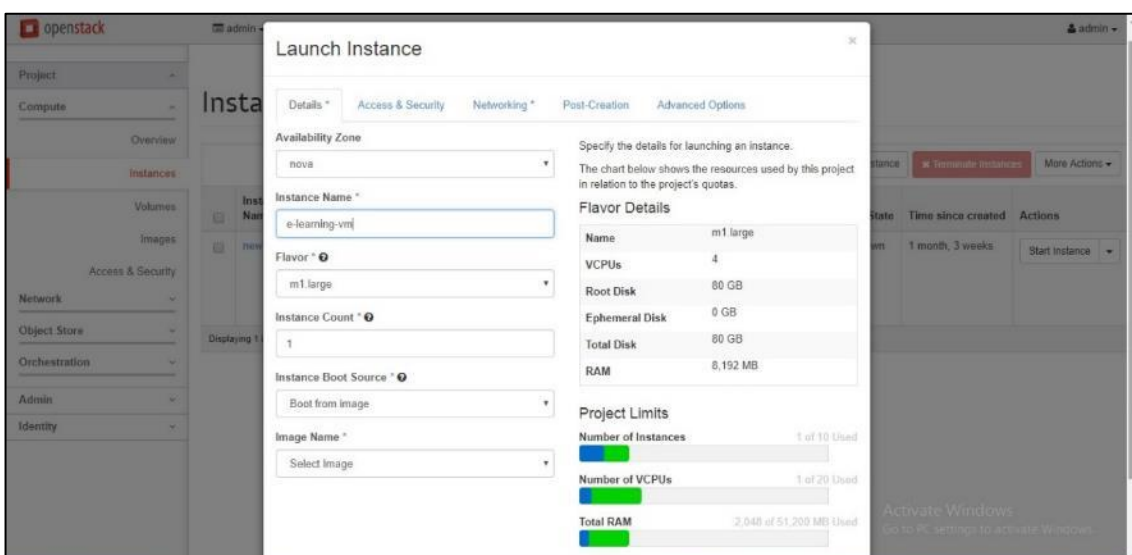
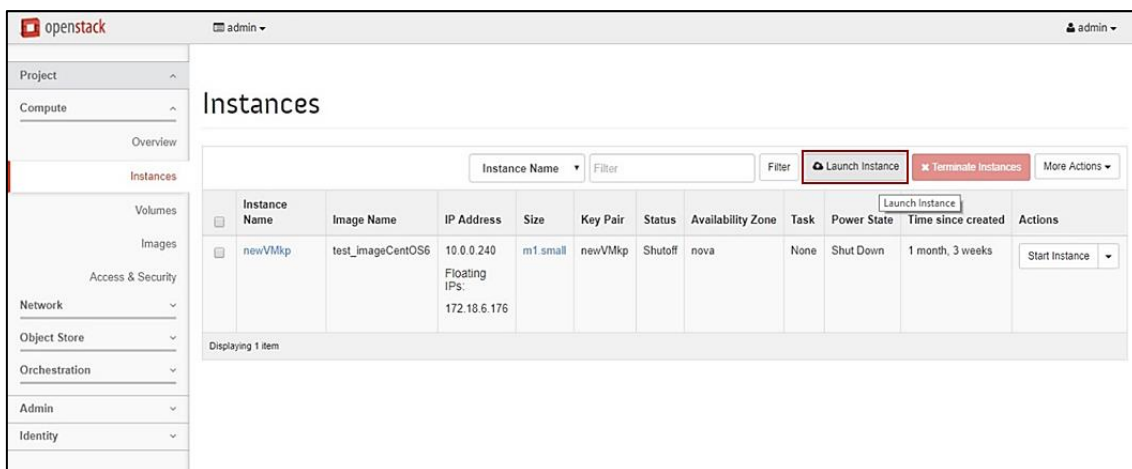
- Prepared new images, own instance / virtual machines
- Assigned the user role for each university

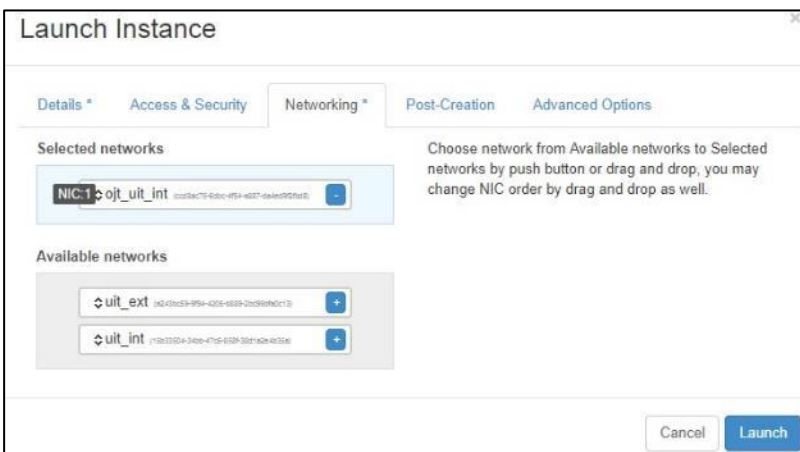
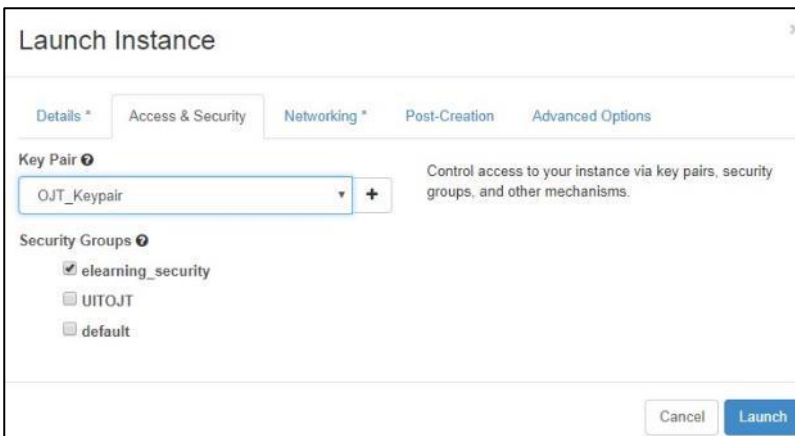
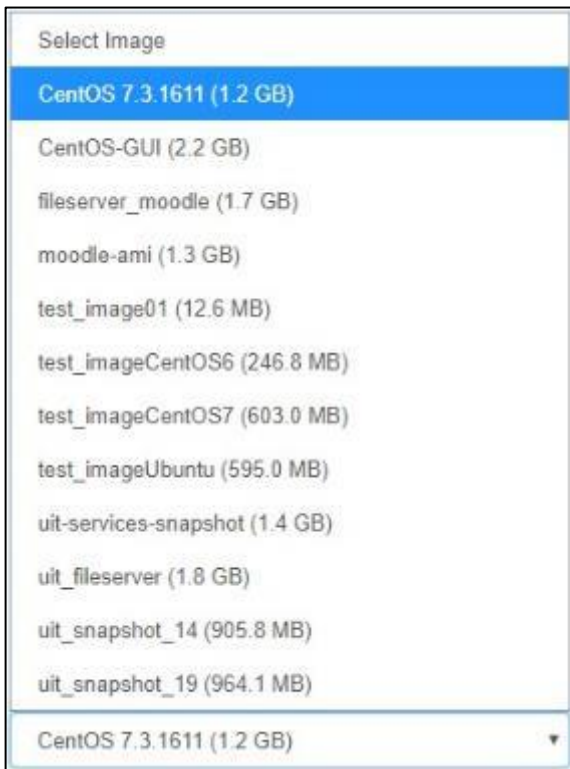
- Provided some cloud services to member universities from UIT
  - ❖ File sharing (Samba File Service)
  - ❖ Course Management System (Moodle)
- Shared materials from UIT
  - ❖ e-Learning Courses developed by UIT Teachers in ASEAN Cyber University Project, which was initiated by Ministry of Education of Republic of Korea (ROK), and UIT has been joined the project as one of the representatives from universities in Myanmar.

Each member university fixed some functions to participate in this project as below;

- Checking the connectivity to UIT Cloud via VPN
- Accessing J3 Cloud services
- Fostering the continuous access to UIT Cloud
- Creating own instances / virtual machines
- Sharing your own materials
- Accessing UIT's shared materials and CMS

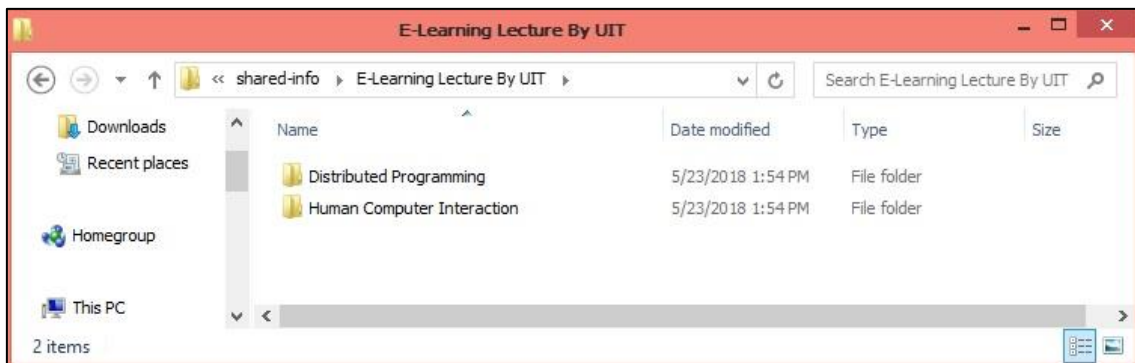
### Examples of the steps for deploying VM and launching a new instance:





### Providing Services on CAT-II Cloud

- File Sharing
  - ✧ Can share the teaching material on J3 Cloud via Samba file server
  - ✧ IP: 172.18.6.142, User: uituser, uituser
- The following figure shows the file sharing with UIT and other member universities.




### Example of University of Computer Studies Monywa.

Each member university can access e-Learning course developed and deployed by UIT's teachers.



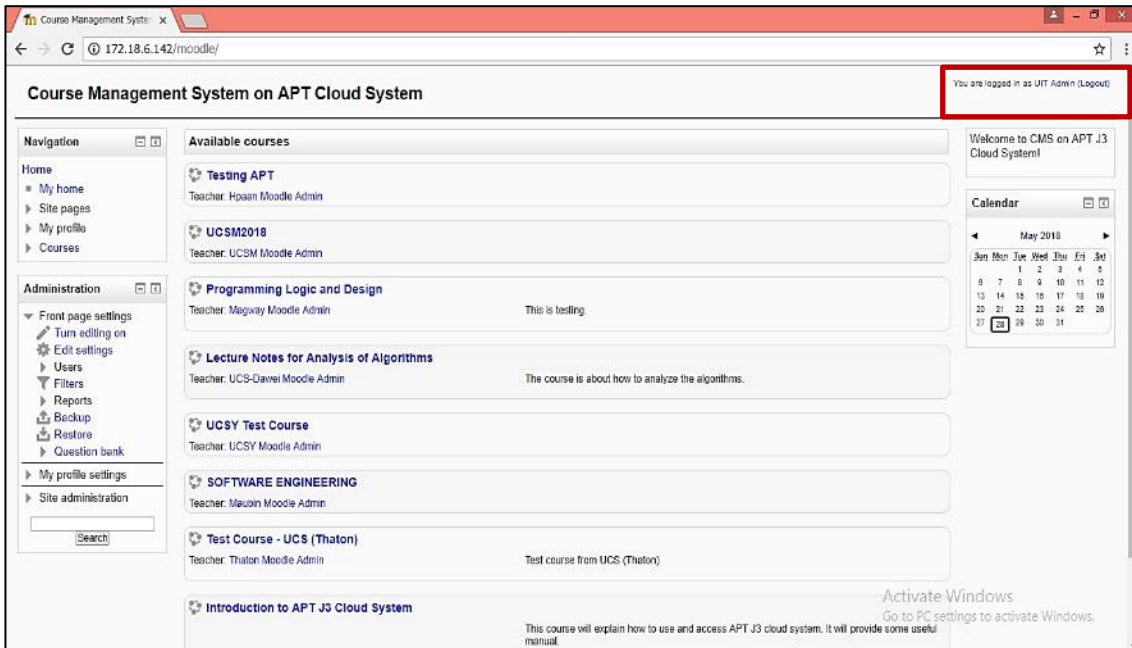
### Course Management System

- Moodle 
- URL: <http://172.18.6.142/moodle>
- Create a user account in 'course creator' role for each member university

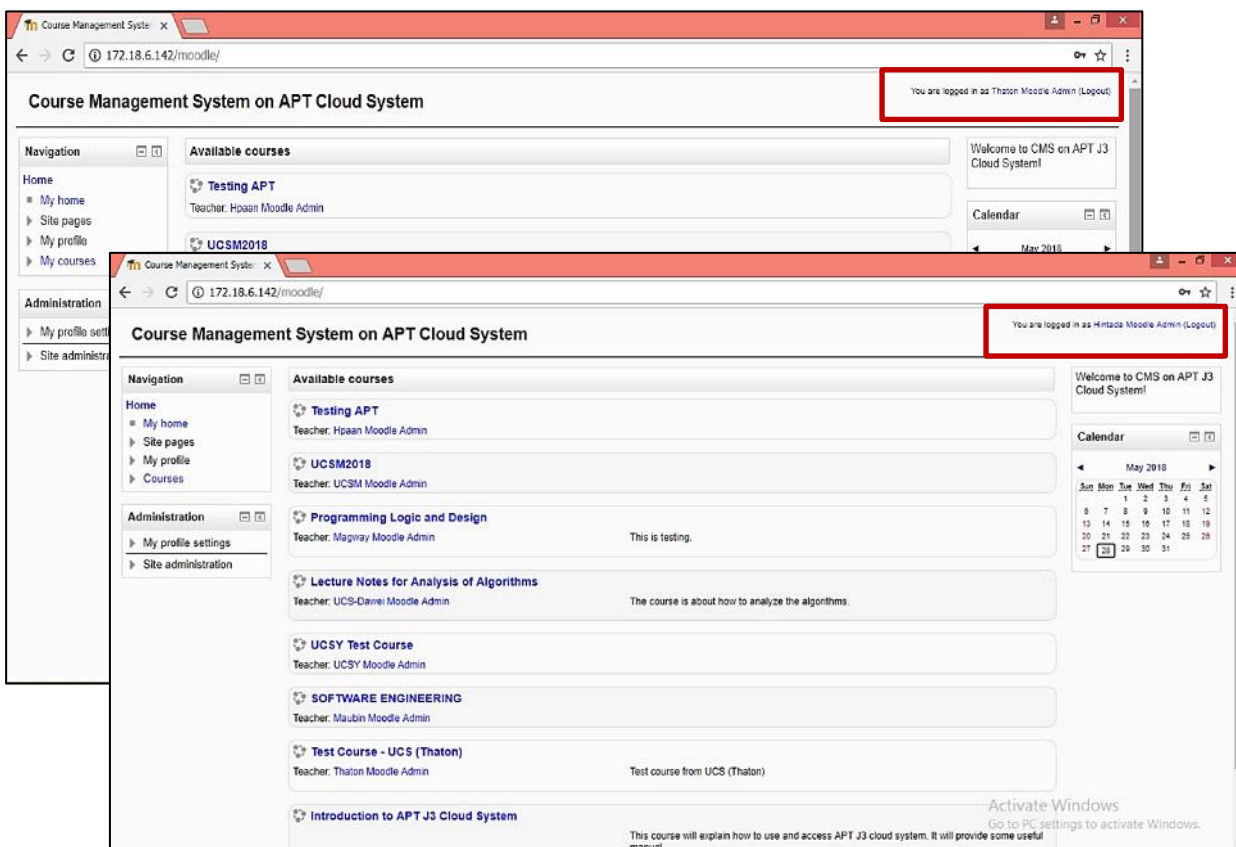
The following figures show the Moodle interface from UIT as administrator, UCS (Thaton) and UCS (Hinthada) as examples of user view.

*ICT Pilot Project for Rural Areas:  
Pilot Project : Academic Cloud System for the nationwide computer universities in Myanmar for ICT capacity building including countermeasures for Cybersecurity (Category-II)*

**UIT Admin view:**



**UCS (Thaton) and UCS (Hinthada) Admin view:**



### 6-8. FINAL WORKSHOP AND COMPLETION CEREMONY

Final workshop and Completion Ceremony final workshop was held on 29<sup>th</sup> May, 2018. Agenda, Photo and participants list are as below:

#### Final Workshop Presentation & Completion Ceremony APT Category II Project

Date	:	29.5.2018 (Tuesday)
Time	:	09:30 am - 12:00 pm
Venue	:	Meeting Room, University of Information Technology
09:30 am - 10:30 am	Opening Speech by Dr. Nay Win Oo, Deputy Director General, Ministry of Education	
	Welcome Speech by Dr. Saw Sanda Aye, Rector, University of Information Technology	
	Congratulatory Speech by Mr. Dai Tanabe, Program Officer, APT	
	Congratulatory Speech by Mr. Than Tun Aung, Ministry of Transport and Communication	
10:30 am - 10:50 am	Coffee Break	
	Progress, Achievement of APT Category II Project and Future plan by Dr. Myat Thida Mon, Professor and Head of Faculty of Computer Systems and Technologies	
10:50 am - 12:00 am	Introduction to the Activities of APT Category II Project by Ms. Maho Nakagawa, Fujitsu Limited.	
	Explanation of System Design and Configuration of APT Category II Project by Dr. Ei Chaw Htoon, Professor, Faculty of Computer Science (and System Demonstration conducted with one of the member universities)	
	"Network Cooperation" - Expansion of Cloud Platform in Myanmar Universities- by Mr. Yosuke Uchiyama, KDDI Foundation	
12:00 am - 1:00 pm	Lunch	

*ICT Pilot Project for Rural Areas:  
Pilot Project : Academic Cloud System for the nationwide computer universities in Myanmar for ICT capacity building including countermeasures for Cybersecurity (Category-II)*

Project members and guests from MOE, UIT, APT, MTC, KDDI Foundation and Fujitsu Limited delivered the congratulatory speech and presentations to share the experiences and future vision and this event was successfully finished. The following pictures are the memory of CAT-II project completion ceremony. Most of the guests mentioned about the expectation for the future expansion of this series of APT projects.



*ICT Pilot Project for Rural Areas:  
Pilot Project : Academic Cloud System for the nationwide computer universities in Myanmar for ICT capacity building including countermeasures for Cybersecurity (Category-II)*



**Participants list:**

No	Name	Organization
1	Dr. Nay Win Oo	Deputy Director General Department of Higher Education, Ministry of Education
2	Mr. Than Tun Aung	Director, Posts and Telecommunications Department, Ministry of Transportation and Communication
3	Mr. Thein Oo	Patron, Myanmar Computer Federation
4	Mr. Yoritaka Sonoda	Chief Representative, Fujitsu Limited (Yangon Branch)

*ICT Pilot Project for Rural Areas:  
Pilot Project : Academic Cloud System for the nationwide computer universities in Myanmar for ICT capacity  
building including countermeasures for Cybersecurity (Category-II)*

No	Name	Organization
5	Mr. Ryo Tabata	Sales Manager, Fujitsu Limited (Yangon Branch)
6	Ms. Ei Kay Kay Khine	Fujitsu Limited (Yangon Branch)
7	Ms. Maho Nakagawa	Fujitsu Limited
8	Dr. Fumio Watanabe	President, KDDI Foundation
9	Mr. Yosuke Uchiyama	Deputy Director, KDDI Foundation
10	Mr. Yoshihiro Nakayama	Manager, KDDI Foundation
11	Mr. Masanori Shiba	Managing Director, KDDI Myanmar Company Limited
12	Mr. Pornchai Leelapornchai	Project Coordinator, APT
13	Mr. Dai Tanabe	Programme Officer, APT
14	Dr. Ye Kyaw Thu	Okayama Prefecture University
15	Dr. Saw Sanda Aye	Rector, UIT
16	Dr. Mie Mie Thet Thwin	Rector, UCSY
17	Dr. Myint Thein	Rector, YTU
18	Dr. Thanda Thein	Pro-rector, UCS (Maubin)
19	Dr. Khin Marlar Tun	Pro-rector, UCS (Hinthada)
20	Dr. Myat Thida Mon	UIT
21	Dr. Ei Chaw Htoon	UIT
22	Dr. Swe Zin Hlaing	UIT
23	U Zaw Myint Naing Oo	UIT
24	Dr. K Zin Lin	UIT
25	Dr. Aye Myat Myat Paing	UCS (Thaton)
26	Dr. Tin Tin Yee	UIT
27	Ms. May Phyo Thu	UCSY
28	Dr. Zin Min Win	UCSM
29	Dr. Khin Nweni Tun	UCS (Taunggyi)
30	Dr. Kyu Kyu Win	UCS (Taunggyi)
31	Dr. Khin Aye Than	UCS (Dawei)
32	Dr. Kyawt Kyawt San	UCS (Dawei)
33	Dr. Thanda Win	YTU
34	Mr. Nyein Chan	KDDI Myanmar

No	Name	Organization
35	Ms. Khin San Lin	KDDI Myanmar
36	Dr. Zarni Sann	UCS (Mandalay)
37	Dr. Win Thandar Aung	UCS (Monywa)
38	Dr. Zarli Cho	UCS (Taungoo)
39	Dr. Hnin Pwint Phyu	UCS (Taungoo)
40	Dr. Soe Lin Aung	UCS (Magway)
41	Dr. Zar Chi Su Su Hlaing	UCS (Magway)
42	Dr. Sandi Win Aye	UCS (Pyay)
43	Dr. Tun Min Naing	UCS (Pathein)
44	Dr. Khin Lay Thwin	UCS (Pathein)
45	Dr. Tha Pyay Win	UCS (Hinthada)
46	Dr. Thandar Lwin	UCS (Maubin)
47	Dr. Win Htay	UCS (Thaton)
48	Dr. May Mya Aung	UCS (Thaton)
49	Dr. Aye Sandar Win	UCS ( Hpaan)
50	Dr. Myint Myint Khaing	UCS (Pinlon) * Member university of expansion project
51	Dr. Thiri Thitsar Khaing	UCS (Pinlon) * Member university of expansion project
52	Dr. Yee Yee Soe	UCS (Loikaw) * Member university of expansion project
53	Dr. Khin Thet Mar	UCS (Lashio) * Member university of expansion project
54	Mr. Than Tun Naing	UCS (Meiktila) * Member university of expansion project

## 6) PROJECT ACHIEVEMENT

### 7-1. CLOUD NETWORK INFRASTRUCTURE

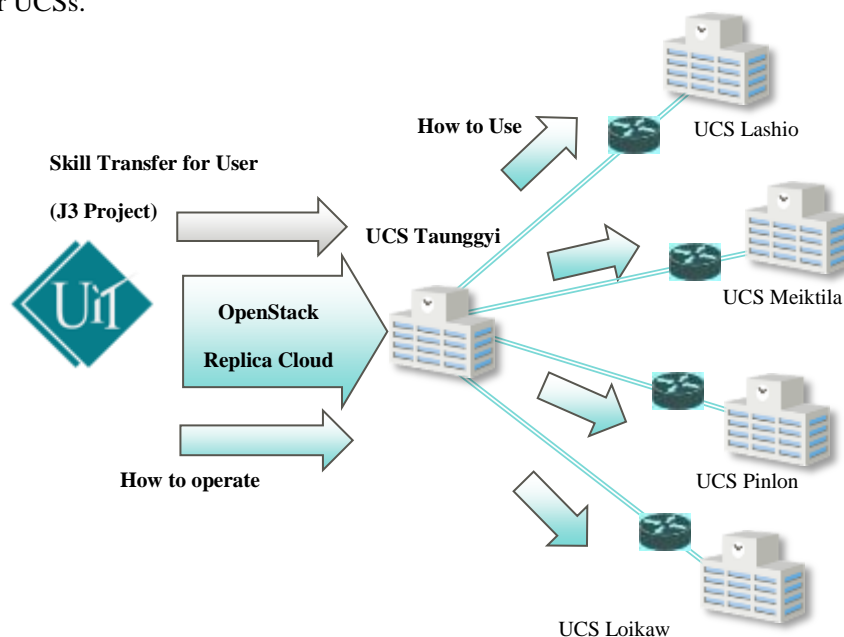
We have established the Pilot Cloud Platform for next 10 other IT universities based on experience of previous project and new knowledge gained from OJT, implemented the platform using OpenStack for cloud services and conducted trials of broadband connectivity to 10 new areas and also, deployed the cloud services for education and administration. We configured the broadband network and deployed the cloud and applications (Samba: file sharing and Moodle: LMS) on Virtual Machines and e-learning lectures.

## 7-2. HUMAN RESOURCE DEVELOPMENT

We organized the lecture and workshop for the deployment of cloud and the workshop for sharing knowledge and hands-on experience regarding OpenStack structure, support for the cloud operation and patch management system for system vulnerability. And we continuously exchanged the experiences of research and knowledge between Myanmar and Japan and discussed and exchanged opinions, ideas and knowledge.

### 7) EXPANSION PROJECT : REPLICA CLOUD CONFIGURATION AND EXTENSION TO 4 ADDITIONAL UNIVERSITIES

We took a trial on May to June 2018 to create Replica Cloud and additional 4 connection to the Universities of Computer Studies in Lashio, Meikhtila, Pinlon, and Loikaw with additional financial support from KDDI foundation and skill transfer from UIT and APT projects' member UCSs to 4 other UCSs.



There are some functions for each parts respectively.

By UIT,

- Configure Cloud Infrastructure
- Prepare new images, own instance / virtual machines
- Assign the user role for each university
- Have prepared some cloud services
  - File sharing (Samba File Service)
  - Course Management System (Moodle)

- Hand-over how to manage and operate Cloud Infrastructure to UCS (Taunggyi)

By UCS (Taunggyi),

- Check the connectivity to UIT Cloud via VPN
- Manage Cloud Infrastructure and services
- Foster the continuous access to the deployed Cloud
- Create own instances / virtual machines
- Share your own materials to member UCSs
- Can access UIT's shared materials and CMS

By UCS (Lashio, Loikaw, Meikhtila, Pinlon),

- Check the connectivity to Cloud via VPN
- Create own instances / virtual machines
- Access the shared materials and CMS from Taunggyi's cloud infrastructure
- Access the shared materials from UIT's cloud if Taunggyi's cloud is not available
- Foster the continuous access to the deployed Cloud

By KDDI Myanmar,

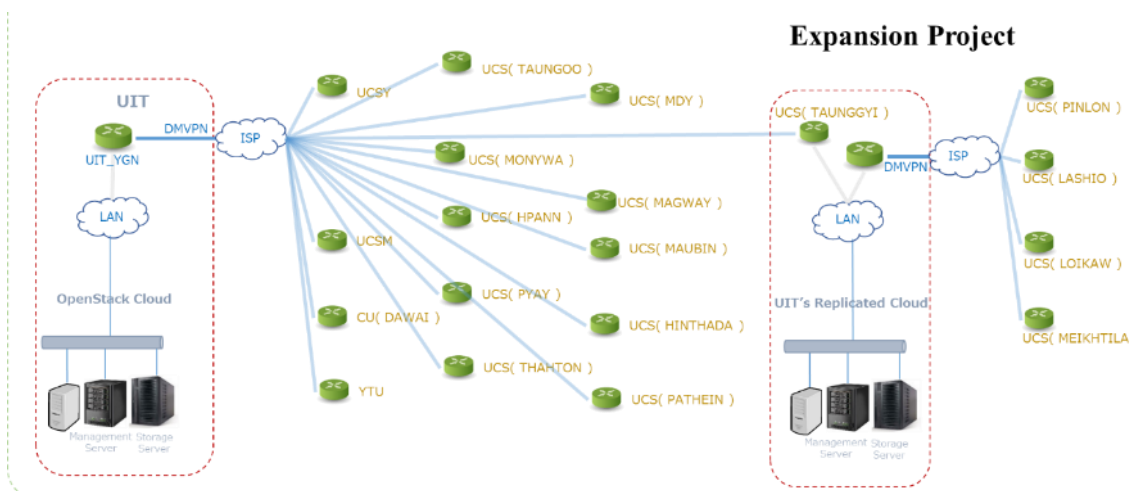
- Prepare the design and network setting for VPN connectivity
- Make schedule to set up VPN in each University
- Set up VPN connectivity among Universities
- Deliver equipment and devices to each University

#### **Equipment list in expansion project**

<b>Sr. No.</b>	<b>Description</b>	<b>Qty</b>	<b>University</b>
1.	Cisco ISR4321-SEC/K9 router	1 per each	UCS (Lashio, Loikaw, Meikhtila, Pinlon)
2.	Cisco ISR4331-SEC/K9 router	1	UCS (Taunggyi)
3.	Cisco Firepower FPR2110-BUN	1	

Sr. No.	Description	Qty	University
4.	Cisco Catalyst WS-C2960X-24TS-L switch	1	
5.	UCSC-C220-M4S -64GB DDR4-2400-MHz LRDIMM/PC4-19200/quad rank/x4/1.2v, 2 x 600GB 12G SAS 10K RPM SFF HDD	3	
6.	31U Rack 600 x 1000 mm and Accessories	1	
7.	KVM Switch- CFP185KMM8-101	1	
8.	UPS- Liebert GXT4 On-Line 5000VA 230V LCD PF0.9 2U Extended	1	

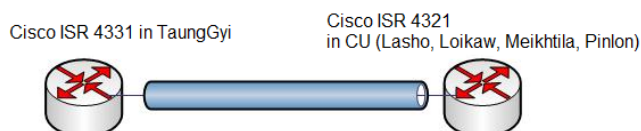
**VPN connectivity for expansion project**



- Setting up ‘Site-to-site VPN tunnel’ between UCS (Taunggyi) and UIT (Hub to Hub)
- Configuring Cisco Firepower Management Center in Firewall at UCS (Taunggyi)



- Setting up ‘Site-to-site VPN tunnel’ between UCS (Taunggyi) and 4 member universities (Hub to Spoke)



## **8) ACCOUNTING REPORT**

The total amount of actual project expense was USD 118,638.95 (Initial payment of USD 93,200 plus balance of USD 25,438.95 under USD1.00 equals JPY110) which is under the approved budget of USD 155,417.50.

Primary reason of the difference between the budget and the actual expense is business trip expense – 1)the budget for kickoff meeting was not spent because it was claimed to the APT J3 2015 project (It was held at the same time as completion report of previous project), 2)Number of project members visited to Japan was limited to 5 due to Myanmar government policy in spite of our original intention of sending 8-10 members to Japan and 3)Japanese experts visited Myanmar for the completion ceremony by their own budget because they had multiple purposes to visit there.

KDDI Foundation has donated USD 67,267.20 for the connectivity extension to additional 4 universities such as Universities of Computer Studies in Lashio, Meikhtila, Pinlon, and Loikaw.

## **9) FUTURE PLANS AND CONCLUSION**

In 2014, the first proposal was initiated as development of private cloud system at Bahan Campus of UCSY (Bahan Campus), later UIT. The second project was introduced public cloud system connected with 5 other universities, and at this year 2018, 10 universities were joined to this cloud networking. Initially, we considered the target was to establish the network among universities in Myanmar and to extend it to international. We recognized one of the most difficult challenge was to increase the bandwidth and reliability of network for each university via VPN. So far, each of universities made effort to improve and increase the internet connection bandwidth and reliability, supported by Ministry of Education.

Myanmar has drastically changed in recent 5-6 years, also our skill and practice of cloud and networking including security was improved. Even the situation of internet connection is still not much improved in usage expense and bandwidth. In this situation, in parallel of APT projects activities, we have been proposing to Ministry of Education regarding establishment of educational cloud network with its concept/method, for extend our network and connection of TEIN. Actually, Myanmar is last country in South-East Asia, which has no “research and educational network”.

In March 2018, KDDI foundation donated hardware equipment (server, router and relevant devices) for extend this APT network to 4 more universities and we established imitation cloud system at University Computer Studies Taunggyi. At end of May, 2018, total number of universities who join to this cloud network is now 20.

Through the series of our APT projects, most popular educational administration/course management application “Moodle” is installed and utilized to share those resources among several universities to

help their administration and teaching work. And for one of the other expansion project, remote lecture (video conference/ multimedia) among several medicine universities in Medical sector in Myanmar is now implementing collaborated with Japanese medical university.

Our APT cloud network is now one of the core infrastructures not only equipment but also human resource which is the big drive of extending cloud networking in Myanmar.

Refer to expense and cost of extending to all universities in Myanmar including applications, we may require step-by-step procedure to this extension in Myanmar. So, we are considering (1) proposing Ministry of Education to have strategy and budget for cloud networking in universities, and basic school as well, (2) in restriction of budget, requesting other computer universities and technological universities to join into this cloud networking (initial target will be all 27 ICT related universities and major technological universities) (3) requesting other faculties universities to connect with international educational collaboration (ongoing : Connect medical universities with Japanese medical university for remote lecture of several significant medical care to improve the quality) (4) ministry with each university is making effort to get minimum bandwidth and quality for affordable and sustainable operation and maintenance including application and function.

We believe our activities during and after APT projects will be one of the good practices for not only mmREN, but also SDGs (Sustainable Development Goals) to improve the quality of life, economy and environment in Myanmar.

## **10) ACKNOWLEDGEMENT**

- We would like to thank Asia-Pacific Telecommunity for sponsor this ICT Pilot Project
- We would like to thank Ministry of Internal Affairs and Communications of Japan for the fund by the Extra Budgetary Contribution from Japan.
- We would like to thank Ministry of Education of Myanmar for understanding and very warm support to the project.
- We would like to thank Ministry of Transport and Communication of Myanmar for understanding and very warm support to the project.
- We would like to thank all the leaders of the 20 member universities for very effective support and contribution to successful implement of this project.
- We would like to thank the leaders and staffs of the University of Information Technology, Fujitsu Limited, Tokyo Technological University, Okayama Prefectural University and KDDI Foundation for their very warm hospitality and cooperation and support to the project team to successfully implement the project.