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EVOLUTION OF ICT INFRASTRUCTURE IN UiTM

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ABSTRACT: The article is about the evolution of UiTM ICT infrastructure, in general. Objective of the article review is to inform and record the changing technology applied throughout the years. The information will circulate around topics on the growth of network communications services that supports UiTM applications over the years. Method of identifying data is based on information reviewed from the paper written by the first author and the work experiences from both authors in the field. Findings from the collection of data will be a general chronological evolution of the entire ICT infrastructure system in UiTM for both intranet and the Internet link. These explanation enables the understanding on how ICT infrastructure evolution and growth in UiTM and can be referred to as a guideline for current or future administrators.

***Keywords*:** ICT infrastructure, intranet, Internet, Network Technology

INTRODUCTION

The purpose of this paper is to provide a history case study of the development of data networks in Universiti Technology MARA, the largest university in Malaysia. In relation to the growth of network infrastructure in the USA and Europe in 1980's many other parts of the world were not keeping pace (Bothon, 2016). In Malaysian scenario, only in 1990s the MSC program was officially inaugurated by the fourth Malaysian Prime Minister, which was on 12 February 1996 to catch up with the digital divide. As explained by Bothon (2016) the development of digital divide, must carry on changing to keep pace upon the changing technology.

Planning for Computer Networking System infrastructure is very important for an organization that relies very much on Information Technology to support its business operations. Networking technology allows for the exchange of data between large and small information systems used primarily by businesses and educational institutions. The scope of the article discusses about the chronological setting and evolution arrangement in the data communication (Networking Technology, 2016) network territory, for connectivity between Universiti Technology MARA's campuses and the Internet. The Internet is a global network of billions of computers and other electronic devices. Internet, enables access to almost any information, communicate with anyone else in the world, and do much more (Internet Basic, 2022). Meanwhile an Intranet is a private network contained within an enterprise that is used to securely share company information and computing resources among employees (Intranet, 2022).

The need to have a sound platform to support data communication is crucial due to the expanding number of campuses, to support vast number of students, and considering upon the growing need to support UiTM business operations via online system, either Intranet or Internet. Since the outbreak of the Covid -19 Pandemic in the world, every business operations are badly affected. This adds to the problem of readiness of organizations to support the growing need to work online and scalable is their Computer Networking System infrastructure.

Based on previous research, ICT infrastructure network projects (ICT infrastructure physical assets) are associated with the infrastructure that require the connection between computers, data loggers, printers, switches, telecommunications, servers, cabling, data rooms, civil works, etc., for exchanging data, communication (Dordal, 2009). Whereby as explain by Wong & Kim, 2017, Networks are physical assets that deliver information systems, which, in turn, host databases and software (ICT). ICT is the infrastructure

and components that enable people and organizations to interact in the digital world. A hefty amount on these investments is linked toward ICT infrastructure physical assets which enabling the ability to designing smarter cities offering quality life to residents and better business processes (Nijkamp & Cohen-Blankshtain, 2013). The approach of an efficiently planned management of operational change, enabled the delivery of good and organized ICT infrastructure (Leydesdorff & Wijsman, 2007). The growth and operation of ICT infrastructure network projects represent a profound change that will bring about organizational processes and methodologies (Anthopoulos et al., 2016; Moktadir, 2018; Lappi et al., 2019).

In the attempt to fulfill the objective of this paper, the Method used to gain data are based on two sources of information. The first source in information reviewed from the paper written by the first author in her thesis paper written in academic paper. The second vital data collection was using based on the work experiences from both authors in the past, plus the current job specification that still relates on ICT infrastructure. These untap tacit knowledge needs to be processed, revisit and transformed into explicit knowledge to be disseminated and use for future as reference.

METHODS

The descriptions, results and reflections in this paper are based largely on past research by the first author (Mengen, 2001) discussion on UiTM current and future network design, experienced work history by both authors, that mostly based on internal nonconfidential data in general. Effectiveness of this study is largely evaluated by including personal work experience. Future predictions about the development came from time history analysis of the situation in UiTM. Historical analysis is a method of the examination of evidence in coming to an understanding of the past.

By using this methods, a consistent and comprehensive narrative is formed on the evolution and impacts of Internet or intranet access in UiTM. This story has never been told before in one place, and here, we link it to the potential for shared, collaborative technical and information sharing.

RESULTS AND DISCUSSIONS

The history of ITM/UiTM Nework System in chronological order by year.

1989	ITM initial started connecting to the Internet through "Rangkaian Komputer Malaysia (Rangkom)" where Malaysian Institute Microelectronic System (MIMOS) was the first Internet Service Provider (ISP) in Malaysia. The early application was email and electronic forum using X.25 Technology (Data Communication in Wide Area Networks) connection. Using copper wire with T- connectors, (X.25, 2022)
1994	ITM starts using JARING (Joint Advanced Integrated Networking) using Leased Line Technology 64kbps. JARING Project was an upgrade from Rangkom Project by MIMOS (Leased line, 2022)
1997	ITM began the Network System Project ITM in Shah Alam campus using Asynchronous Transfer Mode (ATM) 155 Mbps technology as its Network Backbone. Using category 5 copper cable and fiber optic as the backbone link (Asynchronous_Transfer_Mode, 2022) There were initially Seven (7) network center in 1997 (ATM technology) 8 Core Switches, 1500 nodes, 70 shared switches & 2 routers
1998	Network system in UiTM was extended by connecting branch campus Malaysian wide using leased line Corporate Information Superhighway (COINS) provided by "Telekom Malaysia" as the WAN Connection using Frame Relay technology (Frame Relay, 2022).

2003	The Network System Project upgrade for UiTM Shah Alam using 10 Gigabit Ethernet technology

2003   The Network System Project upgrade for UiTM Shah Alam using 10 Gigabit Ethernet technology
All the Network Backbone speed is 10GbE .
Category 6 copper cable was used at workgroup layer plus fiber optics to link between backbones/other layer switches certain distance.
This replaced the ATM Backbone technology that was no longer supported in the market.
The number of core switch , shared switch, nodes, triple in numbers as the requirement for connectivity has then expanded (Gigabit Ethernet, 2022 & Multilayer Switch, 2022)

Internet access Jaring & TM upgraded and used as load balance and backup link.

2008 >   Internet access has more been upgraded to support UiTM campuses
Metro E (TM) ISP service provider but the exact year was not accessible after both authors was transferred to different department/faculty

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Figure 1: The history of ITM/UiTM Nework System Until 2003

Over the years after 2003, the expansion of user node point connection to the Internet & intranet has grown massively. In the early 2000s, Wireless Lan (WLan) technology was not trusted due to its insecurity. Wireless Local Area Network (WLAN) technology emerged in the early 1990s but, was not widely accepted due to its high cost and technological limitations at that time (Kane & Yen, 2001). Nonetheless after the WLan technology mature, application of such devices was use in various suitable places only due to accessibility quality are still not satisfying with comparison to the physical cable.

Below are a few almost current networks architecture design for UiTM infrastructure that has evolve and been used over the years.
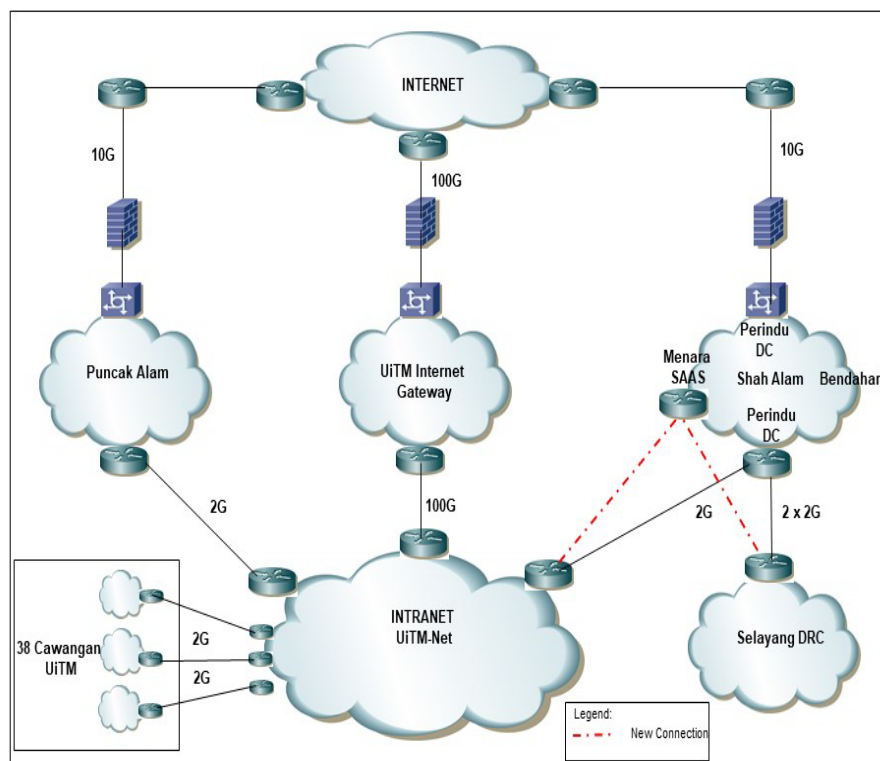

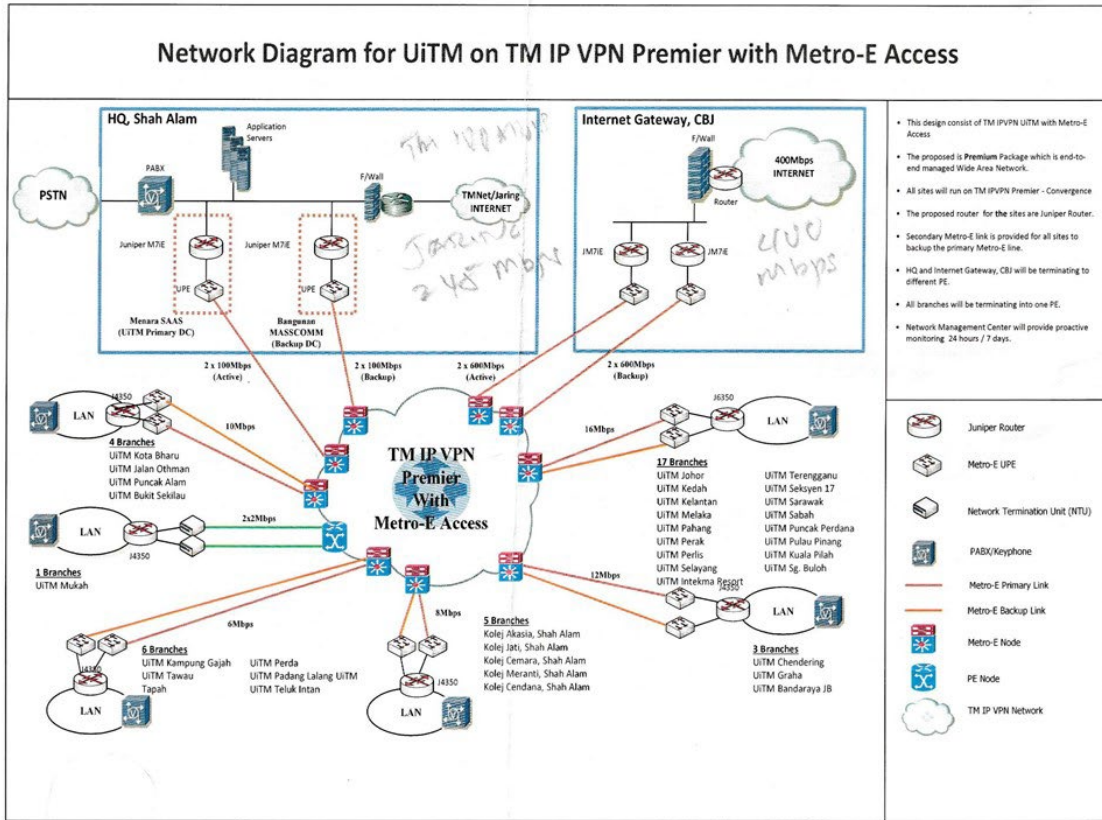*Figure 2:* The Almost Current Enterprise Network Architecture

Figure 3: UiTM Uses Premier Metro-E Access to Branches

CONCLUSION *(Times New Roman, 11 font size, bold, all caps)*

The network infrastructure changes overtime, in relation to the changing technology and user demand in business operation. In UiTM Shah Alam, the local area network technology used was X.25 technology using copper wire with T- connectors, then move to Asynchronous Transfer Mode (ATM) 155 Mbps technology supported by category 5 copper cable and fiber optic as the backbone link, and the last upgrade uses 10gigabit technology at its core switch with category 6 copper cable plus fiber optics to link between backbones/other layer switches certain distance. Evolution period can be seen in terms of year distance below.
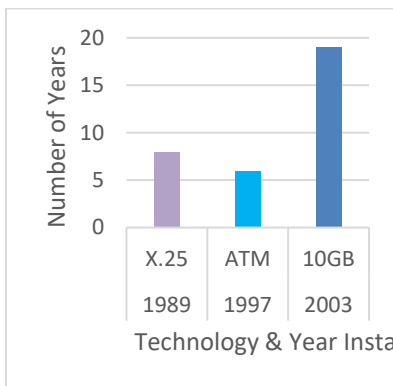
Figure 4: The Backbone Technology Timeline

While the connectivity to the other campuses and the Internet evolution period can be seen in terms of year distance below with the Internet Service Provider (ISP) chosen based on contract maintenance.
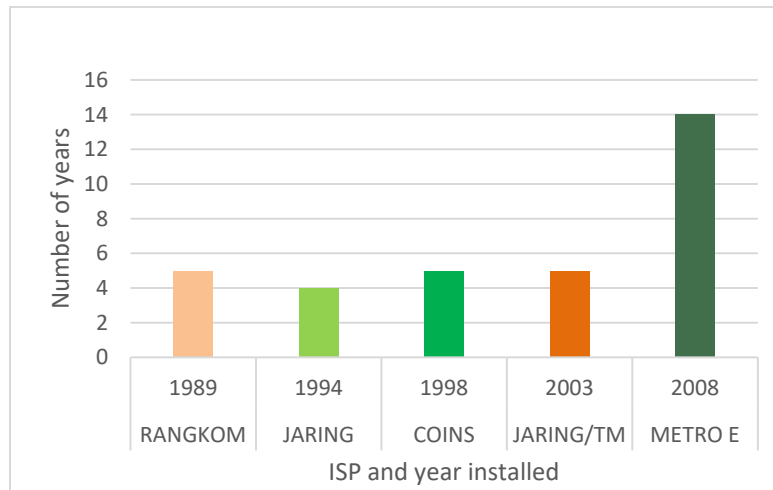

Figure 5: The WAN/Internet Upgrade Timeline

As seen above the findings are limited based on authors experience and backdated knowledge. Thus for future case study, further uptodate findings can ensure documentation on the evolution of such vast infrastructure in ensuring sustainability and good governance/administration without exposing the confidentiality factors.

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