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Historical Overview: The Journey of TelKom in Operating Communications Satellites to Serve the Indonesian Archipelago

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THE JOURNEY OF TELKOM IN OPERATING COMMUNICATIONS SATELLITES TO SERVE THE INDONESIAN ARCHIPELAGO

by Tonda Priyanto

1. Background

In 1976, Indonesia became the 3rd nation in the world operating a Domestic Satellite Communication System using GSO Satellites, the PALAPA A system. This satellite system provided telephony and facsimile services between cities in Indonesia and became the main TV program distribution infrastructure. Today, TELKOM*) has been operating satellite communication networks for 28 years, TELKOM has experienced technology improvements, value added service improvements and also changes in regulations. Nowadays, TELKOM operates 2 satellites, PALAPA B4 and TELKOM-1 to serve telephony trunking including for cellular systems and as data and Internet backbone throughout Indonesia, especially the Eastern part of Indonesia. This paper is intended to describe the journey of TELKOM in operating its satellites and satellite network, earth stations, services and business aspects.

**) Note: TELKOM is PT. TELEKOMUNIKASI INDONESIA Tbk. a public company listed at NYSE, LSE and JSE (Jakarta Stock Exchange)*

2. TELKOM's satellite development

TELKOM' satellites were originally designed for domestic communications as they were intended for unifying Indonesia. The satellites had to cover all islands of Indonesia including East Indonesia to encourage development in the intended regions. The development of TELKOM's satellites is shown in tables 1 and 2. The development followed closely satellite technology developments itself and evolved in line with domestic and regional market demand. Therefore, the capacity and transmission power (EIRP – Effective Isotropic Radiated Power) has been increasing and also the coverage. The increased power is an effort to reduce the link-cost including earth station costs and also for opening new markets.

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Name	Date of Launch	End of Operation	Orbital Slot	Launcher	Manufacture
PALAPA A1	9 Jul 76	1983	83° E	Delta 2914	HS-333 Hughes
PALAPA A2	11 Mar 77	1987	77° E	Delta 2914	HS-333 Hughes
PALAPA B1	16 Jun 83	1990	108° E	STS-7	HS-376 Hughes
PALAPA B2	26 Feb 84	-	Failed	STS-11	HS-376 Hughes
PALAPA B2P	21 Mar 87	1996	113° E	Delta 6925	HS-376 Hughes
PALAPA B2R	14 Apr 90	2000	108° E	Delta 6925	HS-376 Hughes
PALAPA B4	14 May 92	2005	118° E	Delta 7925	HS-376 Hughes
TELKOM-1	13 Aug 99	2016	108° E	Ariane 4	A2100A Lockheed Martin
TELKOM-2	End of 2004	-	118° East	Ariane 5	Starbus 2 - Orbital

Table 1. TELKOM's Satellites

Name	Manufacture	Number of Transponders	Weight Kg.	Power Watt	Peak EIRP dB
PALAPA A1	HS-333 Hughes	12 ST.C	297	NA	33
PALAPA A2	HS-333 Hughes	12 ST.C	297	NA	33
PALAPA B1	HS-376 Hughes	24 ST.C	1475	936	36
PALAPA B2	HS-376 Hughes	24 ST.C	1475	936	36
PALAPA B2P	HS-376 Hughes	24 ST.C	1475	936	36
PALAPA B2R	HS-376 Hughes	24 ST.C	1475	936	36
PALAPA B4	HS-376 Hughes	24 ST.C	1475	936	36
TELKOM-1	A2100A Lockheed Martin	24 ST.C + 12 Ext.C	1761	5233	42
TELKOM-2	Starbus 2 - Orbital	24 ST.C	879	3100	42

Table 2. TELKOM's Satellite Specifications

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The First Generation – PALAPA -A

PALAPA A-1, launched on 8 July 1976 was successfully loaded by traffic from 40 earth stations spread all over Indonesia. A remote earth station and TELKOM's master control station is shown in figure 1. Six of its 12 transponders were loaded by telephony and 1 transponder by the national television program, while the 5 remaining were for backup.

On 11 March 1977, PALAPA -A2, located at orbital slot 77 degree East Longitude, was launched from the Kennedy Space centre, Cape Canaveral, Florida, USA for back up and ready to be operated in the event PALAPA-A1 experienced a failure or when the demand could not be accommodated by PALAPA-A1.

Insert 2 photos:
Earth Station & Telkom's PALAPA A Master Control
(Figure 1)

Second Generation – PALAPA -B

As the end of life of PALAPA-A1 and A2 were in 1983 and 1984 respectively, planning to replace the PALAPA A satellites began in 1979 to maintain the operations of the PALAPA system. The requirements of the second generation satellites was based on estimated domestic telecommunication needs, i.e. PERUMTEL (now PT TELKOM), TVRI (broadcaster), for government use and needs of ASEAN countries based on the ASEAN technical and economical experts Working Group in 1978.

The coverage as well as technical capability were increased: where PALAPA A1 was for the Indonesian territory only, PALAPA B was able to cover the entire ASEAN region. In terms of capacity, PALAPA B capacity was made to 24 transponders, 2-fold that of PALAPA A. PALAPA Bs were placed in a new and better location: 108 deg E, 103 degE and 118 degE, in order to minimize interference.

PALAPA B1 was launched in June 1983 using the Space Transportation System (STS) Challenger and was successfully put into orbital slot 108 degE. PALAPA B1

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was intended for internal use of PERUMTEL. PALAPA B2 was not successfully injected into orbit as it had a perigee kick motor problem. For replacing PALAPA B2, PALAPA B2P was immediately manufactured and launched in March 1987. This satellite was used for 3rd party leases (domestic and overseas). PALAPA B2P was located at 113 deg. E.

The PALAPA B2 satellite was recovered by a special operation of a space shuttle flight and repaired. The re-launch of PALAPA B2 (named B2R) took place in 1990 to replace PALAPA B1. The PALAPA B1 satellite was sold to PT Pasifik Satelit Nusantara (PSN) for their "inclined satellite" business.

As the market grew, in 1992 TELKOM launched PALAPA B4 which is located 118 deg.E to also accommodate the continuous growth of satellite circuit demand in the ASEAN region.

Third Generation

As the PALAPA B2R service would be ended by 1999, in 1995 TELKOM formed a team to study the technical and business aspects for a new satellite generation. This study team came up with the suggestion that TELKOM should expand the satellite capacity to fulfill the very high potential demand for cellular trunking (especially TELKOMSEL's demand, which was growing quite fast at that time) and also to serve VSATs for Internet use. Therefore, the TELKOM-1 satellite (as the new generation satelllite is called), is designed especially for multi carrier use, so that the capacity could reach 2-fold compared to the PALAPA B2R for low bit rate VSATs.

To replace PALAPA B4, TELKOM is again improving the earlier generation satellite's coverage to include Guam and up to India and its neigbouring countries to respond to the market of regional networks – TELKOM-2. The changes of coverage can be seen in figure-2 .

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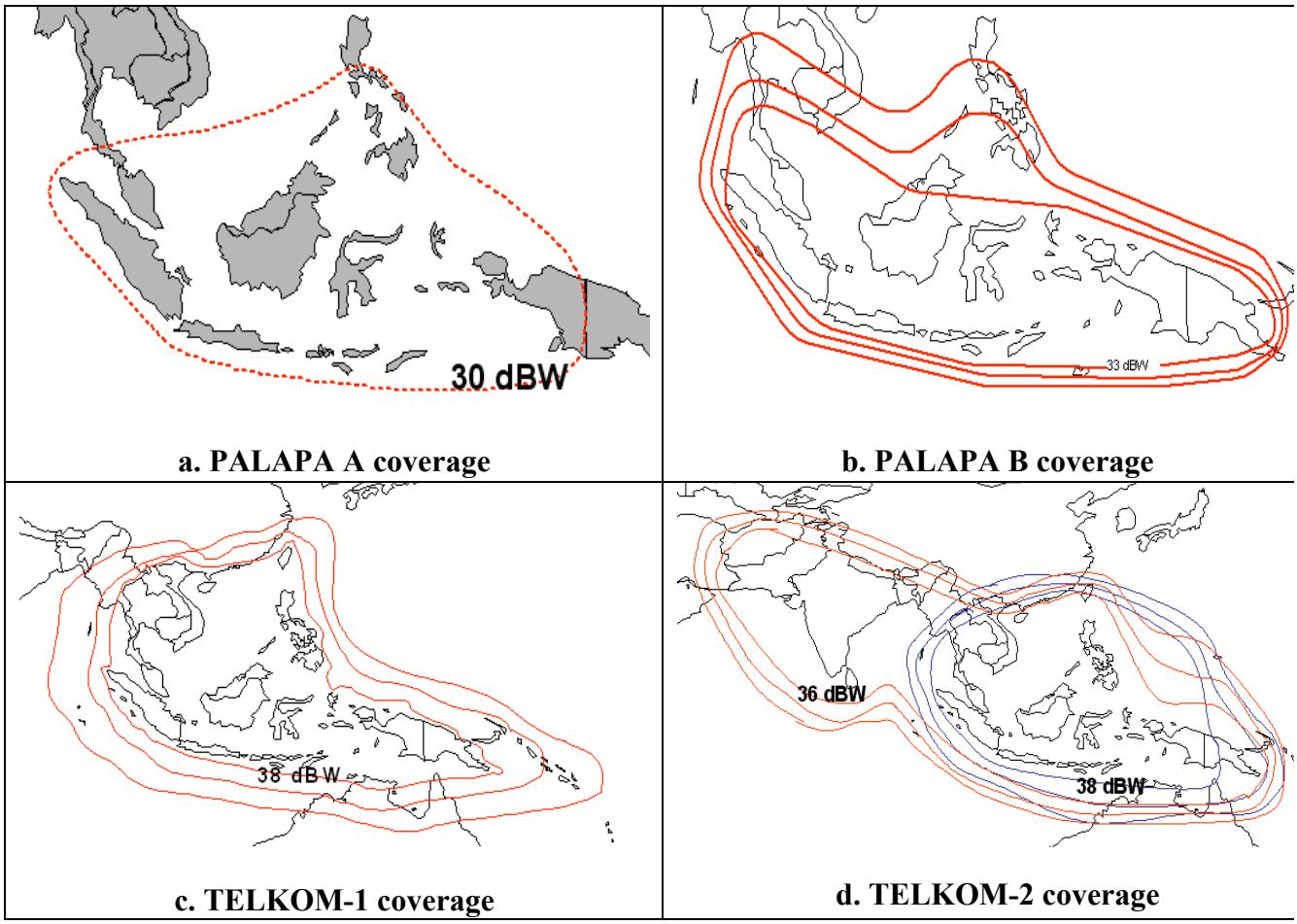

a. PALAPA A coverage

b. PALAPA B coverage

c. TELKOM-1 coverage

d. TELKOM-2 coverage

Figure 2. Coverage of PALAPA A, PALAPA B, TELKOM-1 and TELKOM-2

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Improvement period

As a result of the terrestrial transmission systems development in Indonesia's western region (i.e. microwave terrestrial system spanning Sumatra and fiber optic backbones in Java), the number and capacity of earth stations in Sumatra and Java decreased. In some cities, there is no need to have earth satellite stations, because the traffic is routed through terrestrial facilities.

In the period after 1990, TELKOM then mainly performed optimization of the earth station use. The traffic demand in eastern Indonesia could be fulfilled by relocating earth stations from Java or Sumatra. When used for lower traffic, smaller dishes became more commonly used in order to reduce space as well as for convenience in relocating and transport to remote areas. In addition, TELKOM also replaced the analog satellite transmission systems by digital systems.

The FDM/FM system was replaced by TDMA Medium Bit Rate and Low Bit Rate at the beginning of the 90's. The Medium Bit Rate TDMA system was implemented in 36 earth stations and Low Bit Rate TDMA was implemented in 30 earth stations. In 1995, a new digital system for point to point communications came up, and TELKOM replaced high traffic links between cities that were using TDMA with Intermediate Data Rate (based on 2 Mbps). Then, FDMA was fully cut off by end of 1996

For TV distribution, TELKOM started to implement the MPEG-2 digital system in 1996, and all analog television distribution facilities in TELKOMs satellites were completely digitalized by 2000. By doing so, TELKOM was able to reduce television transponder requirements by at least three quarters with the same quality compared to the analog system transponder requirements. In 1996, TELKOM also started to provide Satellite News Gathering services of which the SNG van is shown in figure 3.a.

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Figure 3.a. TELKOM's SNG	Figure 3.b. One-way satellite Internet access with 1.2 meters antenna receive only

Broadcasting period

While TELKOM expanded its network using digital technology for telephony and cellular trunking, in the year 2000 TELKOM introduced DTH (Direct To Home) using a C-band satellite, i.e. TELKOM-1 by utilizing 3 extended C-band transponders. This service is provided by a subsidiary company of TELKOM, namely PT INDONUSA. It can be seen that technology wise, DTH by (extended) C-band can perform appropriately using an 1.2 meter (4 feet) receive only antenna as shown in figure 3.b.

In the mid 90's, during which period Internet in Indonesia started booming, satellite usage was increasing for IP connections, which was due to limitation of the available cable-network (twisted copper wire) for Internet access. This increasing demand for Internet connections caused a sharp increase of VSATs based on the Internet protocol. In early 2000, TELKOM also introduced one way high speed satellite Internet access speed for mitigating limitation on dial-up connections. The satellite network is also used for widening the coverage area of Internet services.

We can conclude that technology migrations took place in TELKOM as can be seen in figure 4.

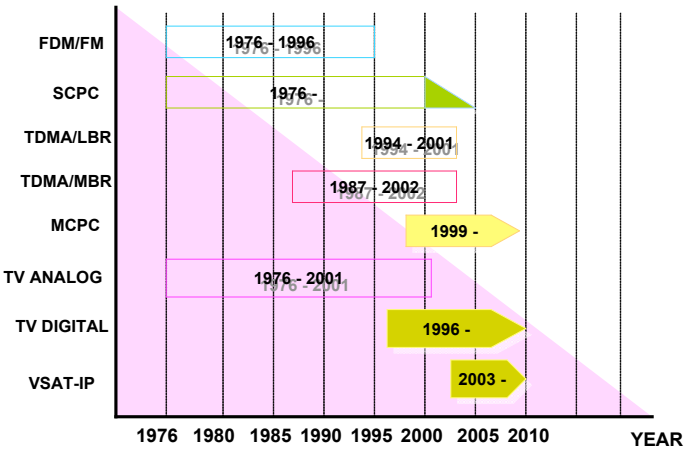

Figure 4. Technology migration in TELKOM's satellite network

3. The development of TELKOM's satellite services

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Starting as the pioneer in satellite technology and services, Indonesia (TELKOM) is more experienced compared to its neighboring countries. This has led to situations where our neighboring countries were utilizing Indonesian satellites for their own domestic purposes, such as Thailand, the Philippines, Malaysia.

PALAPA B2P, which was the satellite intended for domestic and foreign leases, did very good business, and PALAPA B2P became a hot bird. Broadcasters (CNN, ESPN) were also utilizing the PALAPA B2P and people in the footprint of PALAPA B4 can receive their programs.

In 1993, the government started to deregulate the satellite business by approving a private company, although partly owned by TELKOM, to become a satellite operator. PT Satellindo became a satellite operator besides being a cellular operator as it was granted also a cellular license by the government. The PALAPA B2P and its customers were handed over by TELKOM to the new company. After 1993, TELKOM was operating two satellites: PALAPA B2R and PALAPA B4 and continued to market its satellite business steadily. In this time period however, neighboring countries, which did not have satellites, started to build their own national satellites. Thailand has Thaicom, Malaysia has MEASAT and also Asiasat based in Hongkong. This development is visible in table 3 where domestic and foreign leases in 1995 are about 35% of total transponder utilization, down from 55% in 1992.

After the TELKOM-1 satellite was placed in orbit in 1999, TELKOM did intensive efforts to market its capacity for transponder leases, satellite transmission links and television distribution. The result of this activity is shown in table 3 where starting in 1999 there is a (small) decrease for internal use and an increase of domestic leases. With this increase TELKOM's satellites have become the dominant support for domestic satellite networks including the VSAT banking (data) network. To date, almost 25,000 VSAT nodes supporting almost 75% of the banking sector data network are pointed to TELKOM's satellites.

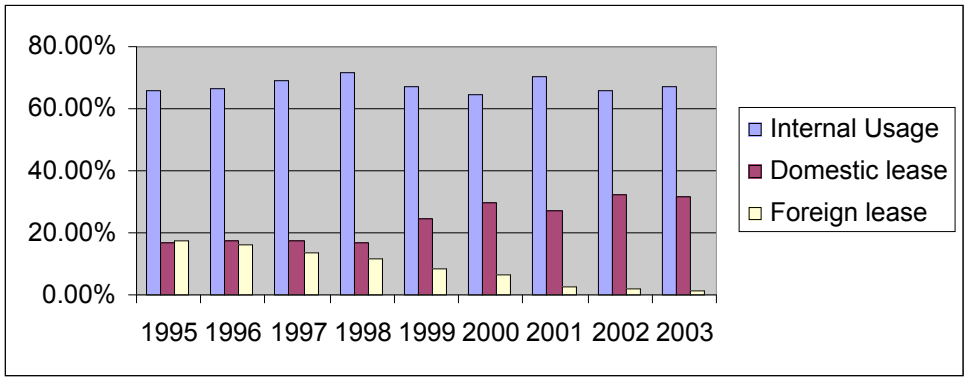

Table 3: Percentage of TELKOM's satellite utilization for internal,

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foreign and domestic lease usage.

To respond to current service demand, TELKOM also changed its strategy to fulfill customer demand by segmenting its customers. By doing so, TELKOM is able to focus to its customers and new satellite business services (called *TELKOMSatellite*), divided into 4 categories as follows:

- ***TELKOMTransponder***: transponder lease for partial and full transponders either full-time or occasional use.
- ***TELKOMSLDTS*** are services for connecting between two or more locations using the satellite network
- ***TELKOMBroadcast*** are services offered to broadcasters in distributing their programs all over Indonesia from their master station and vice versa.
- ***TELKOMTeleport*** are services in providing earth stations to uplinking any information from TELKOM premises.

4. Future development

Considering Indonesia's geographical characteristic and the goal to lessen the "digital divide", using satellites with their unique features is the best technology solution to serve any telecommunication requirement with fast deployment. In order to provide the best service and price to its customers with high availability, it is necessary to reduce costs by performing efficiency in utilizing transponder capacity through updating and use of new coding and advanced modulation techniques.

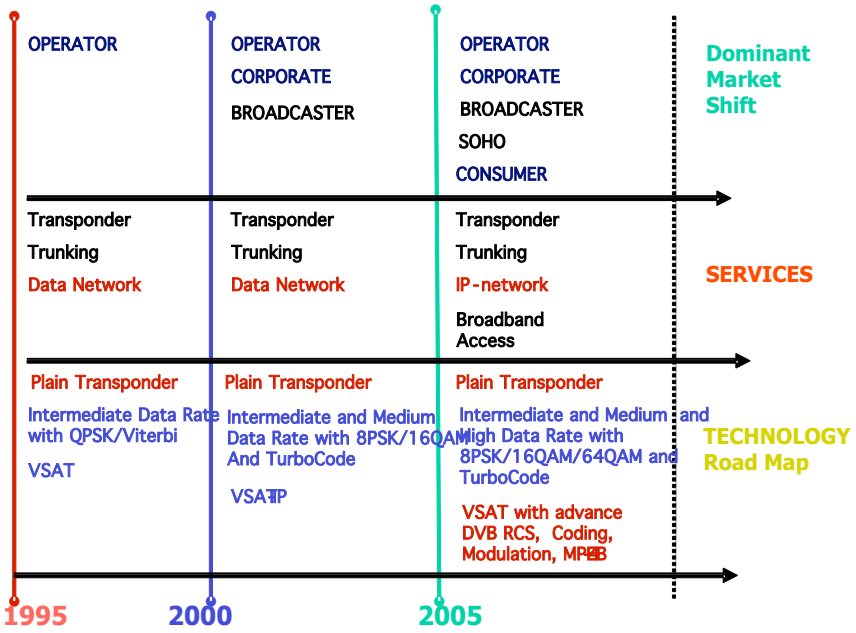

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Figure-5. Road map of market, services and technology.

The above strategy will be implemented in all 4 product categories as stated in section 3, where the road map is shown in figure 5. In the market perspective, TELKOM has to anticipate market changes from "operator" to "consumer" and the technologies associated with it to serve the market.

5. Conclusion

TELKOM has proven that the satellite communication technology is able to provide fast deployment and is very flexible for reconfiguration. Almost 30 years of TELKOM's experience in satellite based services have brought many benefits to the country such as increasing geographical penetration, teledensity, information distribution and Internet access. Therefore, further use of satellites for Indonesia's development and customer satisfaction has become a strong commitment of TELKOM. As full network and service provider, TELKOM is also relying on satellite networks to provide a total solution to its customers. Satellites are also very powerful as emergency solution when terrestrial links are experiencing problems.

About the Author:

The author is the General Manager of TELKOM's Satellite Business Unit.
Tonda Priyanto graduated from Gadjah Mada University, Yogyakarta, Indonesia in 1987 for his first degree and obtained his Master's degree in Telecommunication Technology at Aston University in 1995. He joined TELKOM in 1987 . His first five years assignment was in satellite operations specializing in SCPC/DAMA. During 1995-1996, he was the technical leader for the WLL project in East Java. From 1996 to 1999 he was member of the TELKOM-1 satellite project team, during which period he was also the senior payload engineer in TELKOM's representative office at Lockheed Martin - USA. In 1999 he was assigned to his current post as General Manager of the Satellite Business Unit of TELKOM.