Beneath the veil of the Kumul Submarine Cable Network

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Abstract

The Kumul submarine cable network being developed by Dataco is an important asset which could change the landscape of the telecom industry in PNG. However, it seems that a truly high-speed internet experience will be minimal at the network periphery because 'any network is only as good as its weakest link'. The bulk of the end-users in PNG use microwave-based mobile phone networks and are located at the network periphery. The anticipated socioeconomic benefits of KSCN, economies of scale at competitive prices, can only be enjoyed if and only if the regulator and the stakeholders improve competition at the 2nd tier. Availability of the optical fibre as close as possible to the end user's premises is necessary and must be made accessible through affordable and competitive pricing. Failing this, the slogan 'yes, you will be covered!' will remain a fallacy.

Keywords: Kumul Submarine Cable Network, Highland Optical Fibre Network, PPC II Submarine Cable, Coral Sea Cable, APNG II Submarine Cable, terrestrial microwave backbone, high-speed internet access and mobile communications.

Introduction

Before 2006, the telecommunication sector in Papua New Guinea (PNG) was a monopolized space, only accruing a mere 64000 fixed telephone and a handful of mobile subscribers from a total population of over five million (Watson 2011). The bulk of these users were public servants and private company employees in

towns and the two cities (Lae and Port Moresby). Telikom PNG (TPNG) provided fixed-line phone services to residential homes in urban centres which remained few. B-Mobile was then a fully owned subsidiary of TPNG. Of course, businesses such as financial institutions and other service and manufacturing companies were the target customers of voice and data services provided within the monopoly telecom space.

In 2006, a shift in government policy saw the entry of an international mobile phone service operator, Digicel, significantly changing the landscape and making access to modern communications a reality for ordinary citizens (Suwamaru2015). Since then, Digicel has installed more than 1100 mobile towers across this geographically differentially populated country, in comparison to the modest 300 towers by its nearest rival B-Mobile (Suwamaru 2015). No doubt, Digicel is the new monopoly operator, providing a range of value-added services over its extensive modern mobile communication network. It cannot be denied that all manner of services related to banking, health and education, business and an array of social media services are now being enjoyed over Digicel's extensive mobile network (Suwamaru 2014).

At the time of writing, it is estimated that over four million users now enjoy mobile-based services with no signs of decreasing demand. The use of mobile-based services has become so addictive that research has shown them to be almost indispensable technological artefacts in modern PNG (Suwamaru 2015b). The new monopoly (Digicel) employs a cascaded chain of towers across the country, hosting backbone radio frequency-based microwave links (3-30 GHz bands) to support the transmission of aggregate voice, video and data traffic between base stations and mobile switching centres to serve the population. The mobile switching centres then receive and transmit via microwave into Base Station Transceivers (BTS) which in turn provide access to

users. Extra high frequency, microwave links which also support high bandwidths to accommodate bulkier traffic or load over frequency ranges within 30-300 GHz are used taking into account propagation distance, transmit power, bandwidth and frequency of operation among others. A range of access frequency bands including 800 MHz, 1800 MHz, 1900 MHz and 2100 MHz are used to provide access to end-users from transceiver antennas stationed on tower tops across PNG. As Digicel grows into a mightier monopoly, stringent policy and regulatory instruments are required to ensure a truly competitive Information and Communication Technology (ICT) space, where users may conveniently experience value in choice and price.

In this light, PNG Dataco (Dataco) was formed in 2014 by the Government of PNG (GoPNG) to be a provider of wholesale transmission capacity in PNG (Yafoi 2020). Visioned by the slogan 'Yes, you will be covered', Dataco has taken ownership of certain important assets such as the Gerehu earth station, which is a satellite-based inbound/outbound digital communication gateway operating on the C band ($4 - 8$ GHz or $\lambda = 7.5 - 3.75$ cm). The Gerehu earth station has capabilities for automatically tracking unpredictable movements of the geostationary satellite and hosts important ICT signal processing equipment which performs among other things: (1) provides and maintains signalling to maintain synchronicity of all inbound and outbound communication traffic; (2) modulates and demodulates outbound and inbound traffic; (3) codes and decodes clusters of signals; (4) translates frequency bands to appropriate bands for transmission and reception; and (5) provides amplification of outgoing and incoming radio frequency signals.

This paper notes that other operators, in particular, Digicel and B-Mobile also operate satellite-based international and domestic gateways. Dataco plans to offer wholesale higher capacity and speed through optical fibre based domestic gateway services from

15 provinces and international gateway services from Madang, Port Moresby and through Jayapura (Indonesia) to complement the existing satellite-based facilities.

This paper also investigates socioeconomic aspects arising from the Kumul submarine cable network (KSCN) using primary data collected from field surveys corroborated by secondary data from the current discourse on print and social media. This paper uses the foregoing data to discuss the major beneficiaries insofar as anticipated seamless communications and the resulting socioeconomic benefits are concerned. There are identifiable limitations of the KSCN, however, which are discussed against the backdrop of the slogan 'yes, you will be covered!' By and large, there are geographical hurdles which may render the rollout of optic fibre to the districts, impossible. This being the case, the radio frequency links from districts to the nearest MSC, becomes the weakest link which to a large extent determines user experience of ICT based services.

However, the field survey showed that a good number of the KSCN landing points, except for Madang and Port Moresby, are distanced away from the nearest mobile switches or TPNG exchanges and even further than the nearest BTS facilities. Given this scenario, the advertising slogan may remain deceptive, if the current lack of a consolidated effort between Dataco, TPNG, mobile operators and the regulatory agency persists. At this juncture, it serves a useful purpose to peruse the current literature.

Status quo

The Radio Frequency spectrum is the medium used at the user access layer, the base station entrance, and the microwave link segments in both mobile and legacy telecommunications in PNG (Sinclair 1994). This is largely due to the geographic challenges including mountains, valleys, swamps, lakes and kilometres of oceans that characterise PNG. By nature, radio frequency signal

strength is inversely proportional to the square of the traversed distance (SS $\propto$ 1/r2), hence, repeaters are required to reinforce the signal along the communication path. Electromagnetic radio frequency is related by a simple law - $f = c/\lambda$, where the frequency and the wavelength are inversely related. This implies that, with increases in wavelength, frequency decreases, hence larger distances maybe traversed as longer wavelengths may skip irregular topography increasing propagation distances. At increasing frequencies, wavelength decreases, the travelled distance reduces, unless aided through a structure of repeaters, as is the case for PNG. The frequency spectrum based communication links at the access, base station entrance and microwave backbone stratum are designed and deployed with these factors in mind.

The amount of bandwidth, capacity and speed in a communication channel at higher frequencies is higher but even plentiful using laser light in optical communications. Contrary to electrons travelling along copper wires at reduced bandwidths, state of the art low loss optical fibre uses optical amplification for increased repeater spacing and wavelength division multiplexing (WDM) to increase aggregate bit rate (ITU-T 2009). Laser light has very high frequency, therefore can support over $103 - 106$ times more information than either microwave (>500 Mbps) or satellite-based communications (>100 Mbps). Some not so old submarine cables use optical amplification and WDM techniques to maximise repeater spacing to over 100 Kilometres providing loss levels below ~0.1dB/km.

The KSCN is funded 85 per cent by the Exim Bank of China (Kenneth 2020) and the system is supplied by a world leader in optical fibre, Huawei, which deploys state of the art technology, in comparison to the past optical fibre. In long haul systems, the emphasis is on increasing the capacity transmitted on an optical fibre. This harnesses the WDM technique, using a single pathway

to transmit simultaneously many signals containing voice, images, video and data all of which retain their individuality (ITU 2009). For example, the Highland Morobe province as well as the six Highland provinces, use C band (1530 – 1565 nm) with more channels to support greater capacity and 1.6 Tbps speed, with a channel spacing of 25 GHz. Telecom operators, businesses, universities and hospitals have the opportunity to access bandwidth along this route via optical add/drop multiplexers (OADM). At the time of writing, the number of telecom operators, businesses, universities and hospitals connected to the Highland Optical Fibre Network is unknown.

Similar increases in the S-band (1460 - 1530 nm) and L-band (1565 – 1625 nm) are available with amplification techniques for signals in all three wavelength bands. Advances in optical fibre technology have made available new dry or low water peak fibre having smaller losses over the entire wavelength extending from 1.3 to 1.65μm. Dry water peak fibre in combination with amplification techniques gives optical systems with a larger number of WDM on a single optic fibre (ITU 2009). Levels of attenuation are compared for conventional fibre and low water peak fibre over the wavelength bands (Figure 1) and show

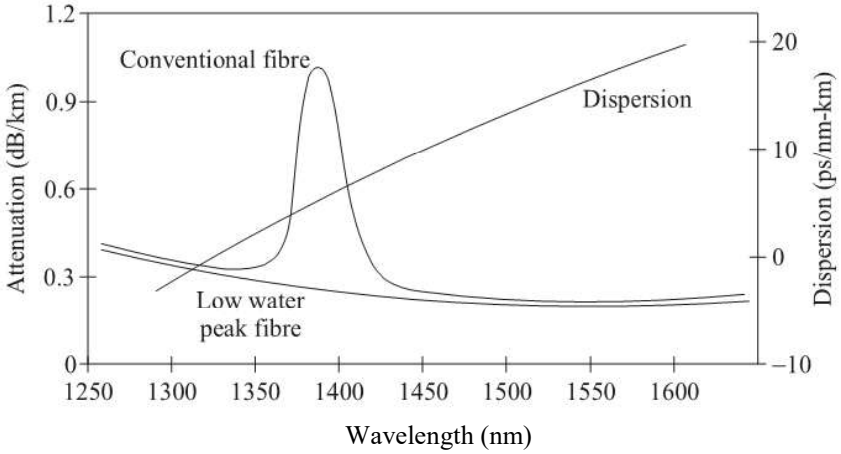

Figure 1: Attenuation of an optical fibre (ITU-T 2009)

Figure 1 shows that conventional fibre exhibits a minimum attenuation at 1310 nm and a pronounced minimum near 1550 nm. In modern low water peak fibre, water content (H2O) has been reduced and attenuation at 1383 nm has disappeared for all practical purposes (ITU-T 2009). The low water peak fibre supports the use of larger wavelength for WDM applications enabling higher bandwidth, capacity and fast speed.

Issues relating to dispersion covering the wavelength band have been overcome by using dispersion-shifted fibre or by limiting the laser spectrum to a single longitudinal mode (NA ND1). There have also been advances in dense wave division multiplexing (DWDM) which works by combining and transmitting multiple signals in tandem at different wavelengths on the same fibre. DWDM systems can carry light signals up to a hundred kilometres without electrical regeneration. Moreover, photonic cross-connect (PXCs) and OADMs have the capacity, space requirements, power consumption, reliability and cost, convenient for use in telecom networks (ITU 2009). The KSCN takes advantage of these attributes to cover a total distance of 5457 Km with 14 provinces each having a landing point (Kenneth 2020). The OADMs make it convenient for government agencies, telecom operators, universities and colleges, hospitals and businesses to enjoy speeds of up to 100 Gbps.

As will be apparent in a forthcoming section, the KSCN landing points are all located in coastal towns across PNG. This presents serious limitation which could impede real benefits from being enjoyed by target entities due to the lack of accessibility to the KSCN. Apart from the conveniences of OADMs for the 2nd tier operators, passive optical networks (PONs) enable accessibility from business offices, hospitals, colleges, universities and even residential apartments (ACMA 20007). For the case of KSCN,

[1] No Author, No date

PON is an optical access network which may extend from the 2nd tier operator's central office (E.G TPNG's office), designed as FTTH (fibre to the home), or TFFB (fibre to the building), FTTC (Fibre to the Cab2) designed according to local demand (Figure 2). For citizens to experience and enjoy the perceived benefits of KSCN at the prescribed speed of 100 Gbps, all existing access bandwidth starved copper wire and radio links could be supplemented by any of these versions of PON. Inaction by concerned agencies to design, build and create a competitive landscape beyond the landing points may render the earlier quoted slogan deceptive.

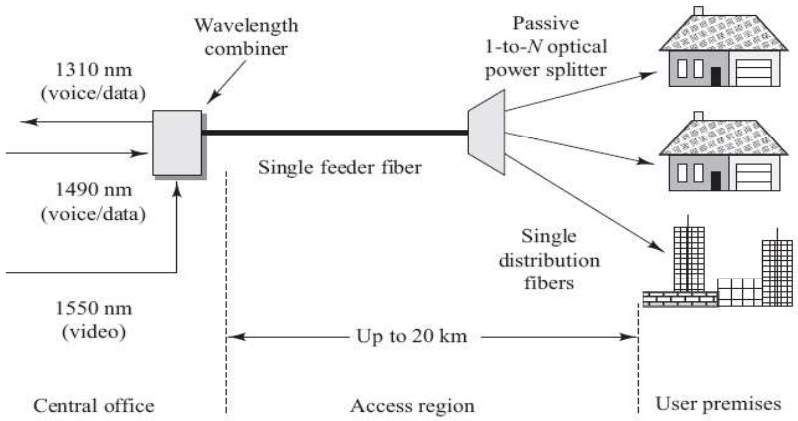

Figure 2: Illustration of passive optical network (ITU 2009).

Regulatory issues

The KSCN is the nation's single most important asset, costing the government over US200 million and if designed, implemented and managed well, could well be a game changer for the country. Three main objectives of the KSCN as identified include: (1) providing stable and reliable network service, enhancing speed, improving quality of internet communication, (2) helping reduce internet pricing by introducing competition mechanism and (3) driving the digital economy by enabling socio-economic development of PNG (Kenneth 2020). There are certain issues,

[2] Road side cabinet

however, that require to be addressed for these objectives to be achieved.

Regarding objective one, optical fibre is a time tested, proven and evolving technology which should provide stable and reliable network service with good speed and quality internet communication (Sinclair 1994). The paradox is that whilst the backbone is stable and reliable unless the entrance and access links which directly connect the bulk of the customers are upgraded, the anticipated fast speed and quality internet communication may be no different from the status quo. This is due to the simple fact that in any end-to-end communication system, the quality of the total link is only as good as the weakest microwave link (Sinclair 1994).

For example, the quality experienced by a mobile user in remote Siwai is a function of the access frequency, entrance frequency and microwave link frequency feeding into the mobile switching centre, wherever this may be located, be it in Arawa or Buka. Any improvements on the radio-based links connecting the KSCN forming the backbone between switching centres across PNG are likely to be minimal, simply because a weak link may exist in the access, entrance and microwave links.

Similarly, in towns and cities, seamless and fast mobile phone experience will only be enjoyed if and only if FTTH, FTTC or FTTB are deployed (ACMA 2007, ITU 2009). A similar argument can be made for mobile phone users in Namatanai, (New Ireland), Kiunga, (Western province) and Pomio, (East New Britain). This is because any one of the cascaded radio frequency-based links cannot accommodate increases in voice, video and data traffic. The radio frequency-based links present weak points of connection compared to the optic fibre in the telecom backbone. Simply because the majority of users depend on radio

frequency, KSCN is likely to offer rural-based users minimal improvements in speed and capacity.

Any improvements in the quality of internet communication across PNG as a result of KSCN would be very much welcomed. However, there is a lack of data on the existing quality of internet communications by the regulatory authorities that are mandated to monitor and enforce the quality of ICT services in PNG. Hence, there exists a lack of quality of service (QoS) data and so any suggestions or claims of improvements on internet communications may be open to interpretation. Ideally, it would be good to have existing data from the regulator on the current enjoyed QoS from sampled locations across PNG, for benchmarking against the anticipated improvements from the KSCN.

The second objective of the KSCN is to help reduce internet pricing by introducing a competition mechanism (Kenneth 2020; Yafoi 2020b). This objective is unclear when in fact there is a new monopoly mobile network operator (Digicel) as a 2nd tier service provider. Of course, B-Mobile and TPNG, radio and television broadcasters, narrowcasters and other minor internet service providers exist but unless optical fibre reaches their operation centres, the beneficial competition to exert downward pressure on internet prices will not occur. Hence to increase competition at the 2nd tier, regulatory support is needed to issue a call for expressions of interest (EOI) for additional mobile network operators' licence. As the total population of PNG is estimated to be over 8 million, it is clear that there is still room for one or two more mobile network operators. The granting of additional licences should increase competition and therefore enable KSCN to reduce internet pricing while benefiting from economies of scale. The issuance of additional mobile operators' license should also enable Dataco to amortise the investment on KSCN and enjoy a return on investment (ROI). With the current

state of affairs, it is difficult to ascertain whether or not such a huge investment may be amortised within an acceptable time frame.

The third objective of the KSCN is to drive the digital economy by enabling socio-economic development of PNG (Yafoi 2020b). In this paper, socioeconomic development refers to practical improvements in health and education indicators including income-earning opportunities (Suwamaru2015a). It serves a useful purpose to ask whether or not the use of KSCN may lead to health, education and income-earning improvements in PNG. The stakes are high, considering the scale of investment and the enthusiasm displayed by leaders from provinces where the KSCN has landed already. The currently available data don't show enough evidence on this third objective.

Anticipated benefits

Certain anticipated benefits to flow from the KSCN are summarised in the following commentary in a recent print media:

> The cable will provide the transmission link on which all communications can ride including, voice, data, television, video, radio and other ICT services such as e-government, e-commerce, e-health, e-education and banking (Pat, 2020).

The completion of the KSCN will be a major accomplishment for PNG, however, a lot more effort may be required to ensure that the asserted benefits are experienced. There are claims that 'ICTs while not an end in themselves have a key role as a basis for economic development, while also promoting social cohesion, cultural enrichment and environmental conservation' (Hassall 2017). Whilst e-commerce relies primarily upon forces of creativity, innovation and entrepreneur aspirations, the same cannot be said of e-government, e-health and e-education in PNG.

E-government in this paper refers to the use of ICTs to improve activities of the public sector organisations (Cullen& Hassall2017). For practical outcomes, the rollout of e-government initiatives depends to a great extent on the leadership and coordination capacity (Hassall 2017). The integrated government information system (IGIS) which was managed by the Ministry of Information and Communication Technology (MICT) has been in operation for many years costing millions of Kina in consultancy, equipment purchase and installation. The IGIS project has since disappeared with no traces of it within MICT and may have been absorbed into the Dataco structure. What can be expected of e-government initiatives upon the completion and use of KSCN?

Private hospitals tend to introduce newer technologies earlier than government-operated ones for many reasons including fast decision making processes, financial and human resources (Auka-Salmang 2020). Concerning e-health, private and public hospitals could be using ICTs in their locality but to date, there haven't been any reports on the use of ICTs to deliver healthcare services between distant locations in PNG. For example, the OPGW3 from Madang through Lae and over through the Highlands provinces runs above or within close proximity to several hospitals, however, no OADM connections have been reported in these facilities. For any e-health initiatives to progress access to the KSCN or the OPWG is important.

Divine Word University (DWU) is the only university in PNG that has embraced ICT within its research, teaching and learning realms. For this to happen, the leadership of DWU recognised the value of ICTs to enhance their core programs. A high-speed OPGW from the SLTE (submarine line terminal equipment) fed from the reconfigurable optical add/drop multiplexer (ROADM) at the TPNG exchange provides the required wavelength to the

[3] Optical ground wire

DWU fire-walled campus-wide server which feeds several hubs as access points. Can other universities in PNG replicate similar ICT facilities adopted by DWU for research, teaching and learning purposes? If so, how can the KSCN enable the progress and adoption of e-education in PNG?

Research method

This is a case study investigating the hypothesised beneficial aspects of the KSCN in PNG. Primary data were collected through submarine cable site inspections whilst secondary data were collected from the print and social media encapsulating quantitative and qualitative formats on the KSCN. Thematic maps were drawn from qualitative data and corroborated with quantitative data from field surveys. This allowed similarity, gaps and paradoxes to be identified which then formed the basis of constructing meaning.

The similarities are the extent to which anticipated benefits of the KSCN are deemed congruent with the corroborated data. Such similarities attest to the anticipated benefits that are practical and align with the hypothesised objectives of the KSCN. The gaps show silhouettes of mismatch between asserted and experienced benefits of KSCN. The asserted benefits are inclusive of those for both the OPGW and KSCN. The paradoxes particularly refer to instances where contradictory findings have emerged from the data when juxtaposed with asserted benefits of the KSCN. These paradoxical cases include data which show 'fit for purpose' networks which have experienced unanticipated adverse consequences. The field visits also uncovered cases where fully functioning networks have been ignored and are not being used.

KSCN simplified

The recent developments in optical fibre technology to serve the national backbone transmission space are unprecedented. If and

only if dimensioned and deployed as close as possible to end-users, will it serve PNG for most practical purposes?

The conceptual diagram (Figure 3) shows the KSCN at landing points containing equipment required to transform the wavelengths into the correct format before further propagation and distribution to all intended destinations. The wavelengths are converted into electrical pulses, amplified and reconverted into wavelengths before multiplexing for OPGW propagation. This happens at the submarine line terminal equipment (SLTE) which coexists with the ROADM4. The ROADM is a wavelength switching equipment which multiplexes or de-multiplexes and routes wavelengths to the respective destinations.

The core mobile network illustrates a typical 2nd tier operator who may access wholesale rate bandwidth from Dataco. The KSCN supplied bandwidth feeds the core mobile network at the 2nd tier operator's cost and more often than not, terminates. From the core network to the end-user, for example, the DWU case, alluded to earlier, uses the OPGW to reach its campus from the TPNG exchange in Madang.

[4] Remote optical add/drop multiplexer

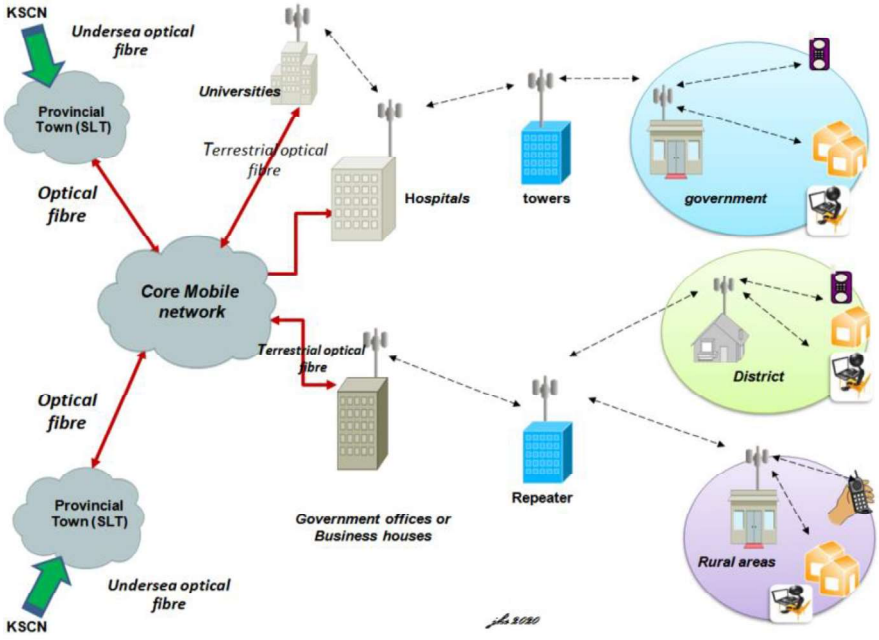

Figure 3: KSCN lands at SLT, thence 2nd tier operators roll-out to their switches.

At the time of writing, none of the major hospitals (3rd tier) has rolled out fibre from the core network to their location of operation. The status quo may hinder the asserted benefits related to e-health.

In areas where major hospitals operate such as Port Moresby, Madang, Lae and Goroka, the OPGW only passes within the proximity but no efforts have been made to access the wavelength for e-health related initiatives. Therein lies the paradox of infrastructure availability but accessibility and use are lacking. This could be due to a lack of leadership and coordination gaps which may impede e-health progress (Cullen & Hassall 2017). Needless to say that moving beyond base station towers, all the communication links rely predominantly on microwave.

Undersea cable projects

The KSCN is the first domestic undersea cable however, undersea cables in PNG existed and were operating by the 1970s (Sinclair 1994). Though the undersea cables of the 1970s may not fully support bandwidth, capacity and speed requirements of today, they served their purposes well.

As opposed to modern optical fibre based cables, the copper-based SEACOM cable station operating out of Madang was designed and built to link Australia-Malaysia-Singapore and Hong Kong, thence to Hawaii and on to to the US. Over time communication traffic between Australia and countries to the north of PNG have grown significantly, thereby limiting the capacity of available circuits to handle traffic between Madang and Australia (Sinclair 1994). Whilst alternative microwave and satellite options have taken some of the load, another undersea cable was just being completed and commissioned into service.

In 1976, the A-PNG undersea cable landed at Taurama beach and onto Boroko to provide a high-quality alternative link. A steam-driven cable ship named John W. Mackay completed laying the 900 Kilometers of sea cable with repeaters at intervals from Port Moresby to Cairns through the great barrier reef in nine days (Sinclair 1994).

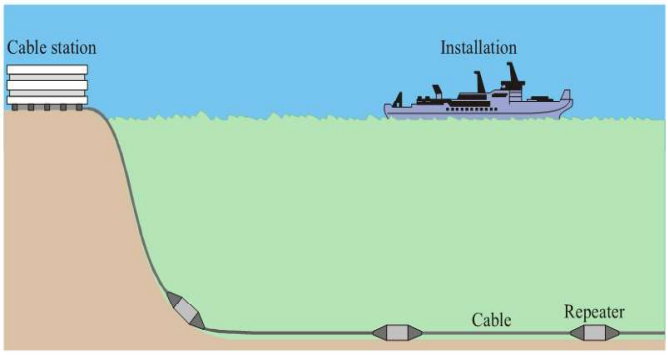

Figure 4: The submarine cable installation and landing station. (Source: ITU 2009)

The A-PNG undersea cable has over many years performed faithfully but volume increases in communication traffic has seen it being upgraded and recently replaced with the optical fibre based Coral Sea cable with higher bandwidth, capacity and speed capabilities (Pat 2020). A typical undersea cable laying scheme is illustrated in Figure 4.

The KSCN, when completed, may have multi-dimensional impacts for PNG from various angles if and only if the regulator, Dataco, 2nd tier and 3rd tier players fully engage in a truly competitive market. Of importance is the creation of a fully competitive 2nd tier telecom landscape which may reduce the wholesale price, thus feeding the 3rd tier actors. Inaction from the regulator or Dataco will fail to yield any of the anticipated objectives such as e-government, e-health and e-education.

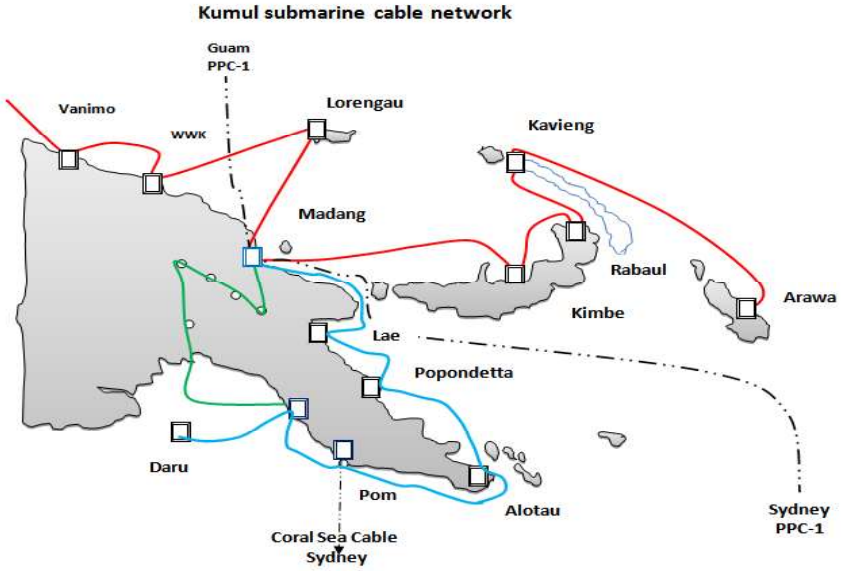

Figure 5: KSCN landing points with the Highlands OPGW - Green line.

The red line shows the provinces to be covered in the first phase by the KSCN, covering the northern part of PNG (Figure 5). Even in this current scheme of things, there is still much to improve on, particular distances away from the KSCN landing spots. The light green line running from north to south is the second phase of the

KSCN. There are great distances to be covered and design and locations of branching units are should be undertaken with diligence. The dark green line shows the existing highland OPGW running through the interior of PNG. Even along this route, there is a lot at stake because this route traverses highly populated regions. PPC-1 and the coral sea cable shown in dotted black lines are international facilities but maybe similarly be subjected to competitive pricing.

Notwithstanding the resources expended thus far, it can be said that benchmarked amortisation of the KSCN depends on factors encapsulating availability, accessibility and affordability in a fully competitive telecom environment.

Data analysis

Table 1: Thematic overview

Item	Agenda	KSCN Assertions	Rating	Comment
1	Economic growth • Economic corridors • Trade centres • New Businesses	Economic growth expected.	Minimal (urban) Low (rural)	Where optical fibre is available, accessible and affordable.
2	New investment • Agriculture • Tourism • Fisheries • Downstream processing	benefit from KSCN	Minimal (urban) Low (rural)	Benefits may be visible in areas where is accessible. Rural areas will rely on Mobile.
3	Job opportunities	No-one left behind	Minimal (tall order)	85% of population rely on mobile
4	Access to optical fibre • Healthcare • Training • Quality education • Training	Society to benefit from access to optical fibre	Minimum. Major hospitals and universities aren't connected.	Bulk of the population uses radio-based mobile network.
5	Improve basic social services	High-speed broadband, affordable and available.	Minimum – IGIS is non-existent.	Service delivery device, IGIS, has evaporated.

Primary data and secondary data have shown that optical fibre roll-out will be limited in scale and not meet design objectives. Firstly, the asserted claims concerning affordable broadband prices emanating from the KSCN are not supported by credible evidence. Evidence shows that broadband internet prices in PNG, even in the presence of KSCN may not be better than what is

currently offered (Louey-Gung 2017). This could be partly the reason why, the current OPGW in Port Moresby, Madang, Lae and the highlands has not been accessed by major business houses, education and health institutions as confirmed during the field survey.

Excessive internet prices and poor management have been blamed as impeding factors in denying hospitals and universities from installing and enjoying optic fibre-enabled services in parts of PNG including Lae (Dumavi & Kari 2020). This scenario has prevented any opportunities in ICT enabled healthcare improvements and training.

On a related matter, economic growth has been predicted to improve in the presence of KSCN. At this point, this cannot be confirmed. In 2007, when Digicel entered the mobile market, 0.7 percentage points growth was recorded (Suwamaru2013). The main contributing factor was the exponential increase in the mobile phone subscriber base across PNG. Hence, Digicel benefited from the economies of scale to amortise its investment and to further its coverage across wider PNG. It would be an interesting research proposition to investigate whether KSCN can replicate Digicel's service penetration record but at the wholesale layer.

The out-going Health secretary listed advancing and progressing government reforms, infrastructure development, successful immunisation campaign and the new healthcare plan, child care and human resource management as major achievements during his tenure (Auka-Salmang, 2020). However, there was no mention of e-health programs within the department as confirmed during field surveys across PNG.

Economic growth has been predicted to improve. At the time of writing, evidence points to high unemployment rates across PNG.

Many college and university graduates aren't able to secure employment (Gerega, 2020a). Economic growth is directly related to job creation hence this could be another research proposition to ascertain if the status quo can improve incited by the activation of the KSCN.

Improvement in basic social services is the last theme earmarked for improvements through the use of KSCN. The use of social media by leaders to inform citizens of certain government programs or decisions have been noted (Suwamaru2014). It may follow that major government departments will access and use KSCN to improve social services. Although the government, MICT sponsored IGIS has ceased functioning, there may be possibilities to use KSCN to make further improvements. The possibility for designing and implementing e-government initiatives may be in sight but further research is required to acquire deeper and detailed knowledge.

Conclusion

At the time of writing, the KSCN was almost 80 per cent complete to complement the existing highland OPGW that runs along the Madang, Lae, Goroka, Simbu, Mt. Hagen, Enga and the Southern Highlands routes. The OPGW is an important asset with the capability equivalent in bandwidth, capacity and speed to the KSCN. Field surveys showed that although the OPGW runs over many towns, and close by private and public institutions, access and use has been far less than expected. There may have been a lack of recognition from concerned stakeholders as well as pricing issues.

Field surveys of the KSCN showed that the landing stations are located far away from major switching centres of 2nd tier telecom service providers. This simply means that any entity that wishes to access wavelength from the KSCN has to build its own optical fibre for interconnection. This may lead to high capital

expenditure (CAPEX) which may discourage would be customers from enjoying the benefits of KSCN. This in effect will limit the chances of Dataco from enjoying economics of scale, thereby affecting amortisation.

Moreover, in many provinces, where the KSCN is earmarked to land, there is minimal competition within the 2nd tier landscape. This presents a potential problem, that is, the lack of economy of scale to reduce the current high-speed internet prices. In this respect, competent regulatory intervention is necessary. To overcome this, the regulator may consider releasing an EOI to invite additional mobile network operators. This should increase competition at the 2nd tier, in turn increasing the user base which may then enable Dataco to amortise its investment.

Summary

The KSCN is a vital asset which may change the landscape of the country's telecom industry and may incite spin-off benefits if managed and sustained competently. At it is currently designed it seems that truly high-speed internet experience at the periphery of 2nd tier networks will be minimal simply because 'any network is only as good as the weakest link'. This is because the bulk of the end-users use microwave-based mobile networks and even if these networks get connected to the KSCN, any improvements will be insignificant. That said, the proposed socioeconomic benefits may only materialise if all stakeholders perform their responsibilities with diligence.

Towards this end, availability of optical fibre as close as possible to the user's premise is important, which must then be made accessible through affordable and competitive pricing. Affordability can happen only under a competitive 2nd tier telecom environment, which may allow Dataco to levy cost-based wholesale pricing. Failing this, the slogan 'yes, you will be covered' will remain a fallacy and KSCN's points of presence

will remain at inconvenient locations for 2nd and 3rd tier operators. Needless to say that if the KSCN remain underutilised, its amortisation will take a considerable time frame.

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