ECONOMIC ANALYSIS

A. Introduction

1. **Project summary.** The Asian Development Bank (ADB) will support Palau to develop a fiber optic submarine cable system (SCS) connecting Palau to Southeast Asia—the Southeast Asia–United States west subsystem (SEA-US) cable. The SCS will provide cost-effective broadband connectivity to boost opportunities for inclusive growth. Enhanced connectivity will address service delivery constraints in key social sectors such as education and health. Belau Submarine Cable Corporation (BSCC) has been set up to construct and operate the cable system in Palau. It will provide transparent wholesale bandwidth access to telecommunication providers in Palau.

2. **Demand projection.** A top–down methodology is used to predict adoption by benchmarking other broadband connectivity projects in the Pacific region.[1] The adoption of O3b Networks, an alternative high speed satellite solution, is taken into account and competition with that service is offset. Demand for capacity per megabit per second (Mbps) is forecast conservatively below the region's average adoption rates, at a growth rate of about 40.0%, declining to 20.0% within the first 5 years after the cable comes into service, and then falling steadily to 3.5%, which is expected to be sustained thereafter. The average annual growth rate over 15 years is 12%. The resulting capacity is positioned at the lower end of all available Pacific-based benchmark data (Figure). On the same basis, subscriber growth has been estimated to peak at 15,000 early adopters by 2021 as new services at lower costs are introduced, followed by a growth rate of 7%, declining steadily to 2% thereafter. Tourist mobile broadband use, a significant factor given Palau's sizable tourism sector, has also been taken into account.

3. **Pricing.** Table 1 outlines pricing per Mbps that ensures the competitiveness of the SCS while ensuring financial viability. At all demand levels, the price has been set to a maximum amount that matches the minimum price level of comparative high speed satellite services. The financial model shows that the chosen price scheme can produce a good return while offering an affordable price to the consumers. Irrespective of demand growth projections, the revenue streams are conservatively capped at 2% of gross domestic product (GDP).

4. **Macroeconomic context.** Palau is an island nation of the Micronesian group of islands in the northern Pacific with a population of about 20,000. Palau receives substantial assistance from the United States through the Compact of Free Association. An overarching challenge for Palau is to achieve self-sufficiency from foreign funding. Palau's economy is highly reliant on tourism and services, with tourism receipts amounting to more than half of GDP and services contributing 89% of total economic output. In FY2013, the economy is estimated to have contracted by 1.7% as the result of a decline in tourist arrivals, but rebounded with growth of 6.9% in FY2014 as tourism recovered strongly. This demonstrates Palau's vulnerability to external shocks and volatility. The International Monetary Fund has identified economic diversification and private sector development as key elements for Palau to sustain growth and protect its economy from such shocks.

5. Palau is on track to achieve the Millennium Development Goals (MDGs) for universal primary education (MDG 2), gender equality and empowerment of women (MDG 3), reduction in child mortality (MDG 4), improving maternal health (MDG 5), combating HIV/AIDS and other

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[1] For details on the referenced regional cables: http://www.submarinecablemap.com/

major diseases (MDG 6), and ensuring environmental sustainability (MDG 7). Some hardship remains in eliminating poverty and hunger (MDG 1), observed at a 7% poverty gap ratio and a 10% expenditure share for the poorest quintile.
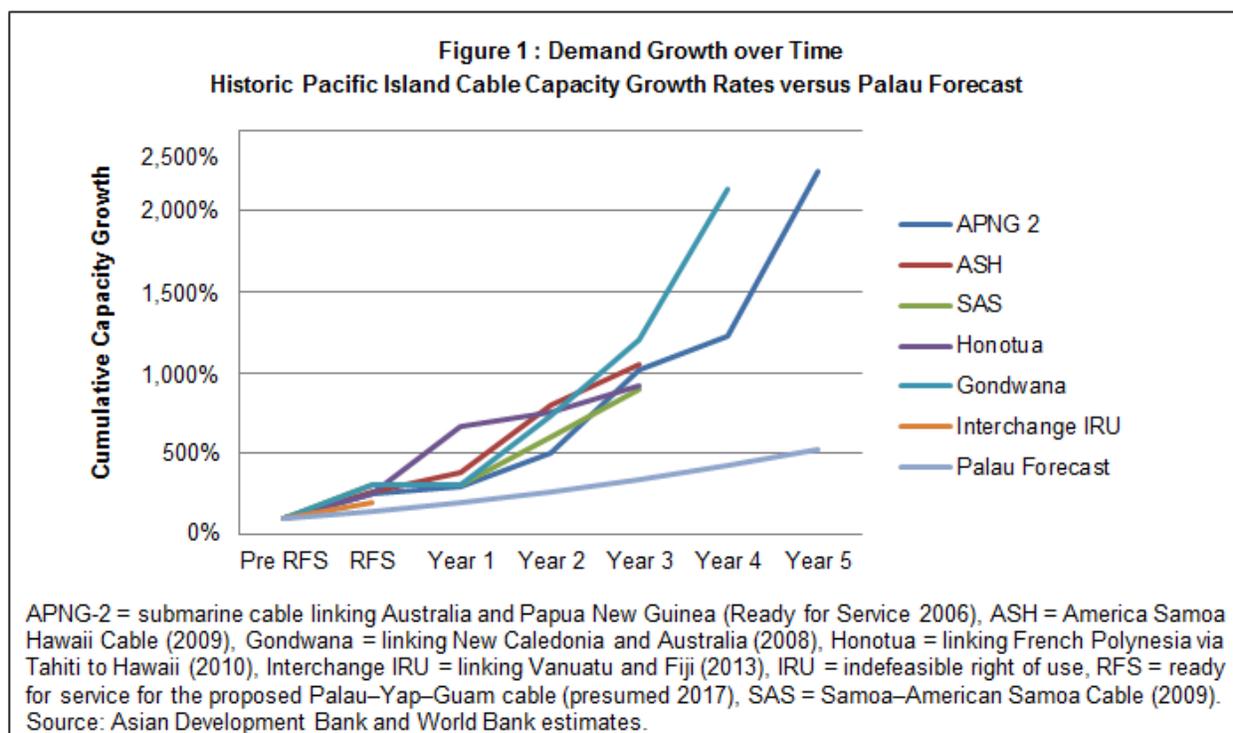

Figure 1 : Demand Growth over Time
Historic Pacific Island Cable Capacity Growth Rates versus Palau Forecast

APNG-2 = submarine cable linking Australia and Papua New Guinea (Ready for Service 2006), ASH = America Samoa Hawaii Cable (2009), Gondwana = linking New Caledonia and Australia (2008), Honotua = linking French Polynesia via Tahiti to Hawaii (2010), Interchange IRU = linking Vanuatu and Fiji (2013), IRU = indefeasible right of use, RFS = ready for service for the proposed Palau–Yap–Guam cable (presumed 2017), SAS = Samoa–American Samoa Cable (2009). Source: Asian Development Bank and World Bank estimates.

Table 1: Proposed Pricing as Demand Increases

Item		2017	2018	2019	2021	2025	2030
Demand	Mbps	269	347	440	668	816	954
Cable	Mbps	66	144	237	668	816	954
Minimum pricing	$/Mbps/month	863	859	575	539	539	539

Mbps = megabit per second.
Source: Asian Development Bank estimates.

6.   The information and communication technology (ICT) sector is widely recognized as an enabler of economic growth, social stability, and development worldwide. Analysis has demonstrated the growth effects of increased access to ICT services, particularly broadband internet services. While some countries in the Pacific region are closing the digital divide in terms of connectivity, Palau trails the trend, as it relies entirely on satellite links for international connectivity. The high cost and scarcity of international bandwidth inhibits the future development of the country and impacts economic and social development more broadly. Further, a high proportion of people have the ability to take advantage of broadband internet access when it is available and affordable, given the extraordinary growth of mobile telephony usage.

7.   Economic analysis was conducted to quantify the project's expected benefits. Economic welfare was defined as the sum of consumer surplus (i.e., the difference between a consumer's willingness to pay and the actual price of a good or service) and producer surplus (the

difference between the actual sales value and the price a producer is willing to offer for a good or service). Incremental economic growth was excluded from the quantitative analysis. Although an oft-cited World Bank study found a correlation between broadband internet penetration and GDP growth rates in 120 countries during 1980–2006,[2] doubts surround the degree of causality, the duration of the incremental growth effect, and the level of risk of double-counting otherwise quantifiable benefits.

8.   **Least-cost analysis.** The project foresees investment financing for a submarine cable system linking Palau to the global cable hub of Guam through the SEA-US SCS. This will result in service improvements for internet linkage and provide international private leased circuit capacity. The default SCS option foresees dedicated spurs from Palau to the SEA-US branching units and onward connection to Guam. This regional initiative was considered for its potential to reduce capital costs compared with a standalone cable, and was determined as the most cost-effective and lowest cost solution that can ensure timely implementation for Palau.

9.   **Economic valuation of costs and benefits.** In February 2014, a detailed economic analysis was prepared for the proposed project. Given this assessment as the basis for the current analysis, capacity demand was updated to take into account O3b high speed satellite contracts. Voice users are considered insignificant in terms of usage and are excluded. It is assumed that the project will result in a new, faster, and more reliable internet service. As such, it is considered a new service and no difference is made between incremental and non-incremental demand. A GDP cap option is added capping total project benefits in order to ensure that ICT sector related benefits are not overvalued as a share of total GDP.

10.   **Estimation of costs.** Palau's share of the capital cost for the purpose of the economic analysis of the SCS is estimated at $25.19 million including physical contingencies, with approximately 50% incurred in 2016 and rest 50% in 2017 including onshore costs. Domestic links are already in place on the main islands with Palau National Communications Corporation's fiber optic network in place.

11.   The analysis used constant 2015 prices and the world price numeraire. All benefits, onshore operating costs, and costs incurred by domestic retail service providers[3] were adjusted to economic values, of which a 40% share was converted to the world price numeraire using a standard conversion factor of 0.9 and shadow wage rate factor of 0.8, in line with Pacific Department (PARD) infrastructure development projects in Palau.[4] No conversion factors were applied to capital costs. Taxes and subsidies, other than domestic trade taxes, were excluded. The economic price of land is not considered beyond its financial costs as the cable runs either deep underneath land with no impact on land use or occupies only a small footprint for the landing station.

12.   Retail service providers (BSCC's wholesale customers) will also incur some incremental capital costs to expand and upgrade their capacity to meet increased demand. These costs will be incurred in small amounts throughout the appraisal period, partly offset by savings from their reduced need for satellite bandwidth. These costs were assumed at a 60% share of total revenue and split at 50% for capital and operational expenditure. The retail service providers' existing domestic capacity and investment programs (independent of the cable project) are

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[2] World Bank. 2009. *Information and Communications for Development 2009: Extending Reach and Increasing Impact.* Washington, DC.
[3] It could be embedded within other businesses in the case of mobile phone or traditional telecom operations or could be businesses dedicated solely to internet services.
[4] 2013 Koror-Airai Sanitation Project (42439-013).

sufficient to cope with the initial surge in demand, given existing fiber optic networks in place and ongoing adoption of 3G services.

13.   Incremental operating costs will be minor and are wherever feasible shared with the SEA-US parties. For BSCC, they are expected to be $0.7 million in 2018, increasing in line with demand growth. Traffic-related capacity charges, paid offshore, start at $0.07 million in the first year of service and reach a maximum of $0.4 million in 2021, after which price drops are assumed to outpace demand growth.

14.   **Estimation of benefits.** Broadband internet access is nominally available now, but the capacity, speed, and reliability fall short of modern expectations, and prices are very high[5]. It is assumed that users of existing data services will migrate to broadband services, as telecommunication service providers take advantage of new products that can be offered, leading to a phase-out of fixed dial-up services. For the analysis, existing internet users are considered in the pool of new customers of newly established, faster, and more reliable internet service products. As such, willingness to pay can be considered for both incremental and non-incremental demand, and corresponds to the entire area under the demand curve. This was evaluated against all capital, operating and maintenance, and telecommunication provider's incremental costs associated with providing such internet services.

15.   The analysis assumed that benefits are proportional to internet users' willingness to pay. The entire area under the demand curve measures the willingness to pay and is calculated as a sum of two components: (i) the annual consumer surplus, estimated at about 0.8% of GDP and determined through existing World Bank estimates of comparable demand curves for mobile telephony in the Peoples' Republic of China, India, and the Philippines, and estimated consumer surplus ratios in those countries;[6] and (ii) the annual revenue per user (ARPU) for retail internet services, which is the product of the ARPU and projected number of subscribers. The ARPU was estimated at 7% of GDP per capita ($70 per subscriber per month in 2016) based on a composite normalized demand curve for the same three countries, which flattens out at 7% beyond a 15% penetration rate. Benefits are considered to grow in line with real GDP growth (assumed at 2% per annum), capped at 3% of GDP.

16.   Other benefits may be substantial, but are more difficult to include in a formal quantitative analysis. They include (i) improved efficiency and quality of service delivery in an e-government regime; (ii) remote delivery of agricultural extension, education, health, policing, judicial, employment, disaster management, and other public services; (iii) mobile banking; and (iv) incremental economic growth. As such benefits are not quantifiable, they are excluded.

17.   **Economic internal rate of return.** Applying the above estimates and assumptions, and allowing benefits to grow in line with real GDP growth, the economic performance of the project is as shown in Table 2 outlining the base case scenario. The economic internal rate of return comfortably exceeds the default social discount rate of 12% per year.

18.   Sensitivity tests were applied as follows: (i) a 20% decrease in benefits, (ii) a 10% increase in capital costs, and (iii) a 10% increase in operating costs. The risk for items (ii) and (iii) are considered low, as the cable system cost estimates are based on similar cable project developments in the region and shared operating costs are conservatively estimated based on

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[5]   In Palau, internet is accessed by only 25% of the population, while 90% have access to mobile phones.
[6]   A. Bhavnani et al. 2008. *The Role of Mobile Phones in Sustainable Rural Poverty Reduction.* Washington, DC: World Bank, ICT Policy Division, Global Information and Communications Department.

quotes received from maintenance firms. The economic risk of decreased benefits is considered low, as benefits are directly proportional to demand and subscriber growth rates, which in turn are assumed to grow at a rate well below similar projects in the region. World Bank support to reforms to the regulatory framework in Palau will further ensure that benefits are passed on to consumers. The project remains economically viable with sensitivity tests applied (Table 3).

Table 2: Summary of Economic Internal Rate of Return Calculation
($ million)

Year	Economic Costs			Economic Benefits[c]	
	Operating Costs[a]	Capital Costs[b]	Total		Net Economic Benefits
2016	0.14	10.75	10.89	0.00	(10.89)
2017	0.42	11.18	11.60	3.79	(7.88)
2018	1.50	3.53	5.03	5.89	0.72
2019	1.63	0.41	2.03	8.34	6.10
2020	2.19	0.94	3.12	8.51	4.96
2025	3.84	1.31	5.15	9.40	3.86
2030	4.08	1.53	5.61	10.38	4.50
2035	4.34	1.76	6.10	11.46	5.17
2040	4.44	1.79	6.23	12.65	6.29
2045	1.57	0.00	1.57	13.96	12.30
				Switching values:	
EIRR	18.8%	Per year		Costs	82%
NPV	11.07			Benefits	(45%)

() = negative, EIRR = economic internal rate of return, NPV = net present value.
[a] Operating costs include BSCC operating costs and internet access fees paid offshore, and incremental operating costs by retailers to maintain network improvements.
[b] Corresponds to the project's financial drawdown schedule during implementation, and includes capital expenditures by retailers to invest in network improvements as the subscriber base grows.
[c] New broadband internet subscribers, including existing internet users migrated to the new product.
Source: Asian Development Bank estimates.

Table 3: Sensitivity Test Results
($ million)

Scenario	ENPV ($ million)	EIRR (%)	Switching Value (%)
Base case scenario	11.1	18.8%	
20% decrease in revenue	8.0	16.4%	28.5%
10% increase in capital expenditures	7.3	16.0%	66.0%
10% increase in operating expenditures	10.7	18.6%	302.0%

EIRR = economic internal rate of return, ENPV = economic net present value.
Source: Asian Development Bank estimates.