ECONOMIC ANALYSIS

A. Introduction

1. **Project summary.** The project will develop and operate a new fiber-optic submarine cable system (SCS) connecting Samoa (Upolu and Savai'i) via Fiji to the existing Southern Cross Cable Network between Australia and the United States, financed by the Asian Development Bank (ADB), the World Bank, the governments of Australia and Samoa, and equity investors. The proposed SCS will provide cost-effective broadband connectivity, expand business opportunities, and boost opportunities for inclusive growth. Better connectivity will also enable broadband solutions to overcome service delivery constraints in key social sectors such as education and health. The project plans to support investments in e-health solutions by establishing an integrated national health information system and corresponding applications to take advantage of the improved information and communication technology (ICT) infrastructure. The project will strengthen the Office of the Regulator (OOTR) to ensure that access and cost benefits are passed on to consumers. The Samoa Submarine Cable Company (SSCC) will be established to provide transparent wholesale bandwidth access to telecommunication providers in Samoa.

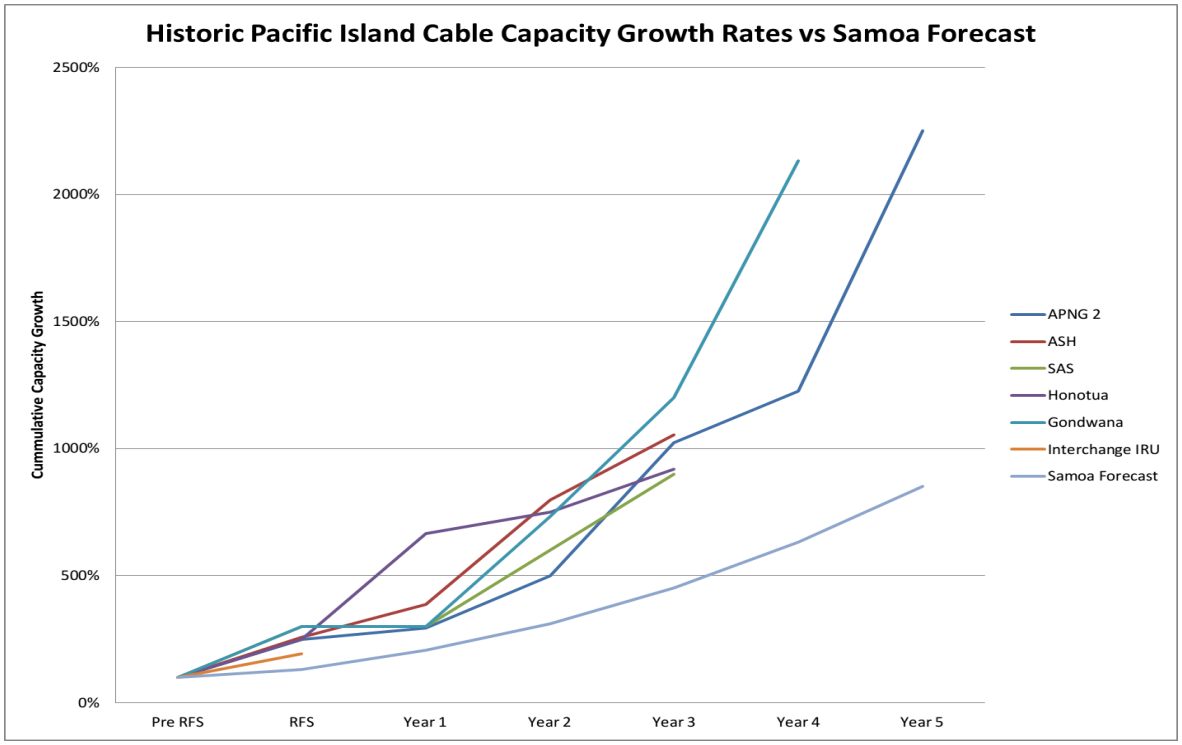
2. **Demand projection.** The analysis employs a top-down methodology by benchmarking other broadband connectivity projects in the Pacific region that match Samoa's current demand distribution across its telecommunication services. Competition with the existing American Samoa–Hawaii (ASH) fiber-optic cable, and its potential future upgrade, is taken into account. Demand is forecast to grow by 60% in the first year, below the region's average adoption rates. This growth is seen to fall to 25% after the first 5 years (based on 30% capacity) of cable service, and then decline steadily over the next 10 years to 1%, which is sustained thereafter. The average annual capacity growth rate of 35% over 25 years is at the lower end of all available Pacific-based benchmark data (Figure 1). Future growth may be even higher because of an exponential increase in mobile internet use, particularly in developing countries, where annual growth rates of 50% are being recorded and 2.9 billion new smartphone users are expected by 2020.[1] On the same basis, subscriber growth has been estimated to peak at 35,000 early adopters after 3 years as new services at lower cost are introduced once the SCS is ready for service. Subscriber growth will slow steadily from 20% to 1% in the long term.

B. Economic Analysis

3. **Macroeconomic context.** Samoa is part of the Polynesian group of South Pacific islands with a population of about 190,000. It is classified as a lower-middle-income economy reliant on fishing, agriculture, and tourism, as well as remittances, which make up 24% of national income. Samoa's economy grew by 1.2% in fiscal year (FY) 2014 (ended 30 June 2014) and an estimated 2.3% in FY2015. In FY2014, Samoa welcomed about 127,000 visitors, with estimates of a 5% increase in FY2015. Tourism and public infrastructure development will continue to drive growth in Samoa, but contributions from agriculture should increase as projects implemented with development partners boost the sector. In the medium term, the economy is expected to grow by 2%.[2] As tourism continues to recover, rising visitor arrivals should propel growth, which is forecast at 1.9% in FY2016.[3]

[1] GSMA, *The Mobile Economy 2015*, GSMA Intelligence, 2015.
[2] International Monetary Fund. 2015. *Article IV Consultations*. Washington, DC.
[3] ADB. 2015. *Pacific Economic Monitor, July 2015*. Manila.

Figure 1: Demand Growth over Time



APNG-2 = submarine cable linking Papua New Guinea and Australia (RFS 2006), ASH = American Samoa-Hawaii Cable (2009), Gondwana = linking New Caledonia and Australia (2008), Honotua = linking French Polynesia via Tahiti to Hawai'i, USA (2010), Interchange IRU = linking Vanuatu and Fiji (2013), SAS = Samoa-American Samoa Cable (2009), IRU: indefeasible right of use, Samoa Forecast = ready for service for the proposed Samoa Fiji cable (presumed 2017).
For details on the referenced regional cables: http://www.submarinecablemap.com/
Source: ADB and World Bank estimates.

4. Samoa is on track to achieve the Millennium Development Goals (MDGs) for universal primary education (MDG2), reduction in child mortality (MDG4), and ensuring environmental sustainability (MDG7). Some hurdles remain in eliminating poverty and hunger (MDG1), given a 8.2% poverty gap ratio and 9.3% expenditure share for the poorest quintile; ensuring gender equality and empowerment of women (MDG3); fulfilling health indicators for improving maternal health (MDG5); and combating HIV/AIDS and other major diseases (MDG6).

5. The ICT sector is recognized as an enabler of economic growth, social stability, and development. High-speed internet bandwidth is already accessible, particularly in Apia, as Samoa connects to internet gateways through American Samoa. However, the infrastructure is at the end of its life, current high costs hamper access and demand growth, and reliability is a major concern. This inhibits connectivity and impacts economic and social development.

6. An 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 actual sales value and the price at which a producer is willing to offer a good or service). Incremental economic growth was excluded from the quantitative analysis. Although an often-cited World Bank study found a correlation between broadband internet penetration and gross domestic product (GDP) growth rates in 120 countries during 1980–

2006[4], there are doubts regarding the degree of causality, the duration of the incremental growth effect, and the level of risk of double-counting otherwise quantifiable benefits.

7. **Least-cost analysis.** Various options for improved internet services were examined from technical, economic, and strategic perspectives. These included cable connections via Tonga to Fiji, to New Zealand, to planned regional cable projects, and geostationary and medium-earth orbit satellite. Two options warranted further evaluation (Table 1). Considering the lifespan, capacity, and capital and operational expenditure, a new cable to Suva, Fiji was selected as the most feasible and least-cost option, providing access to direct internet protocol transit services from Fiji suppliers, or cable extension capacity via Southern Cross to Australia, Hawaii, and the west coast of the United States.

Table 1: Options for Samoa Submarine Cable

Point of Connection	**Type of Cable**	**Capital Expenditure** ($ million)	**Operational Expenditure** ($ million)	**Lifespan** (years)	**Capacity** (Tbps)	**Backhaul costs** ($)
New Zealand	PRE upgrade (recovered cable)	44.8	2.1	25	3.2	0
Fiji	New cable	30.3	1.3	25	3.2	0

PRE = PacRim East cable, Tbps = terabits per second.
Source: Government of Samoa project technical team.

8. **Estimation of costs.** The economic capital cost was estimated at $51.4 million, with 45.0% incurred in 2016 and 55.0% in 2017. This includes physical contingencies, onshore costs, establishment of the SSCC, support to the OOTR, and facilitation of investments in e-health solutions by leveraging the improved ICT infrastructure. Backhaul in Apia is provided through local telecommunication providers' fiber rings and networks.

9. The analysis used constant prices as of 2015 and a world price numeraire. All benefits, onshore operating costs, and all costs incurred by domestic retail service providers 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 other ADB infrastructure development projects in Samoa and the region. No conversion factors were applied to capital costs. Taxes and subsidies, other than domestic trade taxes, were excluded. The economic price of land was not considered beyond its financial costs, as the cable has no impact on land use and occupies only a small footprint for the landing station.

10. Retail service providers (the SSCC's wholesale clients) would incur incremental capital costs to expand and upgrade capacity to meet increased demand in small amounts throughout the appraisal period, partly offset by savings from reduced reliance on either satellite bandwidth or ASH cable capacity. This fact was included and assumed at 30% of total SSCC revenue, divided equally between capital and operational expenditure and adjusted to the world price numeraire. Retail service providers' existing domestic capacity and investment programs (independent of the cable project) are sufficient to cope with the initial surge in demand, given existing fiber-optic networks in place and ongoing adoption of high-speed mobile services.

11. Incremental operating costs for the SSCC were projected at $1.5 million in 2018, increasing in line with demand growth. Traffic-related capacity charges are covered under

[4] The World Bank. 2009. *Information and Communications for Development 2009: Extending Reach and Increasing Impact*. Washington, DC.

indefeasible rights of use with the Fiji landing station as well as Southern Cross, and included in the project costs at $5.8 million.

12. **Estimation of benefits.** Broadband internet access is already available, but is costly and unaffordable to 70% of the population, inhibiting regular access to internet services. At the same time, existing users grapple with service reliability. Such users are expected to migrate to higher-quality broadband services as telecommunication providers improve their service products. The analysis assumes that the benefit to existing internet users would be 25% of the benefit compared with new users, to offset their current willingness to pay in line with expected consumer price reductions. Additional qualitative benefits to existing users, such as improved reliability, have not been considered because quantification would be subjective. Aside from this limitation, willingness to pay can be considered for both incremental and non-incremental demand. This was evaluated against all capital, operation and maintenance, and telecommunication provider's incremental costs associated with providing such internet services. All project components, including activities not directly related to the SCS (e.g., support to the OOTR), were considered as necessary to ensure maximum benefits.

13. 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 People's Republic of China, India, and the Philippines; and estimated consumer surplus ratios in those countries;[5] and (ii) the annual revenue per user (ARPU) for retail internet services, which is the product of the mature market ARPU and projected number of subscribers. The mature market ARPU was estimated at 7% of GDP per capita ($25 per month in 2016) based on calculations for a composite normalized demand curve for the same three countries, which flattens out at 7% beyond a 15% penetration rate. Benefits were seen to grow in line with real GDP growth, capped at 2% of GDP. Given existing—though costly and unreliable—broadband services in Samoa, a differentiation between existing and future users has also been considered by valuing their benefits at a rate of 50% to account for avoided costs as well as improvements of service quality.

14. Quantitative economic benefits of the project's e-health component will be assessed once the scope for the proposed e-health information system has been defined, as foreseen during the design phase. The extent of potential cost recovery thanks to optimized health delivery services, corresponding budget implications, and overall sustainability will be duly considered and is foreseen to be considerable given positive experiences with e-health deployments in other low- and middle-income countries.[6]

15. Other project benefits, though potentially substantial, are excluded because they are difficult to quantify, such as (i) improved efficiency and quality of service delivery through e-government initiatives; (ii) remote delivery of agricultural extension, education, policing, judicial, employment, disaster management, and other public services; (iii) increased opportunities in e-trade and mobile banking; and (iv) resulting incremental economic growth.

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[5] 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 (GICT).

[6] J. D. Piette et al. 2012. *Impacts of e-health on the outcomes of care in low- and middle-income countries: where do we go from here?.* Bulletin of the World Health Organization, 90(5). pp. 365–372, Geneva; A. Beratarrechea et al. 2014. *The impact of mobile health interventions on chronic disease outcomes in developing countries: a systematic review.* Telemedicine and e-Health, 20(1), pp. 75–82, New York.

16. **Economic valuation and internal rate of return.** The economic internal rate of return of 21.2% comfortably exceeds the default social discount rate of 12% per year (Table 2).

17. **Sensitivity analysis.** The main risks to the project's outcomes are (i) an increase in the price of the cable system, (ii) an increase in operating costs, and (iii) a shortfall in anticipated demand and hence revenues and economic benefits. These risks are considered low because (i) cable system cost estimates are based on similar cable projects in the region; (ii) operating costs are based on quotes from maintenance firms and potential landing site firms in Fiji; and (iii) demand is assumed to grow at a rate well below similar projects in the region, as the methodology for the demand projection outlines. The project remains economically viable when sensitivity tests are applied (Table 3).

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

Year	Economic Costs			Economic Benefits[c]	Net Economic Benefits
	Operating Costs[a]	Capital Costs[b]	Total		
2016	0.35	23.31	23.66	0.00	(23.66)
2017	0.35	28.12	28.47	0.00	(28.47)
2018	1.17	0.10	1.27	6.70	5.43
2019	2.22	0.33	2.55	10.16	7.61
2024	4.09	0.42	4.52	19.65	15.14
2029	4.40	0.44	4.83	21.70	16.87
2034	4.88	0.52	5.40	23.96	18.56
2039	5.56	0.67	6.23	26.45	20.22
2044	5.74	0.74	6.48	26.98	20.50
EIRR	21.2%	Switching values:		Costs	170%
NPV	41.16			Benefits	(63%)

() = negative, EIRR = economic internal rate of return, NPV = net present value, switching value = sensitivity percentage test case at which NPV turns zero.
[a] Operating costs include operating costs of the Samoa Submarine Cable Company 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 whose benefits are valued at 50%.
Source: Asian Development Bank estimates.

Table 3: Economic Sensitivity Analysis

Scenario	ENPV ($ millions)	EIRR (%)	Switching Value (%)
Base case	41.2	21.2%	
25% decrease in revenue	34.7	19.3%	62.0%
10% increase in capital expenditures	36.8	19.6%	94.0%
10% increase in operating expenditures	40.0	20.9%	365.0%

ENPV = economic net present value, EIRR = economic internal rate of return, switching value = sensitivity percentage test case at which NPV turns zero.
Source: Asian Development Bank estimates.