



Cable Systems Access IXP and Caching

Final Report

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II. Acronyms and Abbreviations

APNIC	Asia Pacific Network Information Centre
ASN	Autonomous System Number
CAWG	Cable Adoption Working Group
CDN	Content Delivery Network
CEO	Chief Executive Officer
CS2	Coral Sea Cable System
DFAT	Department of Foreign Affairs and Trade (Australia)
DNS	Domain Name Server
EVC	Ethernet Virtual Circuit
GB	Gigabytes
Gbps	Gigabits per Second
ICT	Information and Communications Technology
ICTSU	Information and Communication Technology Support Unit
ICSI	Investment Corporation Solomon Islands
IP	Internet Protocol
IPL	Internet Private Line
IXP	Internet Exchange Point
Long-Term	Timeframe of 6 to 10 Years
MB	Megabytes
Mbps	Megabits per Second
MCA	Ministry of Communication and Aviation (Solomon Islands)
Medium-Term	Timeframe of 3 to 5 Years
OPMC	Office of Prime Minister and Cabinet (Solomon Islands)
OSI	Open Systems Interconnection
PCH	Packet Clearing House
RFS	Ready for Service
ROI	Return on Investment
Short-Term	Timeframe of 1 to 2 Years
SIDN	Solomon Islands Domestic Network
SIEA	Solomon Islands Electricity Authority
SIIXP	Solomon Islands Internet Exchange Point
SINPF	Solomon Islands National Provident Fund
SIRF	Solomon Islands Resource Facility
SINPF	Solomon Islands National Provident Fund
SISCC	Solomon Islands Submarine Cable Company
SPM	Secretary to the Prime Minister (Solomon Islands)
Tbps	Terabits per Second
TCSI	Telecommunications Commission Solomon Islands

1. Summary

The Solomon Islands is on the verge of heralding a new era of Internet connectivity and digitisation through connectivity to the CS2 and SIDN submarine cables. The interconnection of Sydney to Honiara via the CS2 submarine cable is an enabler for economic development and growth, however there are inherent risks to the delivery of submarine fiber optic cable Internet access. Caedus Systems was engaged by OPMC in a technical role to assist in the mitigation of several gaps that were identified in the recently completed Caedus Systems Communications and Cloud Capacity and Technical Audit.

Caedus Systems primary function under the engagement was to support the ICT Advisor to OPMC in the suitable delivery and mass adoption of the CS2 and SIDN submarine cables. OPMC has recently embarked on an ambitious and wide-reaching digital transformation program, which is underpinned by the adoption of CS2 and SIDN. The Solomon Islands Government, and the Australian Government in its capacity as a development partner, are united under the vision of CS2 and SIDN as high-impact development enablers for the benefit of all Solomon Islands people.

Caedus Systems provided technical assistance to the following stakeholders during the course of the engagement: bMobile, DFAT, ICTSU, MCA, OPMC, Our Telekom, Satsol, SINPF, SISCC and TCSI. The Caedus Systems consultants made themselves available to each of the stakeholders, as needed, during the course of the engagement for technical matters relating to CS2 and SIDN. Furthermore, Caedus Systems co-moderated and presented a submarine fiber optic cable seminar during the engagement, which was included as part of the World Bank conference held in Honiara during November 2019.

Caedus Systems consultants visited Honiara a total of four times during the engagement. A key aspect of the work was to participate in the CAWG, which culminated in the creation of a CAWG Matrix, as detailed herein this report. Many of the initiatives detailed in the CAWG Matrix are strategic in nature and are intended to become part of a long-term roadmap that will aid the Solomon Islands in fostering digital transformation. All of the initiatives specified in the CAWG Matrix that directly relate to the impending CS2 and SIDN launch have been achieved at the time of writing this report.

Caedus Systems hereby provides four high-level recommendations, which have been raised from the work that was completed during the engagement, as follows:

1. **Adopt a Capacity Pricing Framework:** Caedus Systems recommend SISCC uphold a traditional capacity pricing framework that is implemented under the agreed upon wholesale pricing structure as tabled by SISCC at the third CAWG meeting;
2. **Establish the SIIXP:** Caedus Systems recommend the establishment of an IXP within the greater Honiara area, proposed to be named "SIIXP", for the purposes of both improving the Internet and promoting economic development within the Solomon Islands;
3. **Phase Out the SISCC IP Transit Product:** Caedus Systems recommend that SISCC establish a roadmap toward abolishing the current IP Transit product over the medium-term as the technical capability of the Solomon Islands telecommunication market matures;
4. **Develop Shared Telecommunications Infrastructure:** Caedus Systems recommend the Solomon Islands invest in shared telecommunications infrastructure in order to promote digital transformation and develop a robust Internet economy.

Caedus Systems provided OPMC with an IXP Framework document and a sample IXP budget to aid in the establishment of the proposed SIIXP. The IXP Framework document also contains the details relevant to a shared content caching approach. The CS2 and SIDN submarine cables launch should be realised as soon as possible given that all of the previously identified gaps have now been addressed.

2. Accomplishments

Caedus Systems provided technical assistance to OPMC in relation to the gaps identified through the recently completed Communications and Cloud Capacity and Technical Audit, which was carried out by Caedus Systems during September of 2019. Caedus Systems provided the technical assistance to OPMC during the period October 22nd, 2019 through January 27th, 2020. Caedus Systems consultants travelled to Honiara on a total of four duty visits through the course of the engagement in order to conduct onsite meetings and work directly with the various stakeholders. The details of the associated Caedus Systems accomplishments are provided herein this section.

2.1. Cable Systems Economist Scope of Work

Caedus Systems consultants worked closely with OPMC to define a scope of works for a Cable Systems Access and Pricing Economic Consultant, which was identified as one of the recommendations from the earlier Caedus Systems audit works. Caedus Systems assisted the ICT Advisor to OPMC in costing the recommended technical assistance engagement for a Cable Systems Access and Pricing Economic Consultant.

Caedus Systems also provided OPMC with a shortlist of four suitable economists that held extensive pacific islands telecommunications experience. Caedus Systems consultants liaised with each of the four shortlisted economists, on behalf of OPMC, to ascertain their desire for the work, of which only two expressed formal interest and availability. Subsequently, SIRF drafted a terms of reference for a Communications Economic Consultant, which was tendered in a restricted process, and ultimately awarded to Mr. John de Ridder.

2.2. World Bank Digital Transformation Conference

A Caedus Systems consultant attended the World Bank Digital Transformation conference, which was held in Honiara on the 6th and 7th of November 2019. OPMC requested that Caedus Systems perform a presentation on Submarine Fiber Optic Cable Systems Adoption during an afternoon session on the second day of the conference. Caedus Systems was further requested to co-moderate the second day afternoon session. The final itinerary consisted of a 1-hour presentation by Caedus Systems, followed by a 1-hour question and answer session that was jointly moderated by the SPM and Caedus Systems.

2.3. Coordination of Activities with Cable Systems Economist

Caedus Systems consultants worked closely with the Cable Systems Economist through the entirety of the engagement. Caedus Systems consultants and the Cable Systems Economist attended a total of 15 joint meetings over the course of a two-week period whilst both parties were onsite in Honiara. Caedus Systems also worked integrally with the Cable Systems Economist to align work activities, review documents and outputs, provide technical advice for Cable Systems Economist deliverables, and coordinate recommendations.

2.4. Cable Adoption Working Group

OPMC in collaboration with MCA established a domain-specific high-level focus group in November 2019, referred to as the CAWG, which was tasked with addressing the key concerns raised from the earlier Caedus Systems audit works, along with providing information in regard to the likely timetable of CS2 and SIDN implementation. The primary objective of the CAWG was to provide the Solomon Islands Government and its development partners with the confidence that appropriate due diligence had been provided in relation to the CS2 and SIDN project ahead of the RFS date.

The CAWG was provided with a high-level mandate, as follows:

1. Detail the CS2 and SIDN throughput targets and mass adoption goals;
2. Review the CS2 and SIDN access models and five-year objectives;
3. Address Internet resiliency and existing retail service provider satellite commitment concerns;
4. Review the short-term wholesale cost-effectiveness and shareholder ROI targets;
5. Address IXP and content caching considerations;
6. Review the SIDN viability and useability issues;
7. Address any regulatory and government policy concerns;
8. Ensure adequate support is provided to SISCC in the lead-up to the CS2 and SIDN RFS date;
9. Ensure adequate support is provided to the retail service providers in the lead-up to the CS2 and SIDN RFS date.

The CAWG was established under the stipulation that it will only relate to CS2 and SIDN adoption concerns, and that it will not be a long-standing focus group beyond the CS2 and SIDN RFS date. The CAWG gathered a total of three times over the course of November and December 2019. The CAWG was chaired by Dr. Jimmie Rodgers (SPM, OPMC), and its voting members consisted of the following:

- Dr. Jimmie Rodgers (SPM, OPMC);
- Mr. Bernard Hill (Commissioner, TCSI);
- Mr. Andrew Schloeffel (Counsellor, DFAT);
- Mr. Keir Preedy (CEO, SISCC);
- Mr. Alwyn Danitofea (Director, MCA);
- Mr. Smith Iniakwala (Director, ICTSU).

The CAWG was also attended by a series of non-voting advisors and consultants, who attended specific meetings as needed, comprised of the following:

- Dr. Derick Mane (Deputy SPM, OPMC);
- Mr. Samuelu Taufao (ICT Advisor, OPMC);
- Mrs. Louise Scott (Advisor, DFAT);
- Mr. John de Ridder (Economist Consultant, OPMC);
- Mr. Matthew Mann (Technical Consultant, OPMC);
- Mr. Adam Mulcahy (Technical Consultant, OPMC).

Caedus Systems assisted OPMC in the planning, establishment and coordination of the CAWG. Caedus Systems also provided OPMC with a preliminary listing of technical concerns in relation to CS2 and SIDN, which formed the basis for the CAWG Matrix as a strategic document.

2.4.1. First Meeting of the Cable Adoption Working Group

The CAWG was convened through the inaugural meeting on the 11th of November 2019, held at the SISCC offices in Honiara. All of the voting members were present. Mr. Samuelu Taufao, Mrs. Louise Scott, Mr. Matthew Mann and Mr. Adam Mulcahy were also present for the meeting as advisors and consultants. The key outputs from the first CAWG meeting are as follows:

- Commissioner Hill tabled a letter detailing the need for SISCC's legal status, shareholding oversight, and future public accountability to be resolved in order for TCSI to maintain a light-handed approach as it applies to the regulation of CS2 and SIDN;
- Consultant Mann tabled a matrix of key concerns raised from the earlier Caedus Systems audit works, with each item within the matrix being discussed, and action items formulated as appropriate by the members;

- Counsellor Schloeffel raised concerns in regard to the pricing of CS2 and SIDN services, which was discussed at length, and the members agreed that SISCC may require further external financial support in order to deliver suitable launch pricing for the CS2 and SIDN RFS date;
- SPM Rodgers raised the potential conflict of interest in relation to the shareholders of SISCC also being the same shareholders of the largest retail service provider in the Solomon Islands, namely Our Telekom;
- CEO Preedy tabled the initial SISCC pricing offer for CS2 and SIDN capacity, which was then discussed between the members at length;
- The CAWG agreed that the submarine cable project is a development enabler for the Solomon Islands, and development benefits should flow on to the people of the Solomon Islands as a top priority;
- The CAWG agreed that the submarine cable project is a significant component of the Solomon Islands Government's Digital Transformation initiative;
- The CAWG agreed that the submarine cable project assets should be utilised to the maximum extend feasible, in order to observe downstream interests over those of upstream interests and to avoid SISCC being a dominant player within the telecommunications market;
- The CAWG agreed that "mass adoption" of the submarine cables needs to be clarified, and that the Solomon Islands Government would consider higher bandwidth usage through ICTSU in order to stimulate consumption while floating a figure of 2-3 Gbps of bandwidth to be purchased by ICTSU.

The first CAWG meeting raised a number of crucial questions which were deferred for ratification in subsequent meetings. Caedus Systems updated the CAWG Matrix to include the additional areas of concern that were raised during the first CAWG meeting.

2.4.2. Second Meeting of the Cable Adoption Working Group

The second CAWG meeting was held on the 28th of November 2019, at the TCSI offices in Honiara. Mr. Haggai Arumae was present instead of Mr. Bernard Hill. Mr. Samuelu Taufao, Mr. John de Ridder, and Mr. Matthew Mann were also present for the meeting as advisors and consultants. The key outputs from the second CAWG meeting are as follows:

- Consultant de Ridder presented on the topic of cable systems pricing, with particular focus on traffic pricing on submarine cables as a consumption model;
- SPM Rodgers indicated that a phased approach to enacting traffic pricing would be required if it were to be adopted by the Solomon Islands;
- CEO Preedy tabled the matter that SISCC's pricing will be unsustainable if the Solomon Islands Government is pursuing a digital transformation agenda whereby the maximum cost of CS2 and SIDN capacity leases are to be regulated by TCSI;
- CEO Preedy tabled the matter that the possibility of a single large customer, acting as a single desk, will further reduce the short-term viability of SISCC due to volumetric discount factors, and therefore SISCC will revise their pricing for review at the third CAWG meeting accordingly;
- SPM Rodgers requested that SISCC investigate pricing CS2 capacity for a 2Gbps commitment at below One Hundred US Dollars (USD \$100.00) per Mbps, to which CEO Preedy responded that SISCC will re-model their pricing based on this request and provide a response ahead of the next CAWG meeting;
- Consultant Mann tabled the concept of a Solomon Islands IXP to be located in Honiara and to be hosted by SISCC, to which the CAWG members agreed that the Solomon Islands IXP should be established as discussed;

- Counsellor Schloeffel tabled that SISCC had requested DFAT delay the repayment of the first tranche of development funding associated with the CS2 and SIDN, and proceeded to set out four provisions that are required be met by SISCC ahead of endorsing the loan repayment reprieve, as follows:
 - A finalised and sustainable pricing model that retains the subsidised access to the Solomon Islands Domestic Network to ensure that there is no disincentive to the provincial roll-out of Internet services, including for new market entrants;
 - Confirmation that IXP and shared content caching services will be managed by SISCC on a purely cost recovery basis and not on a for profit basis;
 - Confirmation that SISCC will provide IP Transit services as an optional extra (at no additional cost) rather than as a mandatory requirement;
 - Confirmation that the TCSI Commissioner is comfortable with SISCC's latest offer to the market.
- The CAWG members were interested in the traffic pricing model, however there were concerns in relation to the short timeframe leading up to the CS2 and SIDN RFS date, along with the innovative and largely untested nature of traffic pricing;
- The CAWG agreed that extending high speed mobile and fixed line Internet access to as many people as possible within the Solomon Islands is a key driver in fostering future demand, for which development partner funding will be solicited;
- The CAWG members noted that the issues of telecommunication services universal access and telecommunications infrastructure sharing are key regulatory factors to further develop the market;
- The CAWG members discussed the issues of IP Transit and retail service provider Internet resiliency at length, and agreed that Internet resiliency is the responsibility of each of the retail service providers and not that of SISCC;
- The CAWG members agreed that the connectivity of a second international submarine cable to the Solomon Islands is a key initiative to ensure future resiliency of Internet services, for which development partner funding will be solicited;
- The CAWG members agreed that access to capacity on the SIDN should not be free, and should be priced at a fair market rate;
- The CAWG members agreed that SISCC should allow the retail service providers to connect and begin testing access to CS2 and SIDN ahead of the signing of any commercial agreements.

Caedus Systems further updated the CAWG Matrix to include the additional areas of concern that were raised during the second CAWG meeting.

2.4.3. Third Meeting of the Cable Adoption Working Group

The third CAWG meeting was held on the 4th of December 2019, at the TCSI offices in Honiara. Mr. Alwyn Danitofea sent his apologies and was unable to attend. Mr. Samuelu Taufao, Mr. John de Ridder, and Mr. Matthew Mann were also present for the meeting as advisors and consultants. The key outputs from the third CAWG meeting are as follows:

- CEO Preedy tabled a new pricing structure for CS2 and SIDN capacity, which was well received by the members;
- CEO Preedy tabled an IXP and shared content caching agreement, which was well received by the members;
- CEO Preedy tabled a justification for maintaining IP Transit services over the medium-term, which was well received by the members;

- SPM Rodgers reaffirmed the Solomon Islands Government’s position that SISCC is responsible for the delivery of services in a manner that most benefits the people of the Solomon Islands and thereby reinforcing the governments digital transformation agenda;
- Commissioner Hill indicated that TCSI would now proceed with the drafting of a 1-year license for SISCC to operate the CS2 and SIDN cables, subject to review of the final pricing structure and access terms, which are to be provided by SISCC;
- Consultant Mann confirmed that the proposed roadmap provided by SISCC, in relation to reducing the inherent risks associated with the following: a single IP Transit failure domain, cyber security exposure, and change management; is appropriate if managed adequately by the SISCC team;
- The CAWG members agreed that the updated pricing structure tabled by SISCC is reasonable and meets the expectations of the members;
- The CAWG members agreed that SISCC should proceed with commercial negotiations with each of the retail service providers based upon the new terms and conditions tabled by SISCC;
- The CAWG members agreed that deferring the repayment to DFAT of the first tranche of development funding associated with the CS2 and SIDN is a reasonable approach as an effort to foster digital transformation within the Solomon Islands over the medium-term;
- The CAWG members agreed that an RFS date of the 1st of February 2020 is feasible and will be targeted, pending the results of commercial negotiations and the issuance of a license from TCSI to SISCC.

Caedus Systems performed a final update of the CAWG Matrix to include the additional areas of concern that were raised during the third CAWG meeting, and the CAWG Matrix was distributed to OPMC for consideration.

2.4.4. Final Outputs of the Cable Adoption Working Group

The final version of the CAWG Matrix is provided herein this report in Attachment I (Cable Adoption Working Group Matrix). A total of 40 initiatives were identified by the CAWG members over the course of the three meetings. The status of each of these initiatives is detailed as follows:

- Completed: 17
- Deferred: 21
- Abandoned: 2

The following colour coding has been utilised within the matrix, which is provided as Attachment I (Cable Adoption Working Group Matrix) to this report:

Completed	
Deferred	
Abandoned	

Many of the initiatives detailed in the CAWG Matrix are strategic in nature and are intended to become part of a long-term roadmap for OPMC to reference in the effort to foster digital transformation within the Solomon Islands. All of the key initiatives that are directly related to the impending CS2 and SIDN launch have been suitably completed at the time of writing this report.

2.5. Consultation with SISCC and Service Providers

Caedus Systems consultants held dedicated meetings with SISCC representatives on a total of four occasions during the course of the engagement. These private meetings exclude the wider consultation provided by Caedus Systems to SISCC during each of the CAWG meetings and also at the seminar during the World Bank Digital Transformation conference. Caedus Systems consultants also maintained electronic communication with SISCC representatives throughout the engagement timeframe.

Caedus Systems consultants met with each of the major retail service providers that operate in the Solomon Islands on a total of eight occasions during the course of the engagement. Caedus Systems offered services to bMobile, Satsol, and Our Telekom for matters relating to the arrival of the CS2 and SIDN submarine cables and associated concerns. Caedus Systems consultants also maintained electronic communication with the major retail service providers during the engagement timeframe.

2.6. Consultation with TCSI

Caedus Systems consultants assisted TCSI in matters relating to the technical aspects of the CS2 and SIDN submarine cables. Caedus Systems consultants were in regular contact with the Commissioner of TCSI throughout the engagement timeframe, with a particular focus on the access and licensing matters. Caedus Systems consultants also worked with TCSI in relation to the proposed governance structure of the recommended SIIXP.

2.7. Additional Briefings

Caedus Systems conducted a number of additional briefings during the engagement for parties that have a direct interest in the CS2 and SIDN submarine cables. Multiple briefings were held with DFAT representatives to ensure stakeholders were abreast of the CS2 and SIDN developments. Caedus Systems also met with the SINPF board of directors and with the CEO of SIEA to discuss the technical aspects of the CS2 and SIDN submarine cables.

2.8. Access Considerations

Caedus Systems advised all of the relevant parties in relation to the access considerations as they apply to the CS2 and SIDN submarine cables. Caedus Systems consultants were in regular contact with TCSI in regard to the proposed SISCC products and the technical aspects of how the retail service providers will interconnect to SISCC for each associated service. Caedus Systems provided guidance to TCSI and DFAT in relation to the sizing of capacity-based circuits, the impact of minimum capacity commitment terms, a testing regime, the deployment of IPL's, elasticity concerns, and the differences between IP Transit and EVC products.

2.9. IXP and Caching Framework

Caedus Systems drafted an IXP and content caching framework document during the engagement, which is titled "SIIXP Framework". The SIIXP Framework has been provided to OPMC for review and consideration. An associated budget document which is titled "SIIXP Sample Budget" has also been given to OPMC. Caedus Systems has provided the following details for the establishment of the proposed SIIXP within the SIIXP Framework document: opportunities, governance structure, member participation guidance, hosting facility requirements, financial requirements, technical operations guidance, and content caching mechanisms. Caedus Systems has also provided a roadmap for the establishment of the SIIXP in Honiara within the SIIXP Framework document.

Caedus Systems proposes that SIIXP be a not-for-profit and carrier-neutral Internet peering exchange that is located in Honiara. Caedus Systems proposes that SIIXP is established with the goal of creating

local IP traffic exchange between autonomous systems for the purposes of both promoting economic development and improving the Internet. The intention of the proposed SIIXP is to allow IP networks present in the Solomon Islands to inter-connect with one another without sending traffic destined for each other's networks through international circuits.

Caedus Systems proposes that the SIIXP network operate independently of all other networks and will serve only as a means of connection among those IP networks that choose to peer at SIIXP. SIIXP is proposed to operate an OSI Model Layer-2 switch, functioning in a redundant configuration, which will be provisioned at a single SIIXP location that is situated within the greater Honiara area.

Caedus Systems have engaged with bMobile, Our Telekom and Satsol throughout the engagement, all of which are enthusiastic about participating in the SIIXP. TCSI has expressed a desire to administer the SIIXP entity. SISCC has shown an interest in being the original hosting facility for the SIIXP and in providing cache-fill services to SIIXP.

3. Challenges

Caedus Systems encountered minimal challenges during the engagement. Each of the challenges faced by Caedus Systems, along with the associated impacts, are listed below:

- Limited availability of key stakeholders for meetings and to attend the CAWG – Required additional coordination effort to ensure adequate representation of parties;
- Difficulty in collecting accurate information from the retail service providers in regard to the network infrastructure available within the Solomon Islands – Required additional meetings and consultation to attain adequate details.

4. Recommendations

Caedus Systems provides the following recommendations for OPMC consideration in relation to the CS2 and SIDN submarine cables.

4.1. Adopt a Capacity Pricing Framework

The Solomon Islands has the opportunity to embrace bandwidth abundance with the arrival of the CS2 and SIDN submarine cables. The CS2 submarine cable from Sydney to Honiara has a theoretical capacity of 20Tbps. At present, the entire Solomon Islands nation utilises less than 2Gbps of Internet capacity, provided via a series of Satellite circuits. The CS2 submarine cable from Sydney to Honiara will be provisioned with 100Gbps of protected production capacity, which will be available to the retail service providers for consumption, upon the RFS date. Caedus Systems has the following associated recommendations:

- Maintain a traditional capacity pricing framework and implement under the agreed upon pricing structure tabled by SISCC at the third CAWG meeting;
- The traffic pricing framework presented to the second CAWG meeting by Mr. John de Ridder is unique and has intrinsic merit, however Caedus Systems believes the Solomon Islands is not a good candidate for a traffic pricing framework due to the following reasons:
 - Traffic pricing is not widely accepted in the backhaul market or telecommunications industry at the time of writing this report;
 - The Solomon Islands presents several fundamental challenges due to the following: its low level of development, its distributed geography, its weak economy, and its population density; therefore, these challenges will inhibit the adoption of a novel concept such as traffic pricing;

- SISCC will need to purchase upstream bandwidth in Australia under a capacity pricing model due to the fact that no upstream telecommunications carrier in Australia presently sells bandwidth using traffic pricing; therefore, if a wholesale traffic pricing framework is adopted by the Solomon Islands, it will become burdensome on SISCC to purchase capacity priced bandwidth and sell traffic priced bandwidth;
- There are technicalities associated with the counting of MB's and GB's of data, which is required to provision a traffic pricing framework; therefore, SISCC may incur additional costs associated with the counting of MB's and GB's of data, which will most likely be passed on to the retail service providers;
- Traffic pricing is so minimally adopted within the telecommunications industry that there may be unknown caveats due to its immaturity, and the Solomon Islands is not a good fit for testing an innovative traffic pricing framework.

It is the view of Caedus Systems that any attempt to implement traffic pricing in the Solomon Islands for the wholesale marketplace be considerate of both the greater telecommunications industry adoption rate of traffic pricing and the barriers to implementation within the Solomon Islands.

4.2. Establish the SIIXP

Caedus Systems recommend the establishment of the SIIXP within the greater Honiara area. The SIIXP is recommended for the purposes of both improving the Internet and promoting economic development within the Solomon Islands. Establishment of the proposed SIIXP is associated with many opportunities, including but not limited to the following:

- Host content locally within the Solomon Islands, including the content served from cache providers, such as: Google, Netflix and Akamai;
- Foster future local content hosting within the Solomon Islands through the provision of a neutral and settlement-free Internet exchange, which is a desirable location for cache providers to locate their equipment;
- Reduce latency and improve end consumer Internet experience through interconnecting the retail service providers at the SIIXP;
- Realise direct savings on international IP Transit by keeping IP traffic local and serving content from local content caches;
- Develop hosting platforms within the Solomon Islands, including public cloud datacentre points of presence and associated investments;
- Provide local access to eGovernment services such as eTax, Telemedicine and eLearning, with such traffic remaining in the Solomon Islands;
- Foster future regional interconnection through peering and IP Transit with neighbouring countries;
- Foster the development of an Internet marketplace and associated cloud services within the Solomon Islands.

It is the view of Caedus Systems that the proposed SIIXP be structured in the following manner:

- TCSI is proposed to engage with PCH for remote mentoring assistance in relation to the establishment of the SIIXP;
- SIIXP is proposed to be established as a non-for-profit company, which is incorporated in Honiara, Solomon Islands, and is administered from the TCSI office;
- SIIXP is recommended to operate using an independent business model, with all operational expenses of SIIXP to be met by the SIIXP non-for-profit entity;

- A board is proposed to be established for the governance of the SIIXP, and will consist of a single representative from each party to the SIIXP, with the purpose of representing the collective interests of all of the SIIXP parties;
- The TCSI commissioner is proposed to chair the SIIXP Governing Board and will also have a single vote;
- TCSI is proposed to draft the required SIIXP agreement and legal documents under guidance from PCH;
- SIIXP will generate income from one-time connection fees and monthly access fees that are charged to each party of the SIIXP;
- Membership to SIIXP is proposed to be voluntary in nature, with each party to the SIIXP being free to choose with whom they bilaterally interconnect;
- The SIIXP governing board will select an appropriate hosting provider for the SIIXP, and the hosting provider will be responsible for the power, cooling, hosting, security, maintenance and technical operation of SIIXP;
- SIIXP will require an estimated Forty Thousand US Dollar (USD \$40,000.00) start-up donation to fund its establishment;
- SIIXP is proposed to operate in a cost recovery manner and will only hold sufficient retained earnings to cater for a catastrophic event such as key equipment failure;
- SIIXP content caching fill traffic is provided as a cost-recovery service from the hosting provider to SIIXP members that sign-up for a content cache access plan;
- SISCC is proposed to provide content cache-fill via the cost-effective fiber interconnects it will have in place to IX Australia via CS2;
- TCSI is proposed to establish the SIIXP non-for-profit company;
- TCSI is proposed to either fund or to solicit an initial donation to fund the SIIXP;
- SISCC is proposed to be the hosting provider for the first SIIXP access point;
- SIIXP is advised to organise technical IXP training from a suitable IXP expert;
- SIIXP is advised to engage with APNIC to encourage content cache providers to place CDN servers at the SIIXP.

The SIIXP governing board will also need to consider the potential for a second SISCC access point, based upon the success of the first SISCC access point and the availability requirements of the SIIXP. The introduction of content caching domestically within the Solomon Islands is inevitable and highly desirable for consumers as it improves their experience, and the proposed SIIXP provides an avenue for all connected retail service providers to benefit accordingly.

4.3. Phase Out the SISCC IP Transit Product

Caedus Systems recommend that SISCC establish a roadmap toward abolishing the current IP Transit product. The SISCC IP Transit product faces several inherent risks which may render it an unacceptable long-term solution for the Solomon Islands. A selection of the risks associated with the SISCC IP Transit product are as follows:

- The SISCC IP Transit product may become a potential single point of failure for all Solomon Islands cable-based Internet access if the majority of the retail service providers choose to purchase the IP Transit offering over the Ethernet Transport offering;
- Increased Internet outages are possible due to SISCC operating as an additional layer of networking and complexity that is being inserted between the service provider autonomous systems and their upstream transit providers as a result of the IP Transit product;

- The retail service providers lose the ability to commercially distinguish themselves to their end consumers, and within the telecommunications market, through the loss of the ability to make independent and strategic upstream commercial routing relationships when purchasing the IP Transit product;
- Future international cable systems that terminate in the Solomon Islands may be subject to the same failure-domain at SISCC if the IP Transit model is maintained over the long-term, thereby limiting the benefits of Internet resiliency and protection that are typically obtained through the establishment of multiple International cable systems into a given country;
- Increased end consumer cost of Internet services as a flow on result of SISCC incurring additional costs through the capital purchase, ongoing operation, and replacement of its IP Transit product;
- Bundling of the SISCC IP Transit product at no additional cost into the SISCC wholesale product line will likely distort the wholesale market, as those retail service providers who choose to purchase Ethernet Transport capacity from SISCC will be at a cost disadvantage to those who choose to purchase the SISCC IP Transit product.

The following risk mitigation strategies have been agreed upon, through the CAWG forum, in order to reduce the risks associated with the SISCC IP Transit product:

- SISCC to implement distributed denial of service protection on the IP Transit product before the CS2 RFS date;
- SISCC to implement industry best practice cyber security policies and controls to protect the IP Transit product before the CS2 RFS date;
- SISCC to implement best practice technical controls to limit the likelihood and impact of an outage to the IP Transit network components;
- SISCC to adopt industry standard change management processes and documentation to limit the likelihood and impact of an outage to the IP Transit network components;
- The retail service providers will be responsible for maintaining their own adequate backup Internet circuits for resiliency purposes.

Caedus Systems recommend that SISCC phase out the IP Transit product over a five-year period following the CS2 RFS date. The proposed five-year phase out period will provide the retail service providers with sufficient time to build the required internal technical capacity associated with direct international routing relationships.

4.4. Develop Shared Telecommunications Infrastructure

The growth of Internet services and the future demand for CS2 and SIDN capacity will be primarily underpinned by the access networks that are in place throughout the Solomon Islands. The Solomon Islands has a reasonably high level of mobile penetration at the time of writing this report, however the mobile broadband and fixed line broadband penetration rates are moderate to low. Caedus Systems recommend the Solomon Islands invest in shared telecommunications infrastructure, with the following considerations:

- TCSI is proposed to investigate suitable telecommunications universal access provisions and a scheme to fund such universal access service obligations;
- TCSI is proposed to investigate suitable telecommunications infrastructure sharing and the market implications of such sharing agreements;
- TCSI is proposed to investigate suitable strategic mobile mast and plant sharing initiatives and the market implications of such sharing agreements;

- TCSI is proposed to review the wholesale competition framework as it applies to multiple submarine cable systems, along with the autonomy and resiliency of the submarine cable operators within the market;
- ICTSU is proposed to liaise with the Ministry of Health to determine the nations Telemedicine requirements;
- ICTSU is proposed to liaise with the Ministry of Education to determine the nations eLearning requirements;
- OPMC is proposed to plan for and foster additional submarine fiber optic cable connectivity to the Solomon Islands to ensure Internet path diversity and resiliency.

A lack of shared fixed line telecommunications infrastructure in the Solomon Islands may hamper the mass adoption prospects of CS2 in the short-term. It is the view of Caedus Systems that shared telecommunications infrastructure, in conjunction with universal access service obligations, will foster the growth of Internet services and the future demand for CS2 and SIDN capacity.

5. Acknowledgements

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- OPMC for providing oversight and guidance of the access, IXP and caching works;
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- SISCC for maintaining clear and open communications and reaching a consensus on key issues;
- SIRF for managing the engagement and administrative matters;
- DFAT for providing funding assistance;
- Mr. Samuelu Taufao for organising the onsite meetings and appointments;
- Dr. Jimmie Rodgers for leadership and strategic planning support.

6. Attachment I – Cable Adoption Working Group Matrix

The following matrix was developed to track the strategic outputs from the CAWG meetings.

Goals	Objectives	Initiatives	Next Steps and Actions	Notes
<p>Mass Adoption</p>	<p>CS2 as a development enabler for the nation</p>	<p>Total capacity on CS2 as a factor of the nation’s pre-cable international aggregate bandwidth within 12-months of CS2 RFS</p>	<p>1. Economic advisor input required to assess the untapped market demand for bandwidth 2. Target of 4Gbps of capacity provisioned at RFS</p>	<p>1. Initial capacity target of 3 - 4Gbps of traffic on CS2 in 12-months is likely to be achieved</p>
		<p>Compound annual growth rate on CS2 for 5-years</p>	<p>1. Economic advisor input required to assess the future market demand for bandwidth 2. Capacity target to be provisioned in 5-years</p>	<p>1. Capacity demand is forecast to reach between 12Gbps - 38Gbps over a 5-year period post RFS</p>
		<p>Provision as much capacity as possible on CS2 at RFS to encourage the purchase of large capacity circuits and discourage satellite</p>	<p>1. Price target of sub-\$100 USD per Mbps for a 1Gbps capacity lease 2. Economic advisor input required to assess the elasticity, pricing, and volumetric factors needed to discourage satellite</p>	<p>1. A 2Gbps lease that is priced at less than \$100 per Mbps is required to discourage satellite usage and is likely to be achieved</p>

		Address concerns in regard to the SISCC shareholding structure and its impact on national development	1. SPM to discuss the national digital transformation goals with both ICSI and SINPF to determine alignment or discrepancy with the shareholders vision for SISCC	
		Reduce the SISCC shareholder return on investment targets and SISCC short term profit guidance	1. Economic advisor input required to assess the SISCC business plan, cost structure and forecast model 2. SPM to discuss the return on investment factors with both ICSI and SINPF as they apply to planned government policies 3. DFAT to consider delaying the repayment timeframes for CS2 and SIDN financing	
	Low-cost high-bandwidth capacity on CS2	CS2 pricing is set at levels that are conducive to large scale capacity purchases by the retail providers	1. Economic advisor input required to compare two bandwidth models for SISCC 2. Economic advisor to provide pricing guidance measured against comparable pacific island nations	

		<p>Alleviate the current satellite Internet commitments at the retail providers to free up cash flow</p>	<ol style="list-style-type: none"> 1. Economic advisor input required to determine if such an intervention is advisable given the potentially unfair commercial impact to select providers in the retail market 2. Technical advisor to liaise with SISCC to determine if Internet resiliency via satellite is required to protect the IP Transit product 	<ol style="list-style-type: none"> 1. Deemed to not be a SISCC responsibility and may have an unstable market impact 2. The retail service providers will be responsible for their own backup circuits
	<p>Digital transformation across the Solomon Islands</p>	<p>Aim to establish 80% population coverage with 4G service within 5-years</p>	<ol style="list-style-type: none"> 1. Digital transformation authority to set specific mass adoption goals as they apply across the entire nation 2. Further economic advisor input to assess the impacts of universal access to aid in achieving digital transformation 	<ol style="list-style-type: none"> 1. Requires formation of the digital transformation authority 2. Requires technical assistance funding
		<p>Aim to establish 80% population coverage with Internet service within 5-years</p>	<ol style="list-style-type: none"> 1. Digital transformation authority to set specific mass adoption goals as they apply across the entire nation 2. Further economic advisor input to assess on the impacts of universal access to aid in achieving digital transformation 	<ol style="list-style-type: none"> 1. Requires formation of the digital transformation authority 2. Requires technical assistance funding

		Rollout Digital ID to 80% of the population within 5-years	1. ICT advisor to liaise with donors on the potential rollout of a Digital ID program	1. Requires technical assistance funding
		Mainstream digital payment utilisation across 80% of the population within 5-years	1. ICT advisor to liaise with donors on the potential rollout of a Digital Payment program	1. Requires technical assistance funding
		Establish Telemedicine services at all healthcare facilities within 5-years	1. Digital transformation authority to liaise with donors on the potential connectivity of all healthcare facilities to SIG-Connect	1. Requires formation of the digital transformation authority
		Establish eLearning services at all educational facilities within 5-years	1. Digital transformation authority to liaise with donors on the potential connectivity of all educational facilities to SIG-Connect	1. Requires formation of the digital transformation authority
		Establish a computer emergency response team within OPMC	1. ICT advisor to liaise with donors on the potential framework for the establishment of a computer emergency response team	1. Requires technical assistance funding

	<p>Key telecommunications infrastructure sharing</p>	<p>Establish a framework for telecommunications infrastructure sharing within 2-years</p>	<p>1. Digital transformation authority to liaise with TCSI in regard to shared telecommunications infrastructure legislative requirements</p>	<p>1. Requires formation of the digital transformation authority</p>
		<p>Identify key telecommunication assets suitable for sharing agreements within 2-years</p>	<p>1. Digital transformation authority to liaise with donors for a study of the key telecommunications assets that are suitable for sharing 2. Further economic advisor input to assess the impact of shared infrastructure on digital transformation goals</p>	<p>1. Requires formation of the digital transformation authority 2. Requires technical assistance funding</p>
		<p>Deploy shared fiber optic backbone networks within 3-years</p>	<p>1. Digital transformation authority to liaise with donors for a study of fiber optic backbone networks that are suitable for sharing 2. Digital transformation authority to investigate the expansion of a shared fiber optic backbones in key locations</p>	<p>1. Requires formation of the digital transformation authority 2. Requires formation of the digital transformation authority</p>

		Deploy shared fiber optic access networks within 3-years	<ol style="list-style-type: none"> 1. Digital transformation authority to liaise with donors for a study of fiber optic access networks that are suitable for sharing 2. Digital transformation authority to investigate the expansion of a shared fiber optic access networks in key locations 	<ol style="list-style-type: none"> 1. Requires formation of the digital transformation authority 2. Requires formation of the digital transformation authority
		Implement strategic mast and plant sharing within 3-years	<ol style="list-style-type: none"> 1. Further economic advisor input to assess mast and plant sharing 	<ol style="list-style-type: none"> 1. Requires technical assistance funding
	Solomon Islands Government network meets public sector needs	Increase SIG-Connect Internet capacity to 2Gbps within 3-year of CS2 RFS	<ol style="list-style-type: none"> 1. ICTSU to release a tender in late 2020 to the retail providers for whole of government bandwidth bids 	<ol style="list-style-type: none"> 1. The ICTSU SIG Connect Internet contracts expire at different times making it difficult to synchronise and tender as a cohesive contract
		Expand SIG-Connect services to all the healthcare and educational facilities within 3-years	<ol style="list-style-type: none"> 1. Government policy decision 	<ol style="list-style-type: none"> 1. Requires technical assistance funding

		Leverage the SIG-Connect higher capacity CS2 Internet purchase to provide cash flow to SISCC and to reduce the unit cost of capacity	1. Government policy decision	1. ICTSU SIG Connect commits approximately \$1.6 Million USD into Internet services at present and this spend is unlikely to increase over the next 3-years
International Access	Deliver a best practice IP Transit product	Implement Distributed Denial of Service protection on the IP Transit product before CS2 RFS	1. Technical advisor to liaise with SISCC in regard to DDoS protection mechanisms	1. SISCC technical experts and external consultants will managed the DDoS protection risks
		Implement industry best practice cyber security policies and controls to protect the IP Transit product before CS2 RFS	1. Technical advisor to liaise with SISCC in regard to essential cyber security controls	1. SISCC management will address cyber security risks and implement appropriate controls
		Implement best practice technical controls to limit the likelihood and impact of an outage to the IP Transit network components	1. SISCC to confirm the change control process for the IP Transit product 2. SISCC to confirm the outsourced management controls for the IP Transit product	1. SISCC management will address change control processes and mechanisms

		Implement Internet protection for the IP Transit product before CS2 RFS	1. Technical advisor to liaise with SISCC to determine if Internet protection should be offered on the IP Transit product	1. The retail service providers will be responsible for their own backup circuits
	Market suitability of SISCC products	Phase out the IP Transit product after a period of 3-years upon the retail providers having built the required internal technical capacity	<ol style="list-style-type: none"> 1. Dependant on assessment by TCSI 2. Dependant on input from the economic advisor 3. Dependant on input from the technical advisor 	<ol style="list-style-type: none"> 1. TCSI views the IP Transit product as a medium-term solution to the present telecommunication markets technical maturity 2. Economic advisor views the IP Transit product as a medium-term solution to the present telecommunication markets technical maturity 3. Technical advisor views the IP Transit product as a medium-term solution to the present telecommunication markets technical maturity
		Ensure the SISCC IP Transit solution doesn't offer built-in IXP services to connected retail providers	1. Technical advisor to recommend potential IXP structures and their associated pros and cons	

Domestic Access	SIDN as a development enabler for the nation	Total capacity on SIDN as a factor of the nation’s pre-cable domestic aggregate bandwidth within 12-months of SIDN RFS	<ol style="list-style-type: none"> 1. Economic advisor input required to assess the untapped market demand for bandwidth 2. Target of 200Mbps of capacity provisioned at RFS 	<ol style="list-style-type: none"> 1. The first 1Gbps of SIDN capacity will be bundled in with applicable capacity purchases on CS2 2. Likely to be achieved due to bundled capacity pricing
		Compound annual growth rate on SIDN for 5-years	<ol style="list-style-type: none"> 1. Economic advisor input required to assess the future market demand for bandwidth 	<ol style="list-style-type: none"> 1. Unlikely to be a significant growth rate on SIDN without major investment in the provincial telecommunications infrastructure
		Provision as much capacity as possible on SIDN at RFS to encourage the purchase of large capacity circuits and discourage satellite	<ol style="list-style-type: none"> 1. Price target of sub-\$15 USD per Mbps for a 100Mbps capacity lease 	<ol style="list-style-type: none"> 1. SIDN capacity will be bundled into CS2 capacity commitments
Internet Resiliency	Adequate Internet resiliency for a mature digital economy	Foster additional submarine fiber optic cable connectivity to the Solomon Islands to ensure Internet path diversity and resiliency	<ol style="list-style-type: none"> 1. Government policy decision 	<ol style="list-style-type: none"> 1. Requires technical assistance funding

		Additional cable systems are configured as separate failure-domains to reduce the risk of a single point of failure	1. Technical advisor to liaise with both SISCC and the ICT Advisor to determine risks and mitigations	
		Additional cable systems are deployed as competitive wholesale elements in regard to pricing and capacity	1. Determine if SISCC as a multiple cable wholesaler impacts future wholesale competitiveness	1. Requires technical assistance funding
	Maintain retail provider autonomy and free market forces	Provide the retail providers with access to multiple diverse routing relationships that are underpinned by international submarine fiber optic circuits	1. Government policy decision	
Local Internet Marketplace	A Solomon Islands IXP in Honiara	Establish a legal framework and governance structure for an independent, neutral, cost-recovery funded and settlement-free based peering service in Honiara within 6-months	1. Technical advisor to liaise with SISCC, TCSI, the ICT Advisor and the retail providers to negotiate an IXP framework 2. Technical advisor to liaise with SISCC, the retail providers and ICTSU in regard to hosting of the IXP services	

		Deploy the first Honiara IXP facility within 6-months	<ol style="list-style-type: none"> 1. Subject to IXP members signing an agreement to participate in settlement-free peering 2. Subject to a suitable location being provided to host the first Honiara IXP location 3. Subject to a suitable governance structure being adopted for the Honiara IXP 4. Subject to funding to source the equipment required at the first Honiara IXP location 	<ol style="list-style-type: none"> 1. TCSI will draft the Solomon Islands IXP agreement which is a legal document 2. Proposed location for the Solomon Islands IXP is at SISCC's Honiara CLS 3. An IXP Framework has been submitted to TCSI to use as the starting point for the IXP agreement 4. Funding is still required for the Solomon Islands IXP start-up costs
	Content Caching at the IXP in Honiara	Establish a shared content caching framework for the deployment of content caching at the Honiara IXP within 6-months	<ol style="list-style-type: none"> 1. Technical advisor to liaise with SISCC, TCSI, the ICT Advisor and the retail providers to negotiate a caching framework 2. Technical advisor to liaise with SISCC, the retail providers and ICTSU in regard to hosting and fill of caching services 	

	Robust ICT Polices	Perform a comprehensive review of the Solomon Islands Government ICT policies within 1-year	1. MCA to liaise with donors to assist with policy needs and policy development assistance	1. Requires technical assistance funding
		Revise and approve the Solomon Islands Government ICT policies to support digital transformation goals within 3-years	1. MCA to liaise with donors to assist with policy needs and policy development assistance	1. Requires technical assistance funding