Forecasted IP Video Services - Measured in Mbps

Island	2009	2010	2011	2012	2013
Hawaii	615	855	1,095	1,335	1,575
Kauai	615	855	1,095	1,335	1,575
Lanai	615	855	1,095	1,335	1,575
Maui	615	855	1,095	1,335	1,575
Molokai	615	855	1,095	1,335	1,575
Oahu	615	855	1,095	1,335	1,575

Assumptions:

Standard Definition streams will be encoded via MPEG-4 with 2.5 Mbps per channel
High Definition streams will be encoded via MPEG-4 with 8 Mbps per channel
Channel lineup assumed to include 150 Standard Definition streams each year
Channel lineup assumed to include 30 HD channels in 2009 and increase by 30 HD channels each year
Bandwidth projections include multicast video only. Unicast video (e.g. Video on Demand) not included.
No capacity lease services are included in the bandwidth projections

Result: By 2013, a total of 48 STS-1's are projected to be required for the multicast video traffic on the SIC transport network. This will permit two line-rate Gigabit Ethernet circuits for multicast video traffic.

Table 3-6 – Forecast of Transport Requirements for IP Video Services

SIC has implemented an OC-48 from Kekaha to Nanakul, as well as OC-192 systems from Waimanalo to Kalamaula, Waimanalo to Pu'unene, and Waimanalo to Pu'ukapu, for transport of IP Video services. As shown in Table 2-6, the IP Video service is anticipated to require 48 STS-1's of capacity on the system by 2013. Therefore, the OC-48 system is projected to be completely exhausted, while the OC-192 systems will likely have capacity for additional bandwidth growth.

3.3 Capacity Lease Positioning

As we look to the future, SIC has the ability to leverage this transport network infrastructure to offer a variety of services to their end customers, as well as to offer transport services to other carriers and enterprise businesses. With regards to providing transport services to other entities, there are three primary categories of transport services types that service providers such as SIC may potentially offer. These include Time Division Multiplexed (TDM) transport services (e.g. DS-1, DS-3, OC-3, etc.), Ethernet Transport Services (e.g. 10/100 Base T, Gigabit Ethernet, etc.), and lambda services. For the purposes of this report, only TDM transport services and Ethernet transport services will be addressed.

SIC is currently positioned very well to offer TDM capacity lease services over their existing SONET infrastructure. As described previously, SIC has an OC-48 reserved for capacity lease traffic from Oahu to Kauai. This equates to 48 DS-3 (or equivalent) circuits. Similarly, SIC has an OC-48 network reserved from Oahu to Molokai, Oahu to Maui, and Oahu to Hawaii. SONET is an excellent technology for transporting TDM services, and these systems may be sufficient to accommodate SIC's capacity lease services to other entities for the foreseeable future.

The existing Fujitsu Flashwave 4500 system has the ability to provide Ethernet over SONET transport. SIC has equipped 2-port, point-to-point Gigabit Ethernet cards in each Flashwave 4500 shelf. This enables them to utilize the Ethernet interface cards for Internet data backhaul, IP Video transport, and/or capacity lease services. However, it should be known that Ethernet over SONET may not be the most efficient methodology for transporting these services. Ethernet interfaces on SONET platforms are typically more expensive than interfaces on pure Ethernet transport platforms. In addition, the Flashwave 4500 terminals at some locations may not have sufficient open slots to add future Ethernet cards as the demand for service requires them. This would entail additional shelves (and thus additional cost) to allow for additional Ethernet services to be offered.

Vantage Point Solutions has noted trends occurring in our customer base in which there is more demand for Ethernet capacity lease services than for comparable TDM services. With this in mind, it is believed that SIC may experience significant growth in the requirements to transport Ethernet services, and this in turn will create the need for network additions to accommodate the potentially burgeoning demand.

3.4 Proposed Network Enhancements

As stated previously in this report, SIC appears to have adequate backbone capacity deployed to handle the projected transport demands for the voice, high-speed Internet, and IP Video services they intend to offer to their end subscribers. However, it should be noted that additional tributary interface cards (e.g. DS-1, DS-3, Gigabit Ethernet, etc.) may be required to support these services.

The primary concern with the existing transport network is the ability to scale to meet the demand for capacity lease services. When examining the three categories of capacity lease services (TDM, Ethernet, and Lambda leases) listed in the previous section, it is apparent that SIC is positioned well to provide some, but not all, of these services. For example, if SIC were to receive a request from a customer to transport three (3) Gigabit Ethernet circuits on the network, the OC-48 that has been deployed for these services would be inadequate. Therefore, additional electronics would need to be deployed to fulfill this example service request.

Vantage Point Solutions has developed three primary recommendations for the SIC Transport network. These recommendations on continued network enhancements include the following:

1. Connect the East and West Transport Networks via fiber optic cable:
   At this time, one of the main shortcomings of the SIC transport network is the lack of continuity between the East Transport Network and the West Transport Network. SIC currently leases bandwidth capacity from other service providers to transport their voice and data traffic to the ultimate destination. Based on the projected bandwidth demands for voice, data, and video services, VPS believes that it is necessary to obtain fiber optic cable connectivity between the East and West networks.

   There may be several options for SIC to procure the fiber optic cable connectivity between the two networks. One such opportunity may be for SIC to lease or purchase dark fibers from another service provider. This may be a cost-effective alternative for SIC. However, it should be noted that VPS has not confirmed if dark fiber is available for lease or purchase along this route. In addition, VPS has not obtained any information regarding the cost to lease or purchase any dark fiber on the island of Oahu.

   The second potential option for SIC is to conduct a joint-build of facilities with another services provider. The potential exists that other service providers may desire to augment their fiber optic cable network to relieve fiber cable constraints or to obtain diverse routing of their fiber infrastructure. If this is the case, then SIC may be able to enter into an agreement to share the cost of construction for the fiber optic cable route and reduce the overall investment requirement.

   The last option is for SIC to construct the fiber optic cable route to connect the East Transport Network and the West Transport Network. This most likely would be the highest cost alternative to SIC.

   Regardless of which option is selected to provide fiber optic cable connectivity between the two systems, additional electronics will be required at the hub location to aggregate this traffic. Given the fact that SIC has already deployed an extensive network using equipment manufactured by Fujitsu Network Communications, it is likely the most efficient solution to utilize the same vendor for the hub of this transport network. This allows for a unified management platform for the transport network.

When considering the products available from Fujitsu that may meet the service goals of SIC, the Flashwave 4500 and Flashwave 9500 platforms are the two likely candidates. At first glance, the Flashwave 9500 appears to be a more desirable solution due to its port density and scalability, additional planning is required to determine the most efficient solution.

2. Implement DWDM system for Layer 2 Ethernet transport services:
The second recommendation for the SIC network is to consider the implementation of DWDM functionality on the network. As stated previously, SIC's existing network provides limited growth potential for Ethernet Transport Services, as well as no options for providing lambda-based capacity lease services.

SIC has deployed Fujitsu Flashwave 7120 platforms in Kekaha, Nanakuli, Waimanalo, Kalamaula, Pu'unene, and Pu'ukapu to serve as optical amplifiers for the SONET system. The Flashwave 7120 is a DWDM platform that Fujitsu resells from BTI systems. The network additions required to convert the existing Flashwave 7120 terminals from amplifiers to full DWDM terminals may include the addition of optical filters, DWDM transponders, and additional shelves. In addition, the transition to DWDM would require a fair amount of reconfiguration and planning to ensure that service disruptions are minimized. A high-level diagram of a proposed DWDM network architecture is shown in Figure 2-3.

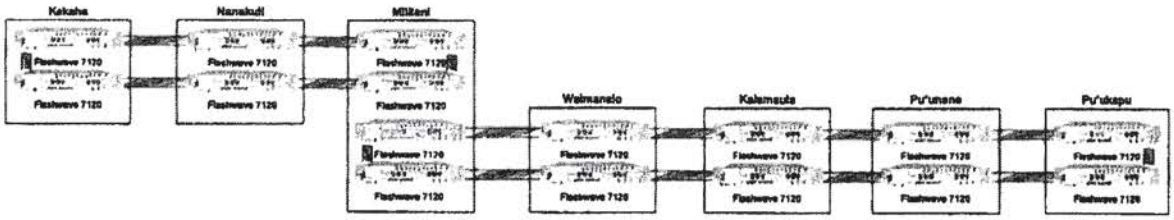

Figure 3-3 – Proposed DWDM Network Architecture

There are distinct advantages to deploying DWDM technology in the SIC network. First, the DWDM system allows SIC to create a folded ring architecture for their Ethernet transport services. Today, the Ethernet services for video and capacity lease traffic would ride across a SONET infrastructure set up in a protected, point-to-point architecture.

Implementing a folded ring architecture allows for a more efficient sharing of Ethernet bandwidth among the various islands. In addition, carrying the

Ethernet traffic in its native format is more efficient and scalable than the Ethernet over SONET infrastructure that is deployed today. BTI Systems, the company that developed the Flashwave 7120, has a family of Layer 2 Ethernet transponder cards available for this platform. This family of cards is referred to as the packetVX product line. The packetVX is effectively a Layer 2 Ethernet switch and a DWDM transponder combined on a single circuit card. The ring facing interfaces on the packetVX are 10 Gbps XFP's, while the client interfaces include 1 Gigabit Ethernet SFP interfaces and 10/100/1000 Base T interfaces with RJ-45 ports. The packetVX product family currently has three different members including:

- packetVX 12/2 – two (2) 10G XFP, ten (10) 1G SFP, two (2) RJ-45
- packetVX 24/2 – two (2) 10G XFP, twenty (20) 1G SFP, four (4) RJ-45
- packetVX 24/4 – four (4) 10G XFP, twenty (20) 1G SFP, four (4) RJ-45

The packetVX may provide flexibility to SIC by providing Layer 2 management capabilities for the Ethernet Transport Services. This product has the ability to provide Quality of Service prioritization on a per-port or per-flow basis. In addition, it provides the network operator with the ability to rate limit bandwidth on a per-port basis. This is important to SIC due to the fact that it would enable them to limit the Ethernet transport bandwidth for a customer to the exact rate (in Mbps) that they are paying for. The packetVX cards also provide protection switching for the Ethernet Transport Services, with an advertised failover of less than 50 milliseconds for point-to-point Ethernet services. SIC may find the packetVX desirable for not only Ethernet capacity lease services, but also for their internal IP Video and Internet data traffic.

Based on correspondence with Fujitsu Network Communications, the Flashwave 7120's are capable of supporting up to eight (8) lambdas per fiber pair for the Kekaha to Nanakuli span. In addition, up to thirty two (32) lambdas can be implemented on each pair of fibers for the Waimanalo to Kalamaula span, as well as the Kalamaula to Pu'unene span. Finally, up to twenty four (24) wavelengths can be deployed on each fiber pair for the Pu'unene to Pu'ukapu span. Each lambda is capable of carrying a 10 Gbps (4xOC-48, OC-192, 10x1 Gigabit Ethernet, or 10 Gigabit Ethernet) service.

4 Switching Network

4.1 Existing Switching Network

The SIC switching network is comprised of a number of components including Lucent 5ESS switching hardware (three CDX's, one VCDX, two RSM's, one DRM, and one 5E 2000), MetaSwitch softswitches (one MG3510 and one MG2510), and Digital Loop Carrier (DLC) equipment. According to SIC, this switching network has evolved into its current state out of necessity over the course of several years. Figure 2-6 provides a graphical depiction of the existing SIC switching network.

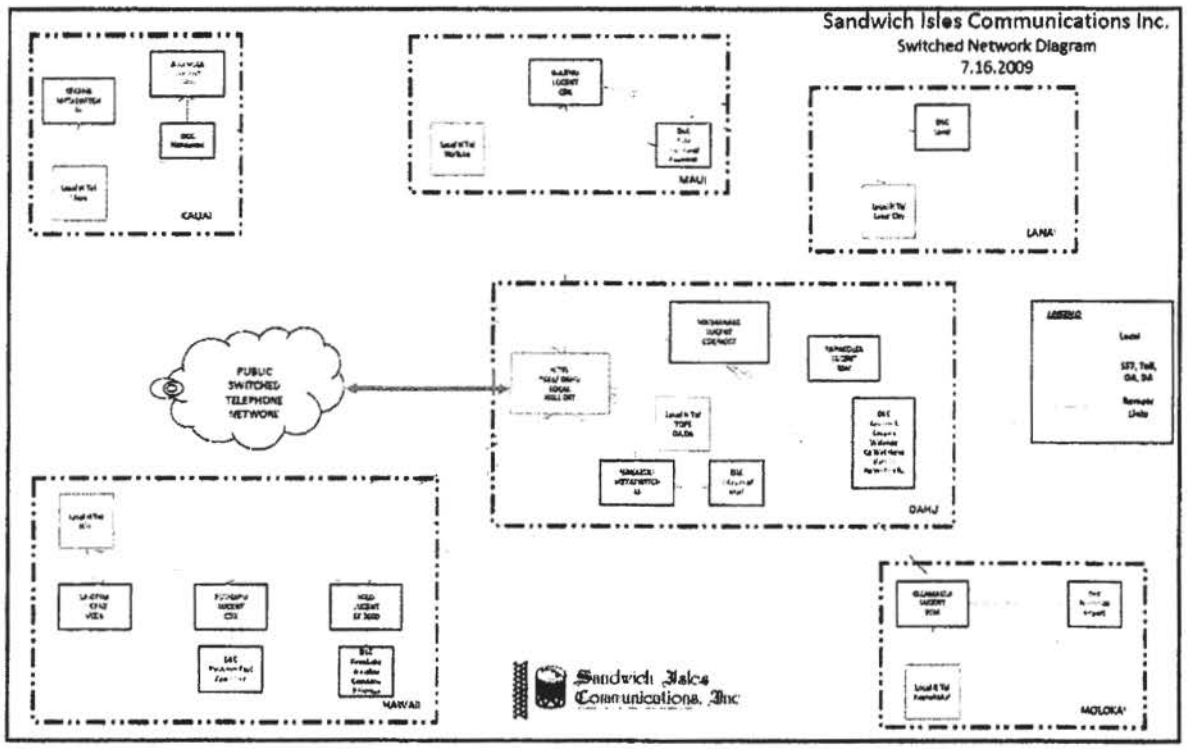

Figure 4-1 - SIC Existing Switching Network

With the exception of the Lucent RSM's located at Papakolea and Kalamaula that home back to the Waimanalo Lucent CDX, the switches deployed by SIC are all stand-alone voice switches. While SIC originally standardized on the Lucent switching platform, they recently have begun transitioning to a softswitch network based on equipment provided by MetaSwitch.

The SIC host switches have trunks that terminate to the Hawaiian Telecom Access Tandem in Honolulu. In addition, SIC relies on Hawaiian Telecom to provide SS7 services for the switched network. Their reliance on Hawaiian Telecom has created

anxiety for SIC due to the fact that Hawaiian Telecom is currently in Chapter 11 bankruptcy.

The forecast for future voice services is shown previously in this report in Table 2-4. Based on this forecast, the total number of DS-1 trunk interfaces that is projected to be required in 2013 for each island is as follows:

- Hawaii: 13 DS-1's
- Kauai: 6 DS-1's
- Lanai: 2 DS-1's
- Maui: 13 DS-1's
- Molokai: 3 DS-1's
- Oahu: 23 DS-1's

Based on these projections, there are no capacity concerns with the existing switching network. Any recommendations on switching network enhancements are based on feature sets, equipment longevity, and operational simplicity.

4.2 Proposed Switching Network Enhancements

As stated previously, the recommendations regarding enhancements to the SIC switching network are primarily based on new feature sets, equipment/vendor viability, and operational simplicity. SIC has embarked on the process of implementing MetaSwitch Media Gateways in their network to ultimately replace the Lucent switching architecture. VPS feels that MetaSwitch is a quality vendor, and we recommend that SIC continue down this path.

VPS has developed four primary recommendations regarding the SIC switching network. These recommendations pertaining to continued network enhancements include the following:

1. Continue the deployment of MetaSwitch Media Gateways:
   As stated previously, SIC has already deployed two MetaSwitch Media Gateways in their network, including an MG2510 at Kekaha and an MG3510 at Nanakuli. As SIC continues forward with this deployment, VPS recommends that they standardize on the use of MG3510 Media Gateways. The primary reason for recommending this larger platform is to help "future proof" the switching network. SIC has tendered an offer to Hawaiian Telecom to purchase their assets on the various islands. If this purchase were to occur, it is likely that the MG3510 is sufficiently sized to meet the current and projected future demand including the Hawaiian Telecom serving areas.

From a switching network architecture standpoint, VPS recommends that SIC deploy a single MG3510 on Hawaii, Kauai, and Maui. It is also recommended that the existing MG2510 in Kekaha (Kauai) be redeployed in Kalamaulu (Molokai). In addition, VPS recommends that SIC deploy one to two MetaSwitch MG3510's on Oahu for Class 5 switching functionality. Each of the MG2510 and MG3510 chassis is proposed to be equipped with Emergency Stand-Alone (ESA) functionality. This will allow for local dialing and local trunking to Hawaiian Telecom in the event that transport link to the Hawaiian Telecom Access Tandem is severed. With MetaSwitch's deployment of ESA, the lines that home to the SIC Media Gateway will continue to have local service. The local trunking available to other carriers (such as Hawaiian Telephone) in the ESA mode is highly dependent upon the configuration of the trunks (MF or ISUP) and the survivability of the SS7 A-Link connectivity. It may be beneficial to configure MF overflow trunks from each SIC Media Gateway to the appropriate Hawaiian Telephone switch in the event that SS7 connectivity is lost.

As part of the proposed network architecture, these Media Gateways, as well as the ones deployed on Oahu, will be interfaced to a centralized pair of Call Agents located on Oahu. The use of centralized Call Agents provides efficiency in capital investments, as well as operational simplicity. In addition, this network architecture has relatively little impact on the availability or reliability of voice services compared to an integrated softswitch architecture. The proposed switching network architecture is shown in Figure 2-7.

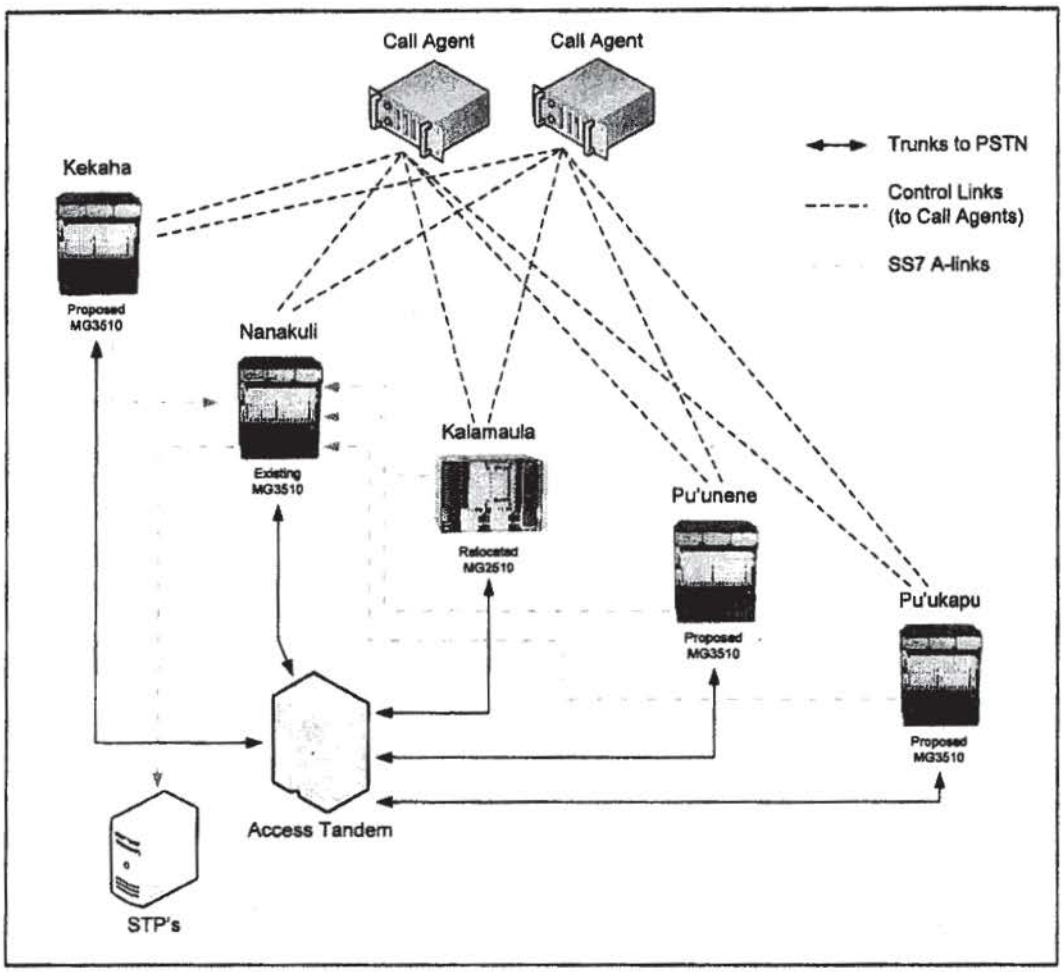

Figure 4-2 - Proposed SIC Switching Network Architecture

As stated previously, one pair of centralized call agents located on Oahu are recommended for the SIC switching network. In addition, it is recommended that all MetaSwitch Media Gateways are capable of operating in the ESA mode. Given the fact that all switches would have trunks to the Hawaiian Telecom Access Tandem on Honolulu, any catastrophic network event (e.g. fiber cut or equipment failure) that would isolate the SIC Media Gateways from the centralized Call Agents would likely also isolate the Media Gateways from the Access Tandem. In this scenario, the ESA functionality would still allow local calls to be made. Ultimately, the usage of centralized call agents on Oahu would have little to no impact on network reliability for services on the other islands due to the likelihood of SS7 A-link connectivity being lost if the connection to the tandem is also lost.

The proposed switching network design includes one Media Gateway on each island. As part of the proposed network architecture, SIC will rely on the use of Fiber to the Premises (FTTP) electronics and Digital Loop Carrier (DLC) equipment to serve the end subscriber. The FTTP and DLC terminals will connect back to the Media Gateway on that island via GR-303 DS-1's, MGCP based Ethernet interfaces, or SIP based Ethernet interfaces. Under ideal conditions, it is desirable to have survivable transport rings from the FTTP or DLC equipment to the central office that houses the Media Gateway. These transport networks will be referred to as "access rings." The use of access rings may help to maximize the service reliability and availability for the end subscribers. This concept is depicted in Figure 2-8.

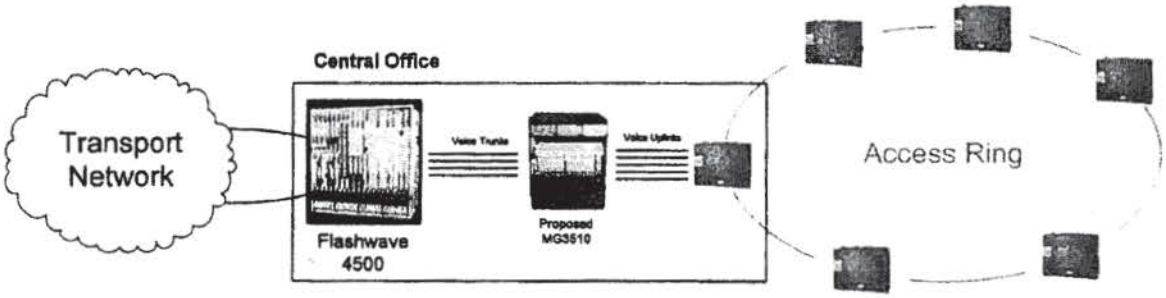

Figure 4-3 - Access Ring Diagram

2. Implement a Feature Server:
   In addition to the transition to a softswitching architecture throughout the SIC service territories, VPS recommends that SIC implement a feature server and offer the associated features to their end subscribers.

   There are two primary options that SIC should consider for a feature server. First, MetaSwitch has a product available called the MetaSphere application suite. In addition, Innovative Systems provides comparable functionality with their Innovative Systems APMAX.

   There are several key features that SIC should consider deploying with a feature server. These services include, but are not limited to, the following:

   - Conference Calling
   - Find Me, Follow Me
   - In-call Transfer
   - Voicemail and Unified Messaging

- Web Portal (click to dial)
- Web Self Care

3. Conduct A-link Consolidation and Evaluate SS7 Services Options:
As stated previously, the fact that Hawaiian Telecom is currently in Chapter 11 bankruptcy protection is causing anxiety for SIC. At this time, SIC desires to explore their options for SS7 services. VPS has identified four primary options for SIC to consider. These options include:

- Continue to utilize the Hawaiian Telecom STPs for SS7 services
- Utilize A-link consolidation feature on MetaSwitch Signalling Gateway card (or external platform such as the Performance Technologies mini-STPs) and purchase SS7 services from another provider such as Verisign or Syniverse
- Purchase a new set of STPs

Based on the size of SIC and the costs to implement and maintain a mated pair of full-blown STPs (such as the Tekelec Eagle STP), VPS feels that the option of purchasing their own set of STPs is not a desirable solution. In addition to the capital investment required, it would be necessary for SIC to purchase transport capacity to regional STP locations. A total of two B-links and two D-links would be required from the SIC STPs to the regional STPs. This ongoing cost would exceed to pricing to consolidate A-links for the Class 5 switches and lease two A-links to a provider such as Verisign or Syniverse. Please refer to the generic SS7 diagram in Figure 2-9.

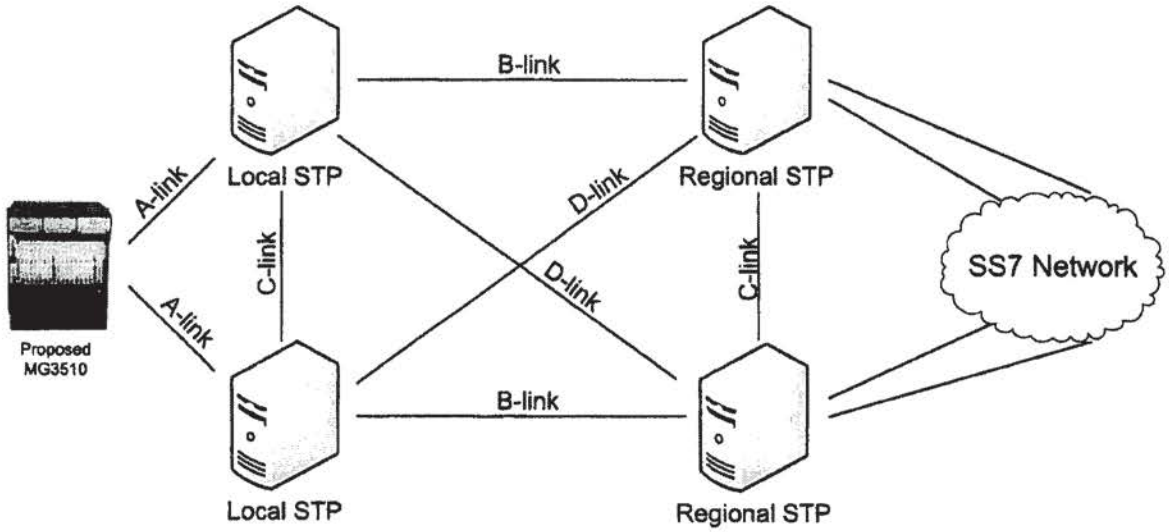

Figure 4-4 – SS7 Generic Diagram

VPS recommends that SIC perform A-link consolidation for their respective switches. In addition, it is recommended that SIC continue to utilize the Hawaiian Telecom STPs for SS7 services. It would also be prudent for SIC to request pricing from other SS7 providers (such as Verisign or Syniverse) and compose a transition plan to migrate away from the Hawaiian Telecom STPs if the situation with that company continues to deteriorate.

4. Explore options for Access Tandem Services:
SIC currently relies on Hawaiian Telecom to provide Access Tandem services for their voice traffic. Due to the bankruptcy proceedings currently underway for Hawaiian Telecom, SIC would like to explore alternative for these services. The only two alternatives available to SIC are to maintain the status quo by continuing to use the Hawaiian Telecom Access Tandem or to deploy their own Access Tandem.

While the Class 4 switching equipment required for an Access Tandem is not an overwhelming capital expenditure, the time and effort required to implement an Access Tandem is significant. In order to get a new Access Tandem operational, it is necessary to negotiate and coordinate with various Interexchange Carriers (IXCs) in order to get them to order circuits to the new Class 4 switch location. This process is extremely time consuming, and often times it takes one year or more to complete. In addition, it may be difficult to get some of the IXCs to agree to order circuits to a proposed SIC Access Tandem due to the small size (in terms of access lines) of the company. If SIC elects to proceed down the path of implementing a new Access Tandem, VPS recommends that they seek out assistance with regards to regulatory code work, LERG changes, ASRs, etc.

5 Network Operations Center

As part of the overall strategic network plan, it is necessary for the Network Operations Center (NOC) to be discussed. At this time, SIC has implemented a NOC in temporary facilities at their Mililani location, and VPS understands that this facility is only staffed during standard business hours. This NOC includes NMS systems for their Transport (Fujitsu), Access (Calix), and Switching (MetaSwitch) equipment. These various NMS systems provide a variety of functionality including system provisioning, alarm reporting, software upgrade services, system backup and restore, and other key features.

In addition, SIC utilizes a program called WhatsUp Gold to monitor their data networking devices. While VPS did not closely evaluate the SIC implementation of WhatsUp Gold, this program is capable of providing Layer 2/3 discovery and mapping, traffic flow monitoring, and Voice over Internet Protocol (VoIP) monitoring.

Based on the cursory level review of the NOC, VPS believes that the current setup is sufficient for the SIC network and its customers. However, there are several potential events that could lead to increased NOC requirements.

First, Waimana Enterprises has tendered an offer to acquire the Hawaiian Telecom properties. Hawaiian Telecom serves approximately 300,000 subscribers, and the additional of those properties would likely require a state-of-the-art NOC center that is staffed 24 hours per day.

Another potential network event that may require modifications to the NOC is the potential for capacity lease sales to other service providers. Depending on the size and scope of these capacity lease arrangements, it may be necessary to staff the NOC center for extended hours, if not 24 hours per day. In addition, service providers often request very strict Service Level Agreements (SLAs) for high-bandwidth capacity lease services. If such agreements are entered into, SIC may need to augment their current system provide the following:

- SLA reporting including
  - circuit uptime
  - bit error rate
  - packet loss
  - latency
  - jitter
- Customer web-portal for viewing monthly SLA reports

In addition, these customers may require that entity providing the capacity lease services provide documentation of the network operations. Based on this, SIC may be required to provide a variety of documents to the end customers including, but not limited to, the following:

- Trouble Reporting/Escalation Procedures
- Network Maintenance Notification Procedures
- Network Outage Reporting Procedures
- Disaster Recovery Planning Documentation

If SIC has not started preparing documentation to address these bullet points, they are strongly encouraged to begin this process. Regardless of whether or not they have a customer request this detail, these procedures and documentation may be good references for the NOC staff, as well as sales tools for potential capacity lease customers.

APPENDIX

Detailed Bandwidth Model

Estimating the Exaflood

Gig to the Home Insert

TFI Slides

Mobile Broadband Rate Charts

Island Maps

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Bandwidth Projection Summary

From	To	Service	GBPS 2009	GBPS 2018	GBPS 2028	Cumulative GBPS 2009	Cumulative GBPS 2018	Cumulative GBPS 2028
Hawaii	Maui	Residential	71.8	188.4	336.2			
		Business	0.3	1.9	3.9			
		Wireless	2.2	44.9	244.7			
	Military / Institutional		4.2	21.0	70.0			
			78.7	256.2	654.8			
Maui	Moloki	Residential	59.4	155.6	277.8	131.2	344.0	614.0
		Business	0.4	2.4	4.8	0.7	4.2	8.7
		Wireless	2.1	40.8	220.7	4.3	85.8	465.3
	Military / Institutional		2.7	12.0	40.0	6.9	33.0	110.0
			64.5	210.8	543.3	143.1	467.0	1,198.1
Moloki	O'ahu	Residential	2.7	7.2	12.8	133.9	351.2	626.8
		Business	0.0	0.9	3.2	0.8	5.1	11.9
		Wireless	0.0	0.0	0.0	4.3	85.8	465.3
	Military / Institutional		0.2	1.8	12.0	7.2	34.8	122.0
			3.0	9.8	28.0	146.1	476.8	1,226.0
Kauai	O'ahu	Residential	26.4	69.3	123.7			
		Business	0.2	1.0	2.2			
		Wireless	0.9	18.5	99.7			
	Military / Institutional		4.4	7.0	42.0			
			32.0	95.9	267.6			

Assumptions

90% of Residences will subscribe to a wired provider for voice, video or data
100% of Businesses will be wired for voice and data
80% of the population will have a mobile phone
Population growth is based on 1% per year, Households based on 2.28 Pop/HH
80% of residential traffic will be between islands, due to video and VOD traffic
30% of business voice and data traffic will be between islands
25% of wireless voice and data traffic will be between islands
Oversubscription rate of 20 was used for residential, business & wireless
Bandwidth Usage based on data from Technology Futures, Inc and Alcatel Lucent
Wireless capabilities are based on technology, subject to FCC release of spectrum
Tourist wireless based on Island visitor days with 80% traffic inter island
Tourist Growth is flat based on tourism data with slow growth in visitors, but for shorter duration

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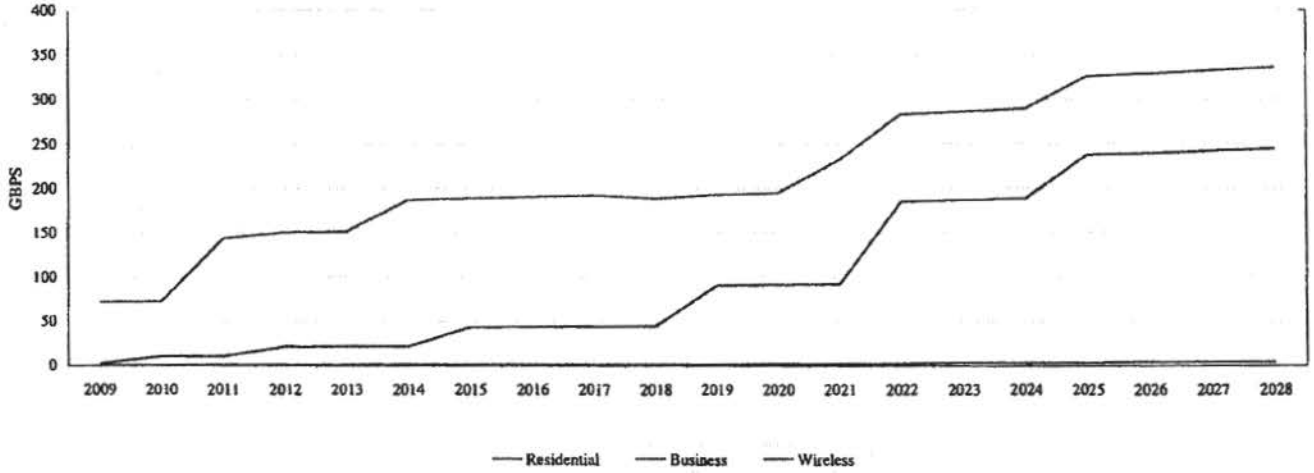
Hawaii Bandwidth (GBPS)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Residential V, V & D DS	26.32	26.32	51.54	53.64	53.64	65.19	65.19	65.19	65.19	63.09	64.14	64.14	75.69	91.44	91.44	91.44	101.94	101.94	101.94	101.94
Residential V, V & D US	0.27	0.27	0.27	0.27	2.37	2.37	7.62	7.62	7.62	7.62	7.62	18.12	22.32	22.32	22.32	25.47	25.47	25.47	25.47	25.47
20 Oversubscription DS	72	73	144	151	152	187	189	191	193	188	193	195	233	284	287	290	326	330	333	336
Oversubscription US	1	1	1	1	7	7	22	22	23	23	23	55	69	69	70	81	82	82	83	84
Business Voice and Data DS	7.92	11.07	26.82	26.82	26.82	37.32	37.32	37.32	42.57	42.57	42.57	53.07	53.07	53.07	68.82	68.82	68.82	79.32	79.32	79.32
Business Voice and Data US	3.68	3.68	11.55	11.55	11.55	11.55	16.80	16.80	16.80	16.80	16.80	16.80	16.80	32.55	32.55	32.55	32.55	32.55	32.55	32.55
20 Oversubscription DS	0	0	1	1	1	2	2	2	2	2	2	2	2	2	3	3	3	4	4	4
Oversubscription US	0	0	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
Wireless Voice & Data DS	1.14	5.34	5.34	10.59	10.59	10.59	21.09	21.09	21.09	21.09	42.09	42.09	42.09	84.09	84.09	84.09	105.09	105.09	105.09	105.09
Wireless Voice & Data US	0.26	2.36	7.61	7.61	7.61	7.61	9.71	11.81	11.81	11.81	11.81	11.81	13.91	13.91	16.01	16.01	18.11	18.11	20.21	20.21
20 Oversubscription DS	2	11	11	21	22	22	44	44	45	45	90	91	92	186	187	189	238	240	242	245
Oversubscription US	1	5	15	15	16	16	20	25	25	25	25	26	30	31	36	36	41	41	47	47

Hawaii Transport Timeline



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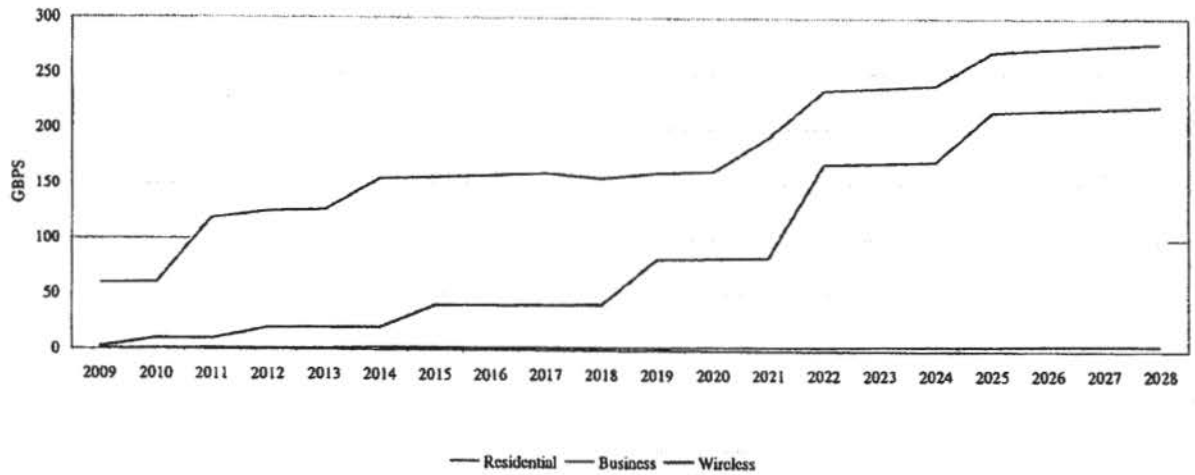
Honolulu - HI001

Maui Bandwidth (GBPS)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Residential V, V & D DS	26.32	26.32	51.54	53.64	53.64	65.19	65.19	65.19	65.19	63.09	64.14	64.14	75.69	91.44	91.44	91.44	101.94	101.94	101.94	101.94
Residential V, V & D US	0.27	0.27	0.27	0.27	2.37	2.37	7.62	7.62	7.62	7.62	7.62	18.12	22.32	22.32	22.32	25.47	25.47	25.47	25.47	25.47
20 Oversubscription DS	59	60	119	125	126	155	156	158	159	156	160	161	192	235	237	239	270	272	275	278
Oversubscription US	1	1	1	1	6	6	18	18	19	19	19	46	57	57	58	67	67	68	69	69
Business Voice and Data DS	7.92	11.07	26.82	26.82	26.82	37.32	37.32	37.32	42.57	42.57	42.57	53.07	53.07	53.07	68.82	68.82	68.82	79.32	79.32	79.32
Business Voice and Data US	3.68	3.68	11.55	11.55	11.55	11.55	16.80	16.80	16.80	16.80	16.80	16.80	16.80	32.55	32.55	32.55	32.55	32.55	32.55	32.55
20 Oversubscription DS	0	1	1	1	1	2	2	2	2	2	2	3	3	3	4	4	4	5	5	5
Oversubscription US	0	0	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
Wireless Voice & Data DS	1.14	5.34	5.34	10.59	10.59	10.59	21.09	21.09	21.09	21.09	42.09	42.09	42.09	84.09	84.09	84.09	105.09	105.09	105.09	105.09
Wireless Voice & Data US	0.26	2.36	7.61	7.61	7.61	7.61	9.71	11.81	11.81	11.81	11.81	11.81	13.91	13.91	16.01	16.01	18.11	18.11	20.21	20.21
20 Oversubscription DS	2	10	10	20	20	20	40	40	41	41	82	83	83	168	170	171	215	217	219	221
Oversubscription US	0	4	14	14	14	14	18	23	23	23	23	23	28	28	32	33	37	37	42	42

Maui Bandwidth Timeline



Sandwich Isles Communications, Inc.

Honolulu - HI001

Molokai Bandwidth (MBPS)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Residential V, V & D DS	26.32	26.32	51.54	53.64	53.64	65.19	65.19	65.19	65.19	63.09	64.14	64.14	75.69	91.44	91.44	91.44	101.94	101.94	101.94	101.94
Residential V, V & D US	0.27	0.27	0.27	0.27	2.37	2.37	7.62	7.62	7.62	7.62	7.62	18.12	22.32	22.32	22.32	25.47	25.47	25.47	25.47	25.47
20 Oversubscription DS	2,728	2,755	5,450	5,728	5,786	7,102	7,173	7,245	7,317	7,152	7,344	7,417	8,841	10,787	10,895	11,004	12,390	12,514	12,639	12,766
Oversubscription US	28	28	28	29	256	258	838	847	855	864	872	2,095	2,607	2,633	2,659	3,065	3,096	3,127	3,158	3,189
Business Voice and Data DS	7.92	11.07	26.82	26.82	26.82	37.32	37.32	37.32	42.57	42.57	42.57	53.07	53.07	53.07	68.82	68.82	68.82	79.32	79.32	79.32
Business Voice and Data US	3.68	3.68	11.55	11.55	11.55	11.55	16.80	16.80	16.80	16.80	16.80	16.80	16.80	32.55	32.55	32.55	32.55	32.55	32.55	32.55
20 Oversubscription DS	18	26	63	64	65	91	92	93	107	108	109	137	139	140	184	185	187	218	220	222
Oversubscription US	9	9	27	28	28	28	41	42	42	43	43	43	44	86	87	88	89	89	90	91
Wireless Voice & Data DS	1.14	5.34	5.34	10.59	10.59	10.59	21.09	21.09	21.09	21.09	42.09	42.09	42.09	84.09	84.09	84.09	105.09	105.09	105.09	105.09
Wireless Voice & Data US	0.26	2.36	7.61	7.61	7.61	7.61	9.71	11.81	11.81	11.81	11.81	11.81	13.91	13.91	16.01	16.01	18.11	18.11	20.21	20.21
20 Oversubscription DS	138	651	656	1,312	1,323	1,333	2,678	2,700	2,722	2,744	5,523	5,568	5,615	11,311	11,405	11,500	14,492	14,614	14,736	14,860
Oversubscription US	21	192	624	629	634	639	822	1,008	1,016	1,025	1,033	1,042	1,237	1,248	1,448	1,460	1,665	1,679	1,890	1,905

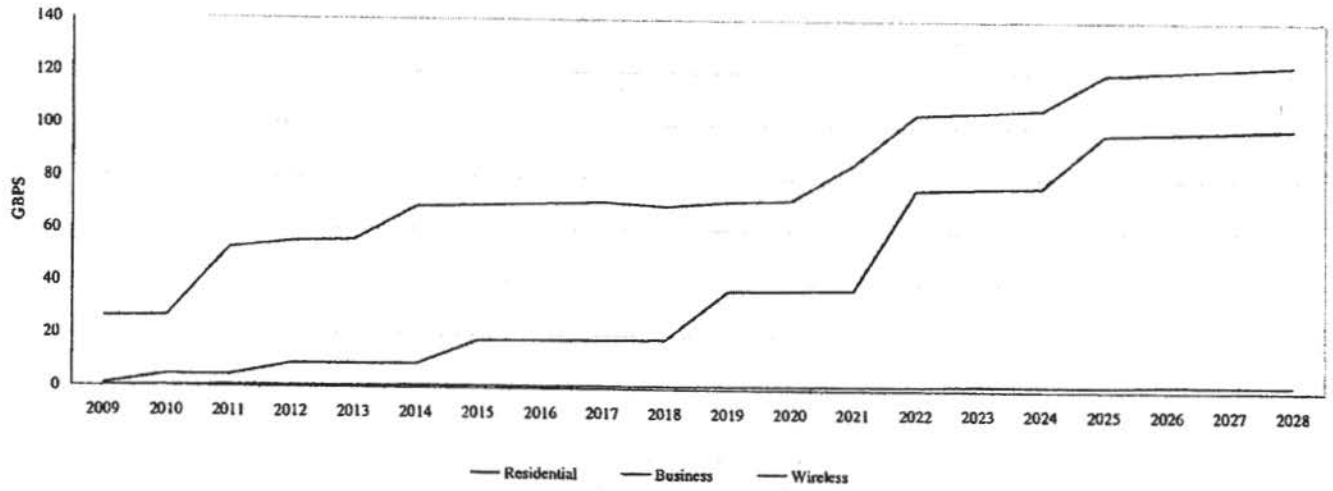
Sandwich Isles Communications, Inc.

Honolulu - HI001

Kauai Bandwidth (GBPS)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Residential V, V & D DS	26.32	26.32	51.54	53.64	53.64	65.19	65.19	65.19	65.19	63.09	64.14	64.14	75.69	91.44	91.44	91.44	101.94	101.94	101.94	101.94
Residential V, V & D US	0.27	0.27	0.27	0.27	2.37	2.37	7.62	7.62	7.62	7.62	7.62	18.12	22.32	22.32	22.32	25.47	25.47	25.47	25.47	25.47
20 Oversubscription DS	26	27	53	56	56	69	70	70	71	69	71	72	86	105	106	107	120	121	123	124
Oversubscription US	0	0	0	0	2	3	8	8	8	8	8	20	25	26	26	30	30	30	31	31
Business Voice and Data DS	7.92	11.07	26.82	26.82	26.82	37.32	37.32	37.32	42.57	42.57	42.57	53.07	53.07	53.07	68.82	68.82	68.82	79.32	79.32	79.32
Business Voice and Data US	3.68	3.68	11.55	11.55	11.55	11.55	16.80	16.80	16.80	16.80	16.80	16.80	16.80	32.55	32.55	32.55	32.55	32.55	32.55	32.55
20 Oversubscription DS	0	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
Oversubscription US	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
Wireless Voice & Data DS	1.14	5.34	5.34	10.59	10.59	10.59	21.09	21.09	21.09	21.09	42.09	42.09	42.09	84.09	84.09	84.09	105.09	105.09	105.09	105.09
Wireless Voice & Data US	0.26	2.36	7.61	7.61	7.61	7.61	9.71	11.81	11.81	11.81	11.81	11.81	13.91	13.91	16.01	16.01	18.11	18.11	20.21	20.21
20 Oversubscription DS	1	4	4	9	9	9	18	18	18	18	37	37	38	76	77	77	97	98	99	100
Oversubscription US	0	2	6	6	6	6	8	10	10	10	10	11	12	13	15	15	17	17	19	19

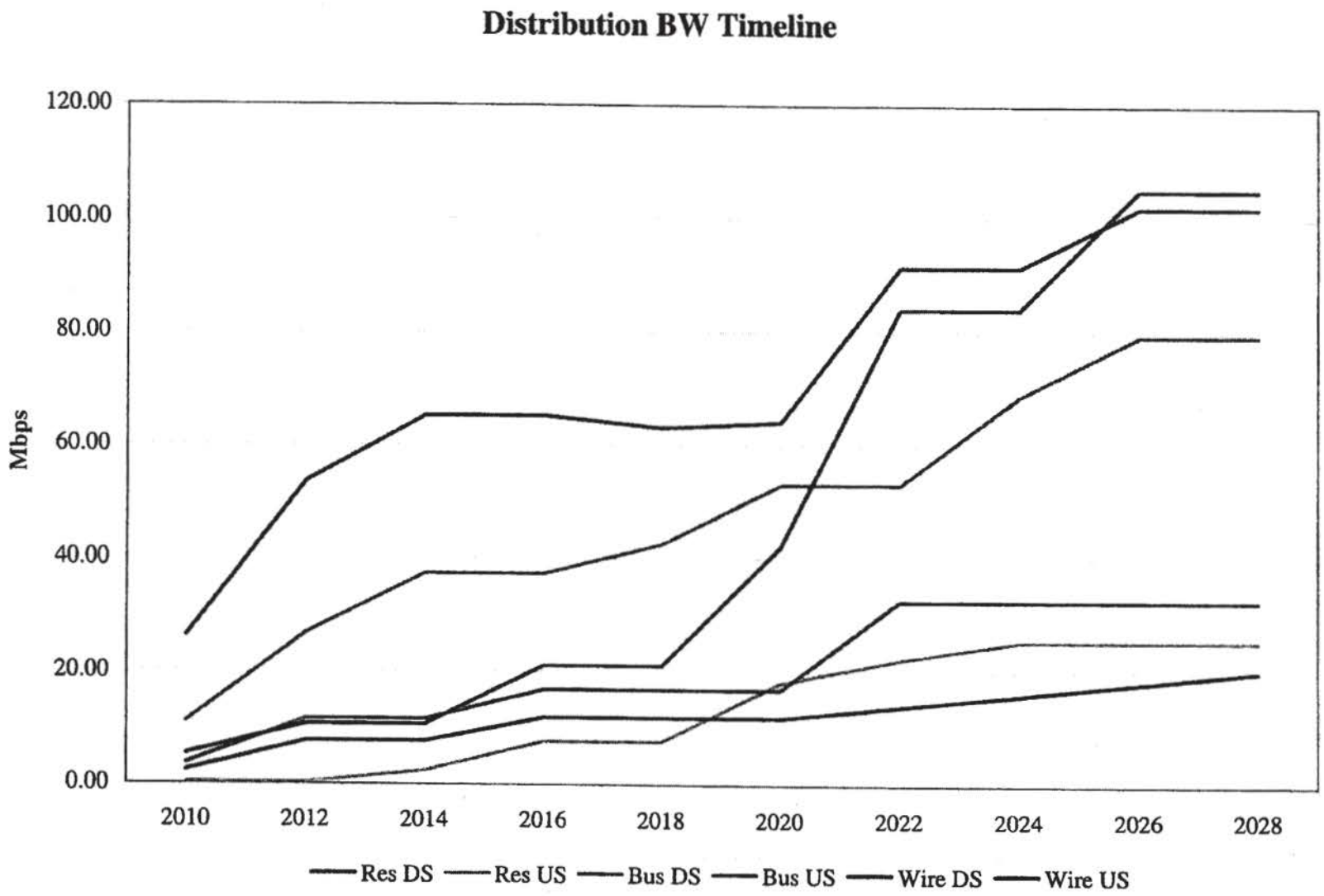
Kauai Bandwidth Timeline



Sandwich Isles Communications, Inc.

Honolulu - HI001

Traditional, Voice, Video & Data		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Island	Households																				
Hawaii	75,189	75,835	76,593	77,359	78,132	78,914	79,703	80,500	81,305	82,118	82,939	83,769	84,606	85,452	86,307	87,170	88,042	88,922	89,811	90,709	91,616
Maui	61,623	62,655	63,282	63,915	64,554	65,200	65,851	66,510	67,175	67,847	68,525	69,211	69,903	70,602	71,308	72,021	72,741	73,468	74,203	74,945	75,695
Molokai (Est.)	2,000	2,879	2,908	2,937	2,967	2,996	3,026	3,057	3,087	3,118	3,149	3,181	3,212	3,245	3,277	3,310	3,343	3,376	3,410	3,444	3,479
O'ahu	332,726	403,053	407,084	411,155	415,266	419,419	423,613	427,849	432,128	436,449	440,814	445,222	449,674	454,171	458,712	463,299	467,932	472,612	477,338	482,111	486,932
Kauai	28,321	27,910	28,189	28,471	28,755	29,043	29,333	29,627	29,923	30,222	30,524	30,830	31,138	31,449	31,764	32,081	32,402	32,726	33,054	33,384	33,718
POP/HH	2.28																				
Business Voice & Data																					
	Businesses																				
Hawaii	3,929	4,074	4,115	4,156	4,198	4,240	4,282	4,325	4,368	4,412	4,456	4,500	4,545	4,591	4,637	4,683	4,730	4,777	4,825	4,873	4,922
Maui	4,295	3,366	3,400	3,434	3,468	3,503	3,538	3,573	3,609	3,645	3,681	3,718	3,755	3,793	3,831	3,869	3,908	3,947	3,986	4,026	4,067
Molokai (Est.)	153	155	156	158	159	161	163	164	166	168	169	171	173	174	176	178	180	181	183	185	187
O'ahu	21,439	21,653	21,870	22,089	22,310	22,533	22,758	22,986	23,215	23,448	23,682	23,919	24,158	24,400	24,644	24,890	25,139	25,390	25,644	25,901	26,160
Kauai	1,897	1,499	1,514	1,530	1,545	1,560	1,576	1,592	1,608	1,624	1,640	1,656	1,673	1,690	1,706	1,724	1,741	1,758	1,776	1,794	1,811
POP/Bus	42.44																				
Mobile Voice & Data																					
	Population																				
Hawaii	171,191	172,903	174,632	176,378	178,142	179,923	181,723	183,540	185,375	187,229	189,101	190,992	192,902	194,831	196,780	198,747	200,735	202,742	204,770	206,817	208,886
Maui	141,440	142,854	144,283	145,726	147,183	148,655	150,141	151,643	153,159	154,691	156,238	157,800	159,378	160,972	162,582	164,207	165,850	167,508	169,183	170,875	172,584
Molokai (Est.)	6,500	6,565	6,631	6,697	6,764	6,832	6,900	6,969	7,039	7,109	7,180	7,252	7,324	7,398	7,472	7,546	7,622	7,698	7,775	7,853	7,931
O'ahu	909,863	918,962	928,151	937,433	946,807	956,275	965,838	975,496	985,251	995,104	1,005,055	1,015,105	1,025,256	1,035,509	1,045,864	1,056,323	1,066,886	1,077,555	1,088,330	1,099,214	1,110,206
Kauai	63,004	63,634	64,270	64,913	65,562	66,218	66,880	67,549	68,224	68,907	69,596	70,292	70,994	71,704	72,421	73,146	73,877	74,616	75,362	76,116	76,877
POP Growth	1%																				
Tourist Wireless	186,965	Represents the Visitors per day on the islands																			
Hawaii	16%	23,932																			
Maui	25%	37,393																			
Molokai (Est.)	1%	1,496																			
O'ahu	46%	68,803																			
Kauai	12%	17,949																			
Inter Island Traffic	80%																				


Distribution BW Timeline
Mbps
120.00
100.00
80.00
60.00
40.00
20.00
0.00
2010
2012
2014
2016
2018
2020
2022
2024
2026
2028
Res DS
Res US
Bus DS
Bus US
Wire DS
Wire US

Sandwich Isles Communications, Inc.

Honolulu - HI001

Residential Bandwidth Timeline

ADVANCED SERVICES

DOWNSTREAM	Mb per Stream	2009 Total	2010 Total	2011 Total	2012 Total	2013 Total	2014 Total	2015 Total	2016 Total	2017 Total	2018 Total	2019 Total	2020 Total	2021 Total	2022 Total	2023 Total	2024 Total	2025 Total	2026 Total	2027 Total
Voice (Switched)	0.064	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Voice (VoIP)	0.084	0.00	0.00	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Local Dial-up Data Access	0.064	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Data - Broadband	0.256	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Data - Broadband	0.384	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Data - Broadband	1.000	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Data - Broadband	2.000	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Data - Broadband	4.000	0.00	0.00	0.00	4.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Data - Broadband	15.000	0.00	0.00	0.00	0.00	0.00	15.00	15.00	15.00	15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Data - Broadband	25.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	25.00	25.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00
Data - Broadband	40.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	40.00	40.00	0.00	0.00	0.00
Data - Broadband	50.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.00	50.00	50.00
Video - DTV (Mpg4)	2.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	4.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Video - HDTV (Mpg4)	8.000	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	8.00	8.00	8.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
Video - HD VoD (Mpeg4)	8.000	0.00	0.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
Video - PVR (Mpg4)	2.000	0.00	0.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Home Networking	0.250	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gaming/Surveillance	5.000	0.00	0.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Downstream Contingency	5%																			
UPSTREAM																				
P2P	0.500	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VPN	0.500	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Interactive Gaming	0.250	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Internet Upstream	0.256	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Internet Upstream	1.000	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Internet Upstream	5.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Social Networking	10.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
SlingBox or Device Placement	1.000	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Internet Upstream	10.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Remote Desktop Control	0.256	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Video Monitoring/Surveillance	5.000	0.00	0.00	0.00	0.00	0.00	0.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Video Conferencing	3.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	3.00	3.00	3.00
Upstream Contingency	5%																			

ADVANCED SERVICES	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Total BW Rqmts - DS	26.32	26.32	51.54	53.64	53.64	65.19	65.19	65.19	65.19	63.09	64.14	64.14	75.69	91.44	91.44	91.44	101.94	101.94	101.94
Total BW Rqmts - US	0.27	0.27	0.27	0.27	2.37	2.37	7.62	7.62	7.62	7.62	7.62	18.12	22.32	22.32	22.32	25.47	25.47	25.47	25.47

Sandwich Isles Communications, Inc.

Honolulu - HI001

Business Bandwidth Timeline

ADVANCED SERVICES

DOWNSTREAM	Mb per Stream	2009 Total	2010 Total	2011 Total	2012 Total	2013 Total	2014 Total	2015 Total	2016 Total	2017 Total	2018 Total	2019 Total	2020 Total	2021 Total	2022 Total	2023 Total	2024 Total	2025 Total	2026 Total	2027 Total	2028 Total
Voice (Switched)	0.064	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Total
Voice (VoIP)	0.084	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Local Dial-up Data Access	0.064	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Data - Broadband - T1	1.544	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54
Data - Broadband	4.000	4.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Data - Broadband	5.000	0.00	0.00	5.00	5.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Data - Broadband	8.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Data - Broadband	10.000	0.00	0.00	0.00	0.00	0.00	10.00	10.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Data - Broadband	15.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	15.00	15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Data - Broadband	25.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	25.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00
Data - Broadband	40.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	40.00	40.00	0.00	0.00	0.00
Data - Broadband	50.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.00	50.00	50.00
Video - DTV (Mpg4)	2.000	2.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Video - HDTV (Mpg4)	8.000	0.00	0.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Video - HD VoD (Mpeg4)	8.000	0.00	0.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Video - PVR (Mpg4)	2.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Video Conferencing SD	3.000	0.00	3.00	3.00	3.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Video Conferencing HD	8.000	0.00	0.00	0.00	0.00	0.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Downstream Contingency	5%																				
UPSTREAM																					
P2P	0.500	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VPN - .5	0.500	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VPN - 5	5.000	0.00	0.00	5.00	5.00	5.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VPN - 10	10.000	0.00	0.00	0.00	0.00	0.00	0.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VPN - 25	25.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Interactive Gaming	0.250	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Email/E-Commerce/Blogging	0.256	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SlingBox or Device Placement	0.256	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.256	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Remote Desktop Control	0.256	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Video Monitoring/Surveillance	3.000	0.00	0.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Video Conferencing	3.000	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Upstream Contingency	5%																				0.00

ADVANCED SERVICES	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Total BW Rqmts - DS	7.92	11.07	26.82	26.82	26.82	37.32	37.32	37.32	42.57	42.57	42.57	53.07	53.07	53.07	68.82	68.82	68.82	79.32	79.32	79.32
Total BW Rqmts - US	3.68	3.68	11.55	11.55	11.55	11.55	16.80	16.80	16.80	16.80	16.80	16.80	16.80	32.55	32.55	32.55	32.55	32.55	32.55	32.55

Sandwich Isles Communications, Inc.

Honolulu - HI001

Wireless Bandwidth Timeline

ADVANCED SERVICES

DOWNSTREAM	Mb per Stream	2009 Total	2010 Total	2011 Total	2012 Total	2013 Total	2014 Total	2015 Total	2016 Total	2017 Total	2018 Total	2019 Total	2020 Total	2021 Total	2022 Total	2023 Total	2024 Total	2025 Total	2026 Total	2027 Total	2028 Total
Voice (Switched)	0.064	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Voice (VoIP)	0.084	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Local Dial-up Data Access	0.064	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Data - Broadband	1.000	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Data - Broadband	5.000	0.00	5.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Data - Broadband	10.000	0.00	0.00	0.00	10.00	10.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Data - Broadband	20.000	0.00	0.00	0.00	0.00	0.00	0.00	20.00	20.00	20.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Data - Broadband	40.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	40.00	40.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Data - Broadband	80.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	80.00	80.00	80.00	0.00	0.00	0.00	0.00
Data - Broadband	100.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	100.00	100.00
Data - Broadband	200.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Data - Broadband	400.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Video - DTV (Mpg4)	0.356	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Video - HDTV (Mpg4)	1.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Video - HD VoD (Mpeg4)	1.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Video - PVR (Mpg4)	2.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Home Networking	0.250	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gaming	0.250	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Downstream Contingency	5%																				
UPSTREAM																					
P2P	0.500	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VPN	3.000	0.00	0.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Interactive Gaming	0.250	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Email/E-Commerce/Blogging	1.000	0.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
SlingBox or Device Placement	0.256	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.256	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Remote Desktop Control	0.256	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Video Monitoring/Surveillance	.000	0.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Video Conferencing	2.000	0.00	0.00	2.00	2.00	2.00	2.00	2.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	6.00	6.00	8.00	8.00	10.00	10.00
Upstream Contingency	5%																				

ADVANCED SERVICES	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Total BW Rqmts - DS	1.1382	5.3382	5.3382	10.5882	10.5882	10.5882	21.0882	21.0882	21.0882	21.0882	42.0882	42.0882	42.0882	84.0882	84.0882	84.0882	105.088	105.088	105.088	105.088
Total BW Rqmts - US	0.2625	2.3625	7.6125	7.6125	7.6125	7.6125	9.7125	11.8125	11.8125	11.8125	11.8125	11.8125	13.9125	13.9125	16.0125	16.0125	18.1125	18.1125	20.2125	20.2125