AIS Success Journey

Thoth Advisory Perspective on Advanced Information System

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Chapter 1. Executive Summary

1.1. Objective and Methodology of this Report

The objective of this Report is to provide an analysis of the AIS success journey by understanding into AIS's business strategy and the strategic decisions that the operator has made relative to three key areas:

1. From the inception of 4G through 5G, has applied the strategy of rapid deployment of network
2. The consumer business, what leads to the current pricing
3. Enterprise business, what is the strategy and what is the logic behind it

Thoth Advisory developed a financial model (Income Statement, Cash Flow, Balance Sheet, and Capital Expenditures) in order to better understand the underlying dynamics (ARPU, subscribers, 4G migration, 5G adoption, RAN energy consumption) driving and defining the boundaries for the business to grow.

1.2. Key findings and Conclusions

AIS will continue to be a revered consumer brand as it adopts innovative services based on advanced fixed and a mobile 5G platform

Known for its award-winning customer services, AIS offers a premium 5G mobile lifestyle experience targeting upper middle class and discerning customers. Comprising extraordinary network coverage, resilience, speed innovative entertainment options, etc. and exceptional loyalty programs with the long standing Serenade brand, provides a revered brand.

AIS is positioning itself to become the go to 5G enterprise/industrial provider

AIS is carefully crafting and implementing a strategy to become the go to provider for 5G private networking, mobile edge and network slicing built on Standalone 5G NR for enterprises and industries. The timeline for this strategy is 3-5 years as AIS understands that 5G enterprise represents a totally new source of revenue and one that will require 5G network performance and quality to be top notch in order to win the confidence of industries and operations technology.

AIS has built a solid data center network with disaster recovery and redundancy split across four regions nationwide

The Thai Data Center (DC) market is heating up with both TRUE and AIS competing with traditional DC providers such as NTT, Telehouse, and others. Hyperscale providers such as Google, Alibaba, and AWS are also establishing edge/cloud regions in Thailand.

For the two leading telecom operators, AIS and TRUE, there is pent-up demand to offer wholesale co-location services. In February 2022, AIS announced the Joint Development Agreement JDA with **Gulf Energy Development Plc Gulf** and **Singapore Telecommunications Limited (Singtel)** to jointly establish a data center business. After that in July 2022, AIS announced the establishment of a subsidiary company **AIS DC Venture Company Limited** (to invest in joint data center business on behalf of AIS).

For AIS, apart from co-location services, data storage, data monetization, and data analytics will become competitive differentiators through service quality and performance. AIS is investing in its data center, data management and storage architecture infrastructure. As 5G will increase the demands on data center and storage AIS will be in a good position to ensure the data center and data storage systems can keep up with the pace of 5G adoption. Mobile Edge (Multi-Access Edge) for 5G will also become a key differentiator for AIS.

Mobile ARPU growth will be challenging but a duopoly market might reduce pressure from 2024 to buy market share with freebies.

Between 2019A – 2022AE mobile ARPUs have continued to decline as AIS has offered more data for the same price due to severe competition. Additionally, working against ARPU growth was an estimated 30% of subscribers on ultra-low (Baht 150/month) pre-paid plans. We expect these low-price plans will be replaced with higher plans from 2023. At the same time that this is occurring, AIS has been able to achieve rapid migration from 4G to 5G and in particular has achieved a robust post-paid 5G adoption. AIS reported at end of 4Q22 that 5G will represent 15% of total subscriber base, up from 5% in 2021A. Thoth Advisory estimates this will grow to 19% in 2023E. AIS currently has four network technologies in operation: 2G, 3G, 4G and 5G. AIS has not announced when it will carry out the 3G shutoff and Thoth Advisory projects that all the operators will only do so if given guidance from the NBTC. By deploying wideband tranreceivers AIS can reduce electricity costs on its 2G/3G/4G network to allow it to focus on energy usage in the new 5G infrastructure.

The reopening of Thailand to travelers has resurrected the prepaid SIM traveler short-term SIM cards and roaming mobile revenues. Prepaid and post-paid subscribers grew 2.6% and 9% ToT, respectively. In Chapter 2 we provide a more detailed analysis of the revenue, ARPUs and subscriber projections.

Figure 1-1 AIS Operating Statistics

AIS (CONSOLIDATED)		OPERATING STATISTICS									
OPERATING STATISTICS		**2019A**	**2020A**	**2021A**	**2022A**	**2023E**	**2024E**	**2025E**	**2026E**	**2027E**	**CAGR 23-27**
Fixed Broadband Subscribers	[000]	**1,037**	**1,337**	**1,772**	**2,169**	**4,631**	**4,821**	**5,091**	**5,295**	**5,464**	20.3%
% Annual Growth	[%]		**28.9%**	**32.5%**	**22.4%**	**113.5%**	**4.1%**	**5.6%**	**4.0%**	**3.2%**	
Net Adds	[000]		**300**	**435**	**397**	**2,462**	**190**	**270**	**204**	**169**	
Total Mobile Subscribers	[000]	**42,014**	**41,437**	**44,117**	**46,013**	**46,968**	**48,642**	**50,622**	**52,628**	**54,567**	3.5%
% Annual Growth	[%]	**2.1%**	**-1.4%**	**6.5%**	**4.3%**	**2.1%**	**3.6%**	**4.1%**	**4.0%**	**3.7%**	
5G Subscribers	[000]	-	239	2,200	6,830	8,968	11,915	15,244	18,395	21,323	25.6%
% Annual Growth	[%]		-	**820.5%**	**210.5%**	**31.3%**	**32.9%**	**27.9%**	**20.7%**	**15.9%**	
5G % of total mobile subscribers	[%]		1%	5%	15%	19%	24%	30%	35%	39%	
Total Post-Paid Subscribers	[000]	**9,107**	**10,192**	**11,522**	**12,560**	**11,587**	**12,429**	**13,315**	**14,171**	**14,895**	3.5%
Total Post-paid as % of total subscribers	[%]	22%	25%	26%	27%	25%	26%	26%	27%	27%	
5G Post-paid Subscribers	[000]	-	56	554	1,841	2,645	3,550	4,587	5,591	6,546	28.9%
5G Post-paid as % of total 5G subscribers	[%]		24%	25%	27%	30%	30%	30%	30%	31%	
3G/4G Post-Paid Subscribers	[000]	6,251	6,985	7,657	8,698	8,942	8,879	8,728	8,580	8,350	-0.8%
Total Pre-paid subscribers	[000]	**32,906**	**31,244**	**32,595**	**33,453**	**35,381**	**36,213**	**37,307**	**38,458**	**39,672**	3.5%
3G/4G Pre-paid Subscribers	[000]	35,763	34,213	34,259	30,485	29,059	27,848	26,650	25,654	24,895	-4.0%
5G Pre-Paid Subscribers	[000]	-	183	1,646	4,989	6,322	8,365	10,656	12,804	14,777	24.3%
FBB ARPU	[THB]	**473.9**	**483.5**	**447.1**	**422.0**	**344.4**	**293.1**	**294.0**	**293.4**	**289.2**	-7.3%
% Annual Growth	[%]	**2.1%**	**2.0%**	**-7.5%**	**-5.6%**	**-18.4%**	**-14.9%**	**0.3%**	**-0.2%**	**-1.4%**	
Mobile Blended ARPU	[THB]	**252.0**	**234.0**	**224.0**	**213.0**	**202.1**	**193.9**	**187.6**	**182.7**	**178.8**	-3.4%
% Annual Growth	[%]	**2.1%**	**-7.1%**	**-4.3%**	**-4.9%**	**-5.1%**	**-4.1%**	**-3.3%**	**-2.6%**	**-2.1%**	
Post-Paid ARPU	[THB]	**537.0**	**486.0**	**473.0**	**455.0**	**476.4**	**470.4**	**466.1**	**452.4**	**439.3**	-0.7%
% Annual Growth	[%]	**2.1%**	**-9.5%**	**-2.7%**	**-3.8%**	**4.7%**	**-1.3%**	**-0.9%**	**-2.9%**	**-2.9%**	
Pre-paid ARPU	[THB]	**173.0**	**154.0**	**136.0**	**123.0**	**137.6**	**127.1**	**119.6**	**113.1**	**106.3**	-2.9%

Source: AIS historicals, Thoth Advisory estimates.

The fixed broadband and enterprise business will help to buoy the revenue equation at AIS by capturing the pent-up demand for broadband (and content)

At the end of 2019A the fixed broadband + enterprise business accounted for 7.5% of total revenue. Fixed broadband (FBB) and enterprise business grew 19.3% and 18.6% respectively in 2022 YoY. The acquisition of **Triple T Broadband (TTTBB)** is expected to completed in 1H23 which will propel AIS to parity with TRUE Corp. In terms of FBB market share. That said, Thoth Advisory does not expect FBB ARPUs to increase anytime soon as there is still downward pressure on ARPUs driven by low end packages being offered by the operators, presumably to grow market share. We should also note that in 2022 AIS derived Baht 12.976 billion from Interconnection charges and **National Telephone Public Company (NT)** (NT was created in 1Q22 by the merger of state-owned companies CAT and TOT) partnership but this decreased -6.1% YoY due to lower network traffic with NTPC.

The acquisition of Triple T Broadband (TTTBB) (also known by the brand name "3BB") from **JAS** (Jasmine international), which is costing Baht 19.5 billion, will also drive up AIS' market share of total revenue to 17.2% in 2023E. Thoth Advisory estimates AIS could need to spend between Baht 1-1.5 billion annually for 2-3 years to integrate the 3BB network into AIS' Fibre network and to migrate xDSL users (Thoth Advisory estimates that about 40% of 3BB's subscribers are xDSL). AIS is expected to fund the Triple T Broadband acquisition with debt. As part of the acquisition deal with JAS, AIS will also purchase 19% stake in **JASIF (Jasmine Broadband Internet Infrastructure Fund)** for Baht 12.92 billion. The deal is pending approval from the NBTC (successor to the NTC). There are two regulations on the books that will need to be complied with in order to receive approval: the 2006 Notification of the National Telecommunications Commission (NTC) regarding measures for the prevention of monopoly or unfair competition in the telecommunications business and the amended Telecom Business Act of 2018.

Section 4.1 provides analysis of the fixed broadband business.

FBB provides a platform from which AIS will grow its digital content services business but we expect AIS to take a conservative approach in terms of content acquisition costs

In terms of Digital Content Services, AIS has taken an approach of bundling some free content and using the consumer spending on the monthly connectivity plan as a foundation. AIS offers bundles on the FBB to post-paid 5G AIS subscribers, for example. During the COVID-19 pandemic, AIS cost its marketing expenses by 9% but we expect this to see YoY growth from 2023 onwards. As a result, AIS has taken a cautious approach to content acquisition because if AIS or for that matter any other operator is too aggressive they could end up with significant liabilities that are brought on by global content (famous content brands) and sports channels which often demand the operator commit to a certain number of subscriptions.

Consumer 5G business strategy is cautiously conservative for the time being

With over 115,000 4G BTS and roughly 26,000 5G NR BTS at end of 3Q22, AIS needs another 2-3 years to achieve the kind of network density that would support mass uptake of AR/VR and mobile gaming high-bandwidth services. Thus, in order not to create excessive expectations as what occurred in South

Korea in 2019 with new 5G users, AIS is introducing the new and exciting services and products such as AR/R but it is doing it in relatively low-key approach.

Thus, the consumer 5G strategy appears to be focused on a "better 4G than 4G" and at the same time offering the latest handsets from Apple and other vendors. The cost of the mass market 5G handsets is still a sort of impediment to faster 5G uptake and will accelerate if 5G mid-market handset prices can continue to come down against the backdrop of global inflation.

In 2H23 or 1H24 Thoth Advisory expects that AIS will start to rollout mmWave services for mmWave devices including dual-mode mobile devices. This strategy is similar to what NTT DoCoMo is doing with mmWave dual-mode (C-band + mmWave band) handsets. AIS will most likely position mmWave as an "ultra-fast" service. We not that this is only possible because of the Standalone architecture.

AIS's balance sheet and cash flow should be able to support levels of capex spending on the order of Baht 28-30+ billion per year out to 2027E

CAPEX for 2022A was reported at Baht 32.313 billion up 25.3% YoY. While some of the Southeast Asia regional counterparts have been struggling to maintain free cash flows to fund 5G network buildout, AIS has been able to maintain healthy balance sheet during the three years of the pandemic, and the pattern of prudent management continues at the operator it will be able to support 5G network construction and expansion and put the pressure on TRUE/DTAC.

AIS is also building a Multi-access Edge Computing (MEC) footprint initially targeting the enterprise market such as industrial parks. We forecast that the EBITDA margin will remain high at between 47%-51% during the 2023E-2027E period (See figure 1-2). Marketing expenses will come back up now that the pandemic has subsided. The one challenge that is a new one for AIS is the rising utility costs due to global inflationary pressure and geopolitical volatilities. As a result, the company will need to look to its technology war chest and accelerate automation across its network domains – optics, RAN, packet core, OSS/BSS and digital e-commerce and content platforms. AIS is expected give cybersecurity and sustainability high priorities in the coming years which means that security of each network domain and energy consumption/savings of each domain will also receive considerable attention.

Figure 1-2 AIS Financial Ratios and capital structure

AIS		FINANCIAL RATIOS									
FY Ending 31 December		2019A	2020A	2021A	2022A	2023E	2024E	2025E	2026E	2027E	CAGR 23-27
Current Ratio	[X]	0.45	0.45	0.39	0.36	0.32	0.31	0.27	0.32	0.40	2.5%
Quick ratio	[X]	0.38	0.41	0.32	0.28	0.32	0.31	0.27	0.32	0.40	7.6%
Earnings Per Share	[X]	10.44	9.17	9.05	8.75	9.94	11.01	11.10	10.79	10.65	4.0%
EBITDA Margin	[X]	43.3%	51.7%	50.4%	48.4%	50.7%	50.5%	49.8%	48.8%	47.5%	
Dividens Per Share	[X]	7.34	7.05	7.39	7.97	7.97	7.97	7.97	7.97	7.97	
	[X]										
Return on Assets	[X]	10.8%	7.9%	7.6%	7.7%	9.2%	10.6%	11.2%	11.1%	11.1%	7.6%
Return on Fixed Assets	[X]	13.0%	8.9%	8.4%	8.6%	10.2%	11.8%	12.4%	12.6%	13.0%	8.7%
ROE as at end of period	[X]	44.8%	36.1%	33.0%	30.4%	34.2%	37.9%	38.2%	37.1%	36.7%	3.8%
	[X]										
Debt/Equity	[X]	3.17	3.63	3.35	2.93	3.03	2.99	2.83	2.54	2.29	-4.8%
Interest Coverage Ratio (EBIT/Interest Paid in One Year)	[X]	13.28	8.94	10.34	10.94	6.45	6.34	5.94	6.80	7.92	-6.3%
Net Debt, Lease liabilities & Spectrum liabilities to EBITDA	[X]	2.22	2.33	2.13	2.08	1.90	1.75	1.47	1.21	1.03	-13.0%
Net Debt to EBITDA	[X]	0.90	0.97	0.98	0.94	1.08	1.03	0.99	0.81	0.64	-7.5%
Net Debt/Equity	[X]	1.06	1.19	1.09	0.98	1.85	2.06	2.00	1.23	0.77	-4.8%

Source: AIS Historicals, Thoth Advisory estimates, 2023.

Enterprise 5G business strategy holds promise for AIS as AIS is starting from a relatively small presence in the enterprise market

Standalone 5G NR was a critical decision that the operator made and has positioned it in a leadership position by building an enterprise 5G platform that will offer network slicing, private networking and mobile edge resources. As of 4Q22, enterprise services including MPLS, VPN and SD-WAN accounted for only 3.4% of total revenue at AIS.

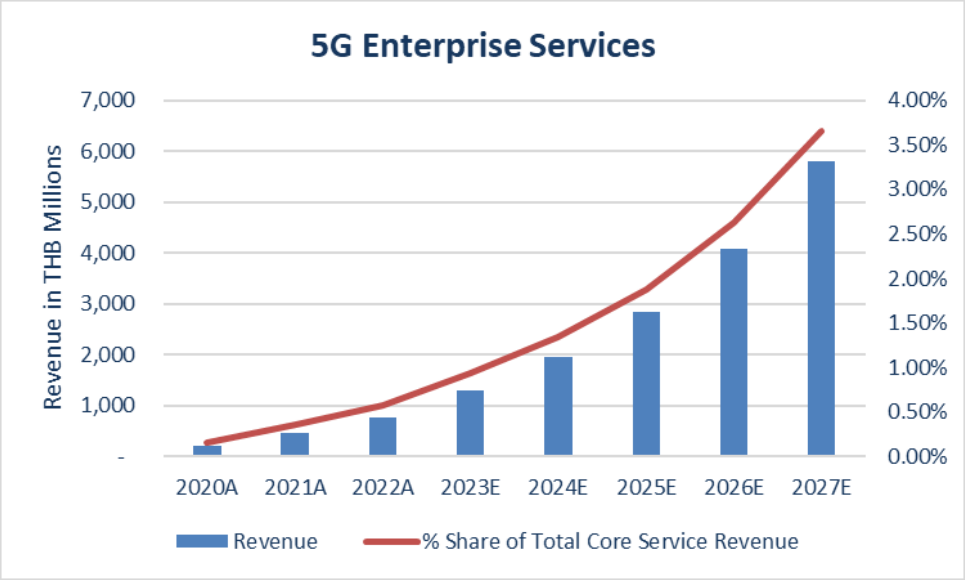
AIS is very active in collaborations with hospitals, manufacturing, and service industries to develop 5G private networking and also to position networking slicing over the AIS-owned spectrum.

For AIS, 5G enterprise services presents significant upside as a new source of revenue tied directly to the economic growth of Thailand's key industries including tourism, healthcare, discrete and process manufacturing, retail, and agriculture. We believe that AIS is well positioned to be the market leader in 5G enterprise services. For AIS there are/will be five sources of 5G enterprise income:

1. **5G (Redcap etc.) M2M Services**
2. **5G SIM cards to corporates**
3. **Enterprise 5G FWA Services** – target will be SMEs principally
4. **Mobile Edge Services** – selling compute and storage resources as a leasing model similar to cloud
5. **5G Private Networking** – managed services and system integration (most likely as collaborations with IT companies)
6. **5G Network slicing** – providing B2C consumer and B2B enterprise slicing over the macro and indoor networks owned and operated AIS.

In Figure 1-2 we provide a view of the potential revenue contribution that 5G enterprise services could provide to AIS to further help its mid- and long-term topline outlook.

Figure 1-3 5G Enterprise Mobile Services could provide as much as 3.6% of total Core Service revenue in 2027E



Note: AIS does not report 5G enterprise services; We have assumed market share of AIS is in the range of 35-55% depending on the enterprise service
Source: Thoth Advisory estimates, 2023

Chapter 2. The AIS Digital Transformation Journey

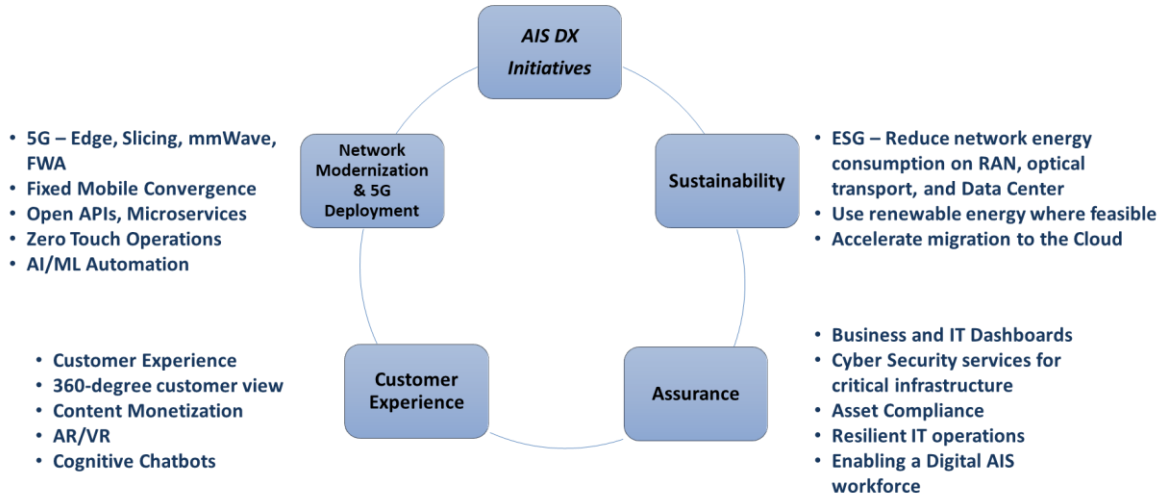
2.1. AIS's Digital Strategy

AIS senior leadership understands that the Digital Transformation journey is an imperative to move beyond selling traditional connectivity by providing Thai customers with a software-enabled and platform-based ecosystem that can be leveraged to create new services for enterprise and vertical opportunities. With enterprise at present accounting for less than 4% of total revenue, AIS is looking to capitalize on 5G to build a 5G enterprise business including 5G-based IoT over the next 2-3 years in order to complement the fixed broadband/IPTV foundational business that AIS has built. The acquisition of 3BB and CS Loxinfo is playing a strategic role in enabling AIS to grow faster.

DX that address the customer omni-channel, automation and back-office operations will enable AIS to better utilize its CAPEX budget going forward which was raised in 2022E. Thoth Advisory expects that AIS will be able to maintain elevated levels of CAPEX (around Baht 30 billion per year) in order to densify its network in urban centers while at the same time achieving >90% coverage of population with its Band n28 700 MHz spectrum.

Containing costs has become even more critical with the current global inflationary pressures caused by rising fuel prices. To that end, AIS is, as suggested above, looking to deploy automation and AI/ML in the network as well in the IT back-end systems to improve customer experience and to implement assurance – reliability, quality of service and resiliency. Finally, sustainability has become an important set of targets for the senior leadership since 2020 and AIS is executing on two fronts: energy saving/reduction and renewable energy. In the next section we elaborate on the key pillars of AIS's DX strategy.

Figure 2-1 Key pillars of AIS's Digital Transformation strategy



Source: Thoth Advisory, 2023

2.2. AIS's DX Strategy

In AIS's own words, the company has transformed itself to "Digital Life Service Provider" by operating three core businesses in the telecom industry (See Figure 2-2). AIS provides mobile, fixed broadband, and digital services, whilst also being one of the largest contributors to the development of Thailand's digital infrastructure. As a leading Digital Life Service Provider, AIS also develops and delivers a range of products and services that support the changes in business and people's lifestyles in the digital era.

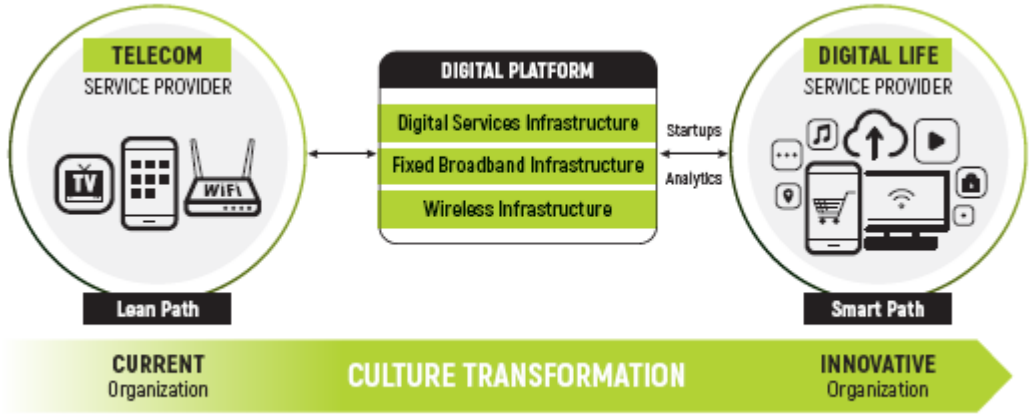
Organic Growth was going to be too slow, so AIS has expanded and filled in gaps through key acquisitions in fixed broadband and IPTV

AIS has carried out two strategic acquisitions and a third acquisition is expected to close in 2023. **Super Broadband Network** Co. was acquired by AIS in order to strengthen its IPTV offering (**AIS Playbox** services is provided by Super Broadband Network). The second acquisition was done in 2017 when AIS acquired **CS Loxinfo (**now renamed **CSL).** CS Loxinfo has a long history in Thailand dating back to 1994 when it was first setup as a JV of CAT and Thaicom. CSL, which is essentially an ISP, offers the following key services:

1. Provision of data center services
2. Satellite broadband access for domestic and international businesses
3. In 2015 it entered the residential broadband market via its High-Speed Condo unit providing fiber access to condominiums situated near the Skytrain and Subway lines in Sukhumvit, Ratchadaphisek, Lat Phrao and Phahon Yothin areas of Bangkok. Download speeds of up to 100Mbps were available in 2015.

The **AIS Fibre brand** was launched in April 2015 offering up to 1 Gbps and VDSL2 in selected locations and in 2023 the premium service has been upgraded to 1.5 and 2.0 Gbps in the DL and 500 and 1,000 Mbps in the UL.

Figure 2-2 The three pillars of AIS's Digital Platform



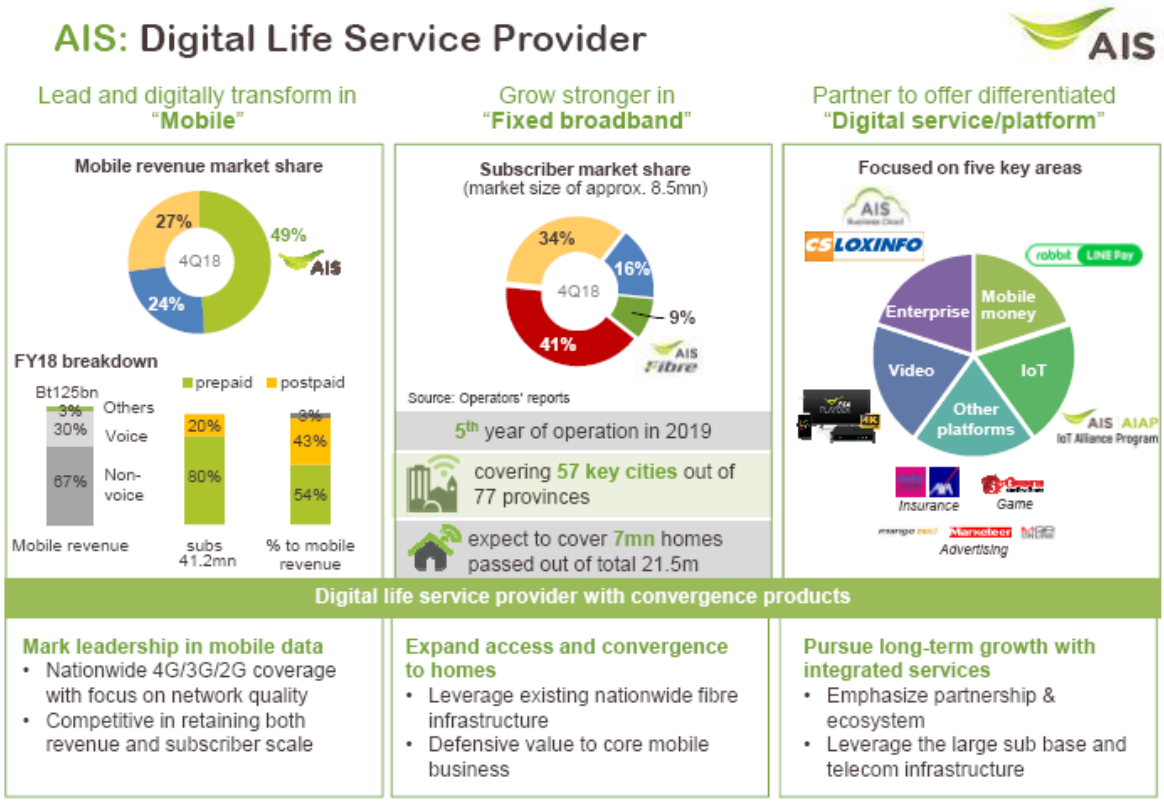
Source: AIS Business Catalog, 2020.

In September 2017, AIS signed a LoI to acquire CS Loxinfo (CSL) from its two major shareholders **Thaicom** (part of AIS' parent group **InTouch Holdings** (formerly Shin Corp) and **Singtel** (itself a direct shareholder in AIS). Thaicom owned 42.07% of the ISP through its subsidiary **DTV Service Company**, while Singtel owned a 14.14% CSL stake. AIS's preliminary indicative offer was THB7.8 (USD0.24) per share, which was open to further negotiation and/or due diligence. Thaicom sold its CSL shares to AIS's subsidiary **Advanced Wireless Network (AWN)** for Baht 1.95 billion which also holds the spectrum licenses for AIS. In 2019, CS Loxinfo rebranded itself as CSL.

Accelerating the brand as the go to provider for digital life services

With Thailand on the precept of entering the 5G era, AIS leadership anticipates that consumers and business users will desire seamless connectivity experience across all their devices, regardless of the underlying network. The brand strategy for AIS is to continue to be viewed as the premier mobile service provider for consumers – providing an extraordinary level of 5G service. The enterprise strategy will closely mirror that of the consumer brand - Enterprise 5G from AIS will be seen as the premier agile infrastructure platform to build applications on.

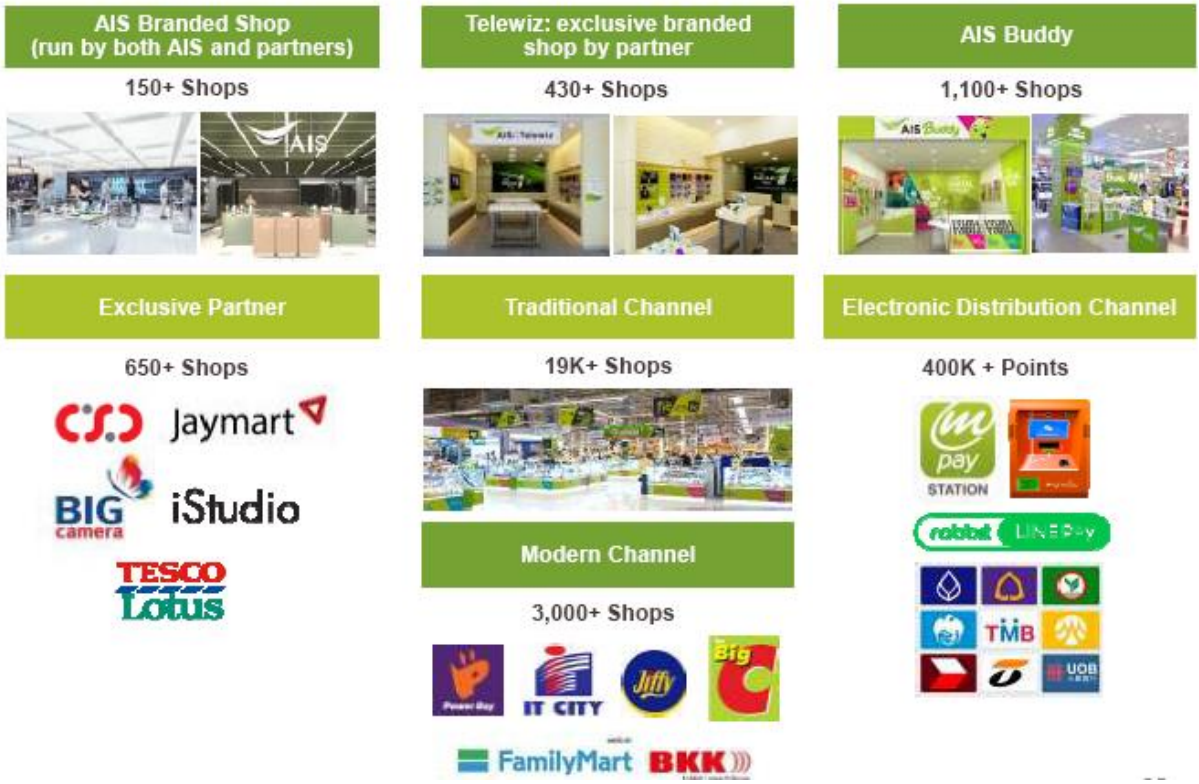
Figure 2-3 AIS's three pillars for Digital Life Services strategy (circa 2019)



Source: AIS, 2019

AIS also operates an e-Wallet service and had roughly 900,000 active users by end of 2018. This is a very competitive area and AIS has more work to do to gain more market share.

Figure 2-4 AIS Distribution Channel Structure (circa 2019)



Source: AIS, 2019.

Construct Digital Services on a 5G + Fixed Broadband platform

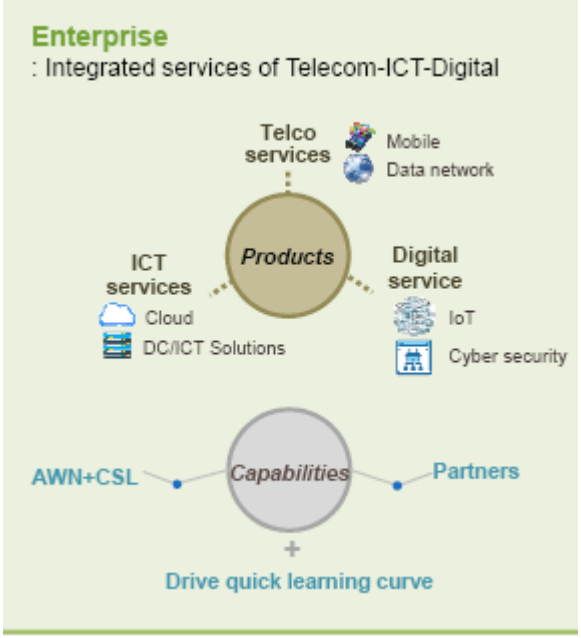
Digital Services is an area which the company has identified as part of its growth strategy. However, due to competition from TRUE, AIS has adopted a strategy of treating the fixed fiber "AIS Fibre" business as the foundation from which to grow non-mobile digital content services. As a consequence, AIS offers an AIS Play bundle for 129 Baht/Month for access to a wide range of content from Netflix, sports, Viu, and news channels. Thus, for AIS the total aggregate ARPU (estimated by Thoth Advisory to be around 1,000 – 1,100 Baht/Month) for its FTTX services is the platform for which to grow its non-mobile digital services.

The mobile part of its digital services strategy is split into enterprise and consumer. On the *consumer* side, AIS is offering 5G-based mobile gaming, AR/VR services which will take time to develop into an important revenue growth contributor. We note that the situation is similar with leading mobile operators in the APAC region.

The *enterprise* side though is a wide-open field and AIS has realized that if it moves fast it can capture a significant portion of the 5G private networking, 5G indoor small cells, and 5G network slicing market in Thailand. As an example, AIS reported that it installed cell sites at 158 hospitals nationwide, 150 in Bangkok and 8 in the provinces.

The networks support medical work by allowing for innovations and solutions that reduce risks to medical workers while facilitating their care of COVID-19 patients. Additional AIS Fibre, 4G, AIS Super Wi-Fi and Smart devices were also provided to enhance management in various areas at the hospitals. In Thoth Advisory's opinion, AIS is very well positioned to offer services to enterprises and government departments that can be enhanced with multiple products.

Figure 2-5 AIS's evolving Enterprise Ecosystem



Source: AIS, 2018

Continue to keep Customer Experience at the center of the GTM strategy

AIS has always had a strong focus on customer experience, however 5G in particular is creating a whole new level of network performance, latency, and capacity requirements that will determine market dominance especially when the TRUE/DTAC merger is completed. AIS has benefited from a CRM team led by Bussaya Satirapipatkul, Executive Vice President of Customer and Service Management, since 2016 when 4G was still being ramped up.

Customer Loyalty Serenade Program

"***Serenade***" is the customer loyalty program at AIS. It has been active for 18 years, and has transitioned from a discount program to being a channel for providing "exclusivity" to the customer. Serenade users are considered a high-value customer segment of AIS – consumers that anticipate excellent service and an “exclusive experience that cannot be found elsewhere.”

The strategy for 2023 (and for the foreseeable future) is to promote Serenade as the premier standard of *mobile customer care program* in Thailand. The initiative, called “Beyond Expectation” is designed to meet consumer needs in the “new normal” through collaborations in the dining, travel, shopping, and health sectors.

Since the lockdown measures were relaxed in 2022, AIS Serenade members have spent more points on travel and transport (up 53%), beverages and desserts (up 78%) and department store shopping (up 136%). AIS has allocated a budget of around Baht 2 billion in 2023 to ensure Serenade customers continue to be engaged and satisfied, as well as growing what AIS calls "brand love" - through services and exclusive privileges. The 2023 campaign includes dining, travel, shopping, and health, as well as ongoing collaborations with every AIS partner to redeem AIS points for a variety of benefits. These can be cash discounts or free products and services.

According to the Bangkok Post (June 2019), the churn rate of AIS Serenade customers is around 1% per month. The number of Serenade customers has grown consistently every year, with over 40% of Serenade users located in Bangkok and major cities, with average data usage of 15GB per month. In July 2022, Bussaya Satirapipatkul, was quoted in the Bangkok Post[1] as sharing that 6 million out of 42 million total AIS users participate in the firm's Serenade program. AIS upgraded the Serenade program as part of a Baht 2 billion budget for AIS's customer service drive. The contribution of high-spending users in the program represents 42% of AIS's total revenue, compared with just 30% three years ago. Ms. Bussaya also pointed out that Serenade users have a low churn rate of only 0.6% and they use an average of nearly 30 gigabytes of data per month.

IVR Speech Recognition

AIS customers make about 10 million call center interactions per year to the two call center numbers (**AIS Call Center 1175** and **Serenade 1148**) each year. Beginning in 2023, an initiative to enhance customer experience (and realize increased efficiencies), AIS introduced IVR speech recognition, which allows customers to go straight to their specific topic by using a voice command. Users would simply say the service that they want, and the speech-recognition system will bypass the usual IVR voice menu and bring the customer immediately to the service. This service is now available from its 1148 call-centre line for its Serenade premium customers, and will be made available at its 1175 call-centre line for general customers in May.

Figure 2-6 AIS IVR Speech Recognition

Source: AIS, 2023

[1] https://www.bangkokpost.com/business/2338173/ais-aims-to-woo-new-users-with-serenade-upgrade

Personalize and drive CX with Cloud+AI based Omnichannel

AIS's omnichannel strategy is a cross-channel content strategy with the aim of improving customer experience (CX) and driving better relationships across all possible channels and touchpoints. This includes traditional and digital channels, point-of-sale, and physical and online experiences (See Figure 2-1). Moreover, at the top of the list for AIS is cloud-based, AI powered omnichannel solutions since Thai customer expectations nowadays is to engage on any channel (and indeed this was accelerated during COVID-19); customers have little tolerance for the poor service experiences of the past.

The AIS Omnichannel marketing model was designed to enable customers to view products and features through any device channel, and all customer information would be saved. The next time the user visited one of the AIS channels, the AIS employee could offer products and services immediately, as the user would not be required to repeat his/her information.

Figure 2-7 AIS's Omnichannel strategy

Source: AIS, 2023.

Counter inflationary pressures by reducing costs with AIOps and Automation

Due to the consolidation of True and DTAC, AIS is will be under significant pressure to grow revenue and reduce cost. With the acquisition of 3BB, AIS will be adding another 171 employees to its staff of 15,000 and with a YoY drop of -2.4% in EBITDA for 3Q22 caused by rising utilities cost, AIS recognizes that their current operational practices must transform from being reactive to proactive, whilst improving customer experience and operational efficiency.

One of the initiatives being pursued by AIS to drive the desired efficiencies is called “AIOPS” which is defined as “leveraging Artificial Intelligence (AI) capabilities for IT and Network operations (AIOps). Using AI and ML, AIS (or any mobile network operator) can monitor and analyze network performance data in real-time, identifying bottlenecks and problems that could impact network performance. The AIOPs routines can automatically adjust network settings and configurations.

The key areas where AIS could benefit from AIOPs are:

- *Predictive maintenance*: AIOPs can be used to analyze data from network equipment and devices, identifying patterns and trends that are likely to become faults. By predicting when equipment is likely to fail, AIS can proactively schedule maintenance and repairs, reducing downtime and improving network availability.
- Intelligent *routing:* An autonomous network can use machine learning algorithms to optimize the routing of data, reducing latency and improving the efficiency of the network.
- *Customer experience management:* AIOPs can rapidly analyze customer data and feedback, identifying trends and patterns where the mobile network is not meeting customer expectations. This information would be used to develop targeted interventions and improvements to the customer experience.
- *Improving customer service:* one of the prevailing deployments of AIOPs is for improving the customer experience by automating routine customer service tasks, such as answering common questions and troubleshooting known technical issues. This helps to reduce the workload of customer service agents and improve the speed and quality of service.

Making Cyber Security a pillar of the AIS brand

AIS views their role as crucial to the cybersecurity challenge being experienced in Thailand because so much passes through their networks. This provides AIS with both a challenge and an opportunity. The challenge is ensuring their own networks are completely secure, end-to-end, and the opportunity is to promote their premium services by marketing secure applications and services to Thai customers.

Emergence of Cyber Crime on Mobile Applications

It is worth noting as a backdrop here that cyber-crime is increasingly being conducted on mobile platforms in Thailand:

> *Consumers and banks are being cautioned by the Bank of Thailand (BoT) regarding an elevated risk of financial cyber-crime. One recent victim lost Baht 101,560 from his bank account after falling victim to a malware attack after downloading an unsafe dating app called 'Sweet Meet'. Once the malware was installed, threat actors were able to remotely access and control the victim's phone to transfer money from the user's bank account.*
>
> Source: https://www.blackpanda.com/asia-cyber-summary-posts/20-jan-2023-asia-cyber-summary

AIS's Cyber Security offerings fall into two segments: enterprise and consumer, elaborated below.

Enterprise Cyber Security Services

AIS maintains a thriving MSSP (Managed Security Services Provider) business with an offering branded as "One Stop Cybersecurity Service" for businesses across Thailand. The MSSP team at AIS is staffed with Cyber specialists to provide offensive security services, covering Vulnerability Assessment (VA), Penetration Testing (Pentest), and Red Team Assessment (iPentest). **AIS Cyber Security Operations Center (CSOC)** began in 2020. They initially partnered with Trustwave, and then expanded in 2021 and announced a Managed Security Service Provider (MSSP) partnership with **Palo Alto Networks**, followed by **Cisco.**

AIS and Cisco partnered to enable businesses in Thailand to improve their cyber resiliency by offering Cisco's Cloud Security Managed Services. AIS views this partnership as essential to help its corporate customers navigate an evolving threat landscape as Thai businesses continue their digitalization efforts and new TA (Threat Actors) emerge.

Consumer Cyber Security Services

AIS considers this topic to be "good for business" and important for its CSR (Corporate Social Responsibilities) initiative to help its customers to be digitally "safe" by being proactive in highlighting the challenges of Cyber Crime. To that end, AIS has developed the *Aunjai* Cyber offering to encourage digital skills with its customer base to build cyber knowledge so that "people are not naïve" and can negotiate the digital world safely. AIS worked with government agencies to launch an new online course, "Aunjai Cyber" for the teaching of digital skills to protect against Cyber threats. The view of AIS leadership is that the key to defeating cyber threats is correct knowledge – and that AIS must dedicate resources "to sharing its knowledge with the Thai public as a weapon to deter any potential cyber threat."

Be the market leader for Sustainability / Energy Savings

In 2021, the government Thailand pledged to accelerate action to achieve net-zero emissions by 2065 out of the concern that Thailand is one of the top 10 countries most affected by climate change and to join the global community in immediate efforts to fight climate change.

AIS's targets for 2023 are reducing Green House Gas (GHG) emissions intensity as calculated from the ration of direct and indirect emissions to data traffic by 90% compared with a baseline in 2015. AIS is also aiming to increase renewable energy usage to 5% of the total energy consumption.

Conserving energy has become a business imperative in light of the recent rising cost of energy, which totals about between 20-30% of total operating expenses, and the impact of geopolitical events which drive up the cost of energy. The growing energy prices in 2023 will put even more pressure on margins at AIS (See Section 3.4 OPEX).

Energy reduction/savings: Network Initiatives

In order to reduce GHG, AIS has several tools at their disposal – (1) introduce solar power on cell sites where it is feasible (AIS is already doing this) and (2) reduce the actual energy consumption of the network (AIS is aiming to reduce energy usage on the 3G/4G/5G RAN and also on the optical transport network. It is important to note that Thailand is a sparsely populated country with high mountains many rural areas. The population is mainly concentrated in several large cities, and network requirements can be quite uneven.

According to McKinsey – "all operators have considerable scope to cut energy costs and consumption. In current mobile networks, for example, transferring data only consumes around 15% of energy. Some 85% is wasted because of heat loss in power amplifiers, equipment kept idling when there is no data transmission, and inefficiency in systems such as rectifiers, cooling systems, and battery units".

This can be done through several approaches:

1. Enhance the sleep cycles through micro-sleeping during the hours when cell sites are not transmitting a lot of data

2. Upgrade the 4G cell sites with multiple bands each with a separate power amplifier to an integrated wideband transceiver architecture. This can reduce the usage by > 1 kWatt.

3. AIS might not be able to accelerate the shutdown of 3G network until the NBTC provides official guidance but with an estimated 46k 3G basestations there would be an operational and financial incentive to migrate 3G subs to 4G.5G.

Enterprise ESG Solutions

To take advantage of the opportunities presented under the ESG banner, AIS has developed several "Smart Solution" services to enable corporate clients a fee service to enhance energy efficiency as a means to reduce GHG emissions.

Smart Solutions (branded as Smart Factory, Smart Property & Building Management Solution) are AIS offerings that incorporate 5G, IoT, data analytics, and AI to monitor, track and analyze data to enhance efficiency in production, energy and resource consumption at client locations. Components of the *Smart Solution* offerings at AIS includes:

- Machine Monitoring by IoT
- Asset Tracking
- Wastewater System Monitoring
- IoT sensors to manage energy consumption in the building, parking, property, and security systems.
- Enhanced CCTV to Intelligent Surveillance by AI-Vision

Chapter 3. Financial and Operational Analysis

3.1. Key takeaways

The key takeaways are:

1. *Revenue growth* over the forecast period will come from 5G (post-paid) consumer, 5G enterprise services fixed enterprise services and consumer/enterprise fixed broadband (FBB) as well as cloud connectivity and co-location services. FBB may be reaching a plateau with the acquisition of 3BB since investment will be needed to integrate the two companies' networks. Moreover, in 2H22 AIS started to offer low-price FBB packages for new customers as well as bundling of FBB+5G post-paid for its post-paid customers. AIS has been actively migrating 4G post-paid customers to 5G post-paid by offering discounts of up to 50% on data plans. Thoth Advisory forecasts that the share of 5G as a % of total mobile subscribers at AIS will grow from 15% in 2022A to 39% in 2027E.
2. *Reported 3Q22 EBITDA* dropped -3.5% YoY as EBITDA has started to come under pressure as marketing spending is being raised, utility prices (inflation) surge and total maintenance costs increase as the 5G network grows larger. Reported 4Q22 EBITDA declined YoY -1.8% due to lower operating profit with rising utility cost and resumed marketing spending increase. The regulatory fee paid to the government remains at 4.2% of core service revenue. Content including Disney+ hotstar and Olympic program are increasing. Thoth Advisory believes that content acquisition costs will most likely continue to grow as AIS expands the digital services AIS Play platform.
3. *Network OPEX,* as mentioned above*, is* starting to increase from 2022A due to rapid rise in electricity costs but also due to the added absolute amount of electricity needed for 5G base stations. In 3Q22 network costs grew 10.9% YoY and although 4Q22 was not explicitly disclosed by AIS we believe this line item is closely being managed by AIS.
4. *5G enterprise services* represents a new incremental revenue opportunity for AIS. Thoth Advisory forecasts that by 2027E, 5G enterprise services will account for 3.2% of Core Service revenue. In order to capitalize on that opportunity AIS is investing in network slicing, cloud computing and Multi-access Edge (MEC) as a single platform that can be presented to enterprise customers. Since AIS has introduced NR Standalone already it will be in an excellent position to purse private networking and network slicing for enterprises.
5. C*apital structure and balance sheet* appear to be sound, barring any unforeseen extraordinary items, and should be able to support annual CAPEX spend levels on the order of Baht 30 billion.
6. *Impact of the duopoly* which will be created when the TRUE/DTAC merger is completed could take off some of the pricing pressure and consequently ARPUs, but generally Thoth Advisory believes post-paid and pre-paid ARPU is on the downward trend that will be very difficult to reverse. Generally speaking, pre-paid ARPU will be more negatively affected by inflationary pressures because domestic purchasing power as a consequence is being reduced. Competition was intense in 2021A-2022A as the market continued to sell unlimited post-paid data packages driving the ARPU downward. The reopening of borders is having a positive impact on mobile revenues which will grow in 2023E.

3.2. Financial Modeling Methodology

In order to carry out analysis of different scenarios we have built a financial model of AIS using the methodology outline in Figure 3-1. The key components of the model are:

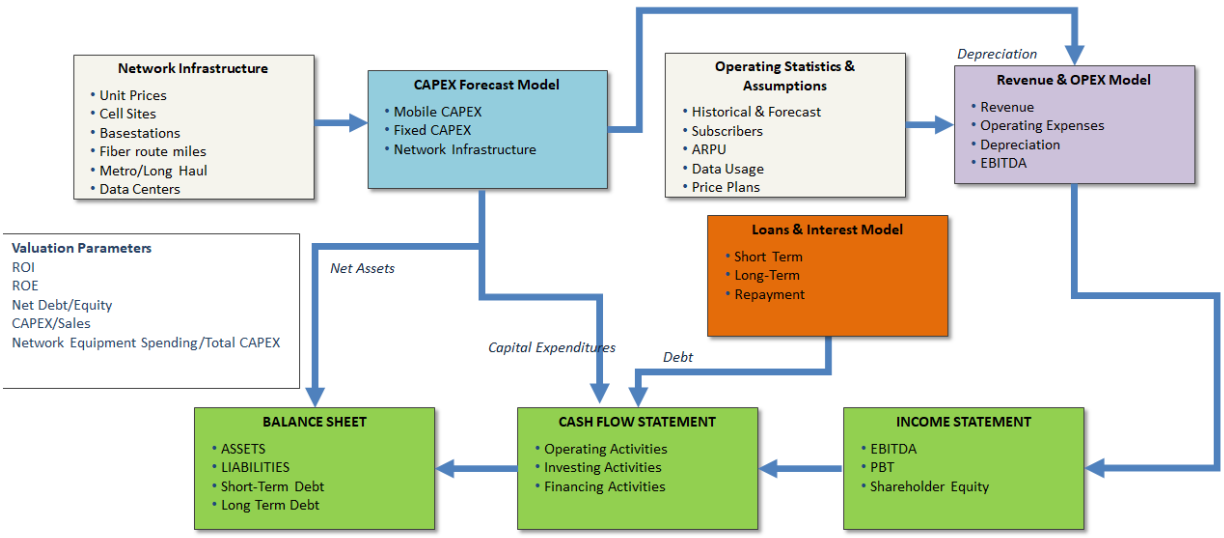
- Revenue Model – ARPU, Data Usage, and Subscribers, Service segmentation (technology generation, pre-paid/post-paid, FTTH versus xDSL)
- OPEX Model – Selling General & Administrative (SG&A), Staff costs, Network Costs,; key parameters are network maintenance and electricity cost inflation and the increase in TOT partnership OPEX as the network scales.
- CAPEX Model -fixed versus mobile, network technology segmentation

The outputs of the model are:

- Income Statement
- Cash Flow Model
- Balance Sheet
- Ratio Analysis

Our AIS financial model thus enables us to investigate the tradeoffs between subscriber growth, 4G to 5G migration, post-paid growth and ARPU compression in a market that is emerging to become essentially a duopoly with AIS/3BB and TRUE/DTAC.

Figure 3-1 Telecom Operator Financial and Network Model



Source: Thoth Advisory, 2023.

3.3. Revenue and Subscriber growth Outlook

In the 3Q22 Investor Presentation AIS says,

> *"consumer purchasing power was limited following rising energy price and inflation. The increased cost of living put pressure on consumers to spend wisely and reduced costs where required The economic recovery benefited tourist related industries and growth remained sporadically in the affluent segment with higher purchasing power."*

Essentially what this means is that AIS, for the time being, cannot rely on consumer purchasing power to expand until inflationary pressures subside. As a consequence, the most likely scenario is what we refer to here as the "**Base Case**" (See Figures 3-2 and 3-3).

In 4Q22, AIS reported Core Service revenue of Baht 33,840 million, improving 1.3% YoY due to non-mobile business -FBB and enterprise. For the full year 2022A, core service revenue grew 1.6% with FBB and enterprise segment showing double digit growth and mobile a slight decline YoY of -0.5%. EBITDA declined -1.8% YoY in 2022A due to operating profit with rising utility cost and resumption of increase in marketing spending.

Over the next 2-3 years AIS will need to reverse the trend of the past two years of YoY negative growth of -6.5% and -0.7%, respectively. We are optimistic that 5G adoption along with rationalization of low ARPU plans will be the main driver of that potential revenue growth.

Figure 3-2 Base Case Mobile Income Statement 2019A-2027E

AIS (CONSOLIDATED)		INCOME STATEMENT									
FY Ending 31 December	**UNITS**	**2019A**	**2020A**	**2021A**	**2022A**	**2023E**	**2024E**	**2025E**	**2026E**	**2027E**	**CAGR 23-27**
TOTAL REVENUES	[THB M]	**180,894**	**172,890**	**181,333**	**185,485**	**193,514**	**200,997**	**207,889**	**214,097**	**219,503**	3.4%
% Annual Growth	[%]		-4.4%	4.9%	2.3%	4.3%	3.9%	3.4%	3.0%	2.5%	
CORE SERVICES	[THB M]	**136,572**	**129,594**	**130,972**	**133,033**	**140,031**	**146,017**	**151,037**	**155,286**	**158,642**	3.6%
% Annual Growth	[%]	7.9%	-5.1%	1.1%	1.6%	5.3%	4.3%	3.4%	2.8%	2.2%	
Mobile Services	[THB M]	126,341	118,082	117,244	116,696	118,549	122,242	125,920	128,918	131,403	2.4%
% Annual Growth	[%]	7.9%	-6.5%	-0.7%	-0.5%	1.6%	3.1%	3.0%	2.4%	1.9%	
% of Revenue	[%]	69.8%	68.3%	64.7%	62.9%	61.3%	60.8%	60.6%	60.2%	59.9%	
% of Core Revenue	[%]	92.5%	91.1%	89.5%	87.7%	84.7%	83.7%	83.4%	83.0%	82.8%	
Fixed Broadband Services	[THB M]	5,722	6,959	8,436	10,064	14,769	16,611	17,491	18,269	18,659	13.1%
% Annual Growth	[%]		21.6%	21.2%	19.3%	46.8%	12.5%	5.3%	4.5%	2.1%	
% of Revenue	[%]	3.2%	4.0%	4.7%	5.4%	7.6%	8.3%	8.4%	8.5%	8.5%	
% of Core Revenue	[%]	4.2%	5.4%	6.4%	7.6%	10.5%	11.4%	11.6%	11.8%	11.8%	
Enterprise Services (incl 5G Enterprise)	[THB M]	4,509	4,552	5,291	6,274	6,713	7,164	7,626	8,099	8,580	6.5%
% Annual Growth	[%]		1.0%	16.2%	18.6%	7.0%	6.7%	6.5%	6.2%	5.9%	
% of Revenue	[%]	2.5%	2.6%	2.9%	3.4%	3.5%	3.6%	3.7%	3.8%	3.9%	
% of Core Revenue	[%]	3.3%	3.5%	4.0%	4.7%	4.8%	4.9%	5.0%	5.2%	5.4%	
OTHER SERVICES	[THB M]	**44,321**	**43,296**	**50,361**	**52,451**	**53,483**	**54,980**	**56,853**	**58,811**	**60,861**	3.0%
TOT Partnership & Interconnection Revenue	[THB M]	13,557	13,722	13,820	12,976	12,625	12,285	12,235	12,186	12,138	-1.3%
% Annual Growth	[%]		1.2%	0.7%	-6.1%	-2.7%	-2.7%	-0.4%	-0.4%	-0.4%	
Device Sales	[THB M]	30,765	29,574	36,542	39,476	40,857	42,696	44,617	46,625	48,723	4.3%
% Annual Growth	[%]		-3.9%	23.6%	8.0%	3.5%	4.5%	4.5%	4.5%	4.5%	
TOTAL OPERATING EXPENSES	[THB M]	**(139,639)**	**(135,177)**	**(143,120)**	**(148,267)**	**(150,711)**	**(153,254)**	**(159,148)**	**(167,948)**	**(175,061)**	3.4%
% Annual Growth	[%]		-3.2%	5.9%	3.6%	1.6%	1.7%	3.8%	5.5%	4.2%	
% of Revenue	[%]	77.2%	78.2%	78.9%	79.9%	77.9%	76.2%	76.6%	78.4%	79.8%	
Salaries & Benefits	[THB M]	(19,879)	(17,732)	(15,665)	(15,327)	(15,437)	(15,725)	(16,203)	(16,737)	(17,332)	2.5%
Marketing Expenses	[THB M]	(7,861)	(6,598)	(6,002)	(6,769)	(7,135)	(7,741)	(8,399)	(9,113)	(9,887)	7.9%
Cost of Services	[THB M]	(111,899)	(110,847)	(121,453)	(126,171)	(128,140)	(129,787)	(134,545)	(142,099)	(147,841)	3.2%
Other Cost of Services (content, etc.)	[THB M]	(6,025)	(7,904)	(9,017)	(7,740)	(8,011)	(8,277)	(8,552)	(8,837)	(9,131)	3.4%
License Fees/Spectrum Charges	[THB M]	(5,300)	(5,309)	(5,320)	(5,320)	(5,320)	(5,426)	(5,589)	(5,757)	(5,930)	2.2%
Network OPEX & TOT Partnership	[THB M]	(30,412)	(18,110)	(19,128)	(19,147)	(19,339)	(20,712)	(22,576)	(24,607)	(26,822)	7.0%
Doubtful accounts & bad debts & loss on contract terminatio	[THB M]	(2,521)	-	-	(1,966)	(1,966)	(1,966)	(1,966)	(1,966)	(1,966)	0.0%
Cost of SIM and Devices Sales	[THB M]	(30,412)	(29,314)	(36,215)	(39,096)	(40,449)	(42,269)	(44,171)	(46,159)	(48,236)	4.3%
Depreciation & Amoritzation	[THB M]	(37,229)	(50,210)	(51,773)	(52,902)	(55,022)	(53,103)	(53,657)	(56,739)	(57,723)	1.8%
% Annual Growth	[%]		-16.1%	-9.0%	12.8%	5.4%	8.5%	8.5%	8.5%	8.5%	
EBIT	[THB M]	**41,255**	**37,711**	**38,179**	**36,960**	**42,802**	**47,743**	**48,741**	**46,148**	**44,441**	3.8%
EBITDA	[THB M]	**78,339**	**89,385**	**91,408**	**89,729**	**98,116**	**101,575**	**103,575**	**104,524**	**104,273**	3.0%
% Annual Growth	[%]		14.1%	2.3%	-1.8%	9.3%	3.5%	2.0%	0.9%	-0.2%	
EBITDA Margin	[%]	50.4%	48.4%	50.7%	50.5%	49.8%	48.8%	47.5%	46.2%	44.7%	
Profit Before Tax	[THB M]	**37,317**	**32,359**	**32,894**	**32,182**	**36,651**	**40,706**	**41,029**	**39,855**	**39,319**	4.1%
NET INCOME	[THB M]	**31,048**	**27,271**	**26,924**	**26,013**	**29,546**	**32,751**	**33,006**	**32,078**	**31,655**	4.0%
% Annual Growth	[%]		-12.2%	-1.3%	-3.4%	13.6%	10.9%	0.8%	-2.8%	-1.3%	
CAPEX	[THB M]	**(23,029)**	**(28,057)**	**(25,786)**	**(32,319)**	**(28,220)**	**(27,973)**	**(27,728)**	**(26,486)**	**(26,246)**	-4.1%
% Annual Growth	[%]		21.8%	-8.1%	25.3%	-12.7%	-0.9%	-0.9%	-4.5%	-0.9%	

Source: AIS Historicals, Thoth Advisory estimates, 2023.

Figure 3-3 AIS Operating Statistics

AIS (CONSOLIDATED)			OPERATING STATISTICS									
OPERATING STATISTICS			**2019A**	**2020A**	**2021A**	**2022A**	**2023E**	**2024E**	**2025E**	**2026E**	**2027E**	**CAGR 23-27**
Fixed Broadband Subscribers		[000]	**1,037**	**1,337**	**1,772**	**2,169**	**4,631**	**4,821**	**5,091**	**5,295**	**5,464**	20.3%
	% Annual Growth	[%]		**28.9%**	**32.5%**	**22.4%**	**113.5%**	**4.1%**	**5.6%**	**4.0%**	**3.2%**	
	Net Adds	[000]		**300**	**435**	**397**	**2,462**	**190**	**270**	**204**	**169**	
Total Mobile Subscribers		[000]	**42,014**	**41,437**	**44,117**	**46,013**	**46,968**	**48,642**	**50,622**	**52,628**	**54,567**	3.5%
	% Annual Growth	[%]	**2.1%**	**-1.4%**	**6.5%**	**4.3%**	**2.1%**	**3.6%**	**4.1%**	**4.0%**	**3.7%**	
5G Subscribers		[000]	-	239	2,200	6,830	8,968	11,915	15,244	18,395	21,323	25.6%
	% Annual Growth	[%]		**-**	**820.5%**	**210.5%**	**31.3%**	**32.9%**	**27.9%**	**20.7%**	**15.9%**	
5G % of total mobile subscribers		[%]		1%	5%	15%	19%	24%	30%	35%	39%	
Total Post-Paid Subscribers		[000]	**9,107**	**10,192**	**11,522**	**12,560**	**11,587**	**12,429**	**13,315**	**14,171**	**14,895**	3.5%
Total Post-paid as % of total subscribers		[%]	22%	25%	26%	27%	25%	26%	26%	27%	27%	
5G Post-paid Subscribers		[000]	-	56	554	1,841	2,645	3,550	4,587	5,591	6,546	28.9%
5G Post-paid as % of total 5G subscribers		[%]		24%	25%	27%	30%	30%	30%	30%	31%	
3G/4G Post-Paid Subscribers		[000]	6,251	6,985	7,657	8,698	8,942	8,879	8,728	8,580	8,350	-0.8%
Total Pre-paid subscribers		[000]	**32,906**	**31,244**	**32,595**	**33,453**	**35,381**	**36,213**	**37,307**	**38,458**	**39,672**	3.5%
3G/4G Pre-paid Subscribers		[000]	35,763	34,213	34,259	30,485	29,059	27,848	26,650	25,654	24,895	-4.0%
5G Pre-Paid Subscribers		[000]	-	183	1,646	4,989	6,322	8,365	10,656	12,804	14,777	24.3%
FBB ARPU		[THB]	**473.9**	**483.5**	**447.1**	**422.0**	**344.4**	**293.1**	**294.0**	**293.4**	**289.2**	-7.3%
	% Annual Growth	[%]	**2.1%**	**2.0%**	**-7.5%**	**-5.6%**	**-18.4%**	**-14.9%**	**0.3%**	**-0.2%**	**-1.4%**	
Mobile Blended ARPU		[THB]	**252.0**	**234.0**	**224.0**	**213.0**	**202.1**	**193.9**	**187.6**	**182.7**	**178.8**	-3.4%
	% Annual Growth	[%]	**2.1%**	**-7.1%**	**-4.3%**	**-4.9%**	**-5.1%**	**-4.1%**	**-3.3%**	**-2.6%**	**-2.1%**	
Post-Paid ARPU		[THB]	**537.0**	**486.0**	**473.0**	**455.0**	**476.4**	**470.4**	**466.1**	**452.4**	**439.3**	-0.7%
	% Annual Growth	[%]	**2.1%**	**-9.5%**	**-2.7%**	**-3.8%**	**4.7%**	**-1.3%**	**-0.9%**	**-2.9%**	**-2.9%**	
Pre-paid ARPU		[THB]	**173.0**	**154.0**	**136.0**	**123.0**	**137.6**	**127.1**	**119.6**	**113.1**	**106.3**	-2.9%

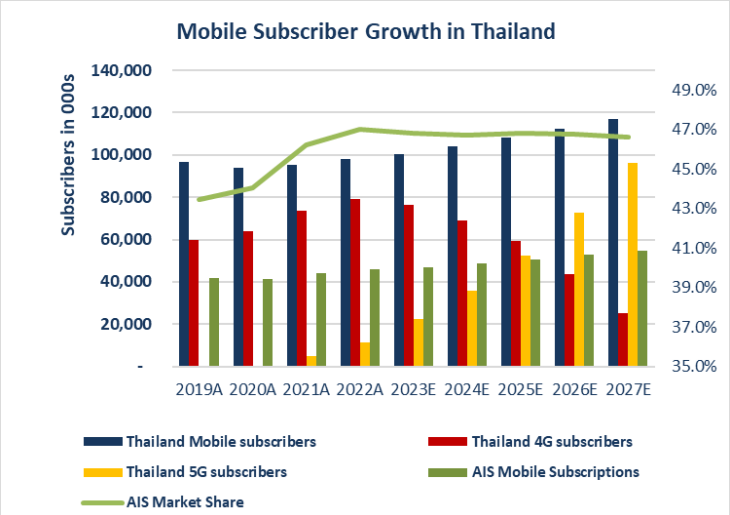
Source: AIS Historicals, Thoth Advisory estimates, 2023.

AIS Mobile Revenue Growth will depend on momentum from 5G post-paid adoption

Thoth Advisory estimates that 5G post-paid subscriber growth was 24%, 25% and estimated 27%, respectively in 2020A-2022A. The migration from 4G to 5G appears to be accelerating at AIS: 5G subscriptions grew 210.5% YoY in 2022A and we project will grow 31.3% YoY in 2023E. As of end of October 2022, AIS had installed 26K 5G BTS representing 76% coverage of the population with 5.5 million subscribers (adding 1.6 million in 3Q alone).

Figure 3-3 shows Thoth Advisory's projection for total mobile subscription growth in Thailand along with AIS market share estimates. Between 2019A - 2022A, AIS grew its mobile subscriber market share from 43.5% to 47.0%. Between 2023-2025, the competition between AIS and TRUE/DTAC might be intense but under a duopoly it is possible that ARPUs could flatten out somewhat by 2025. Monthly data usage will continue to grow at 16-20+% per annum.

Figure 3-4 Mobile subscriber growth in Thailand

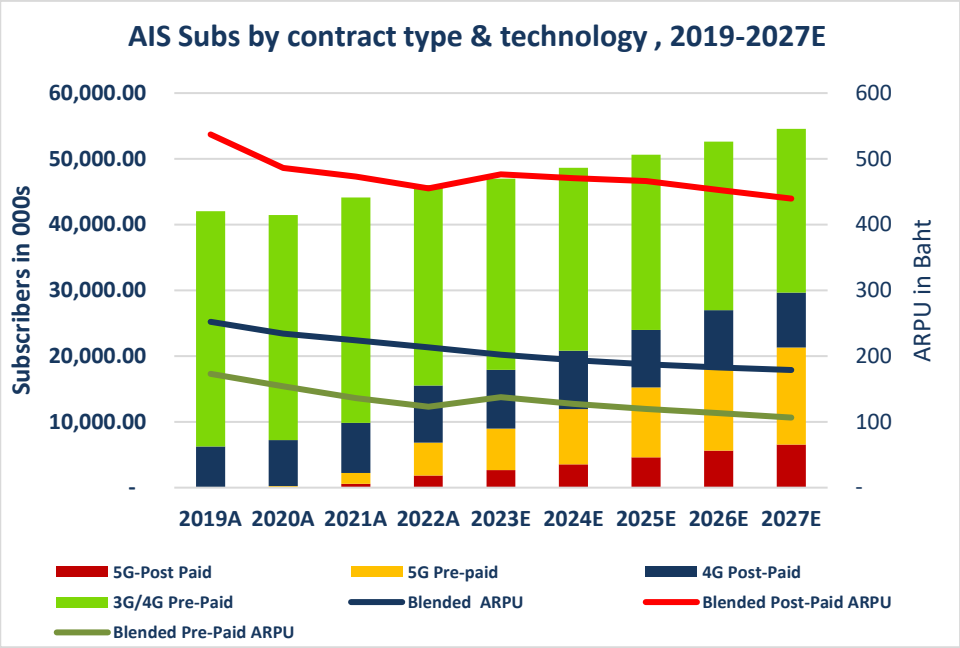


Source: AIS historicals, Thoth Advisory estimates, 2023

In Thailand 5G subscribers will surpass 4G subscribers in 2025 which suggests that TRUE and AIS will both need to keep elevated 5G CAPEX in place for the next 3-years. At AIS, Post-Paid 5G will surpass post-paid 4G by 2026.

Post-paid subscriptions at AIS will grow CAGR 6.8% while Pre-paid will grow at 2.7% CAGR (2022-2026) (See Figure 3-5). 5G post-paid subscribers will surpass 4G post-paid by end of 2024 or early 2025.

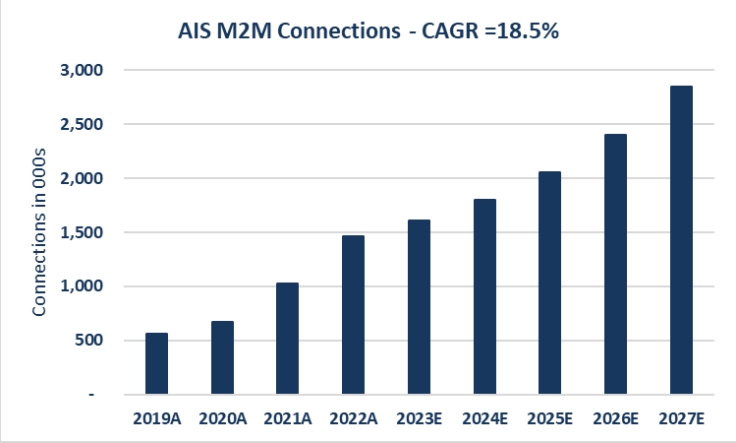
Figure 3-5 Subscribers by contract type and technology, 2019A-2027E



Source: AIS historicals, Thoth Advisory estimates, 2023

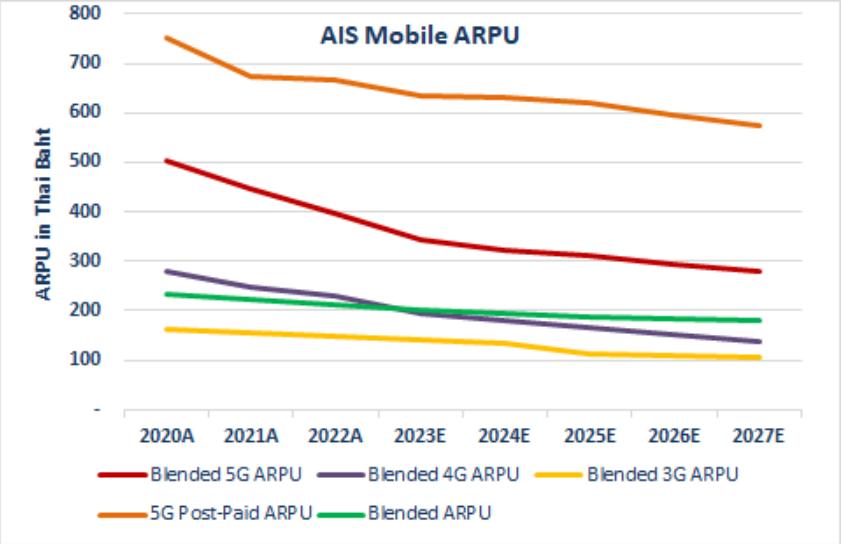
The combination of migration from 4G to 5G and the growing expansion of 5G post-paid subscribers will lead to 4G and 5G ARPUs converging by 2026 (blended 5G ARPU will be less than 20% higher than that for 4G) which is when Thailand on a whole will see 5G subscribers surpass 4G subscribers.

Figure 3-6 AIS M2M Connections, 2019A-2027E



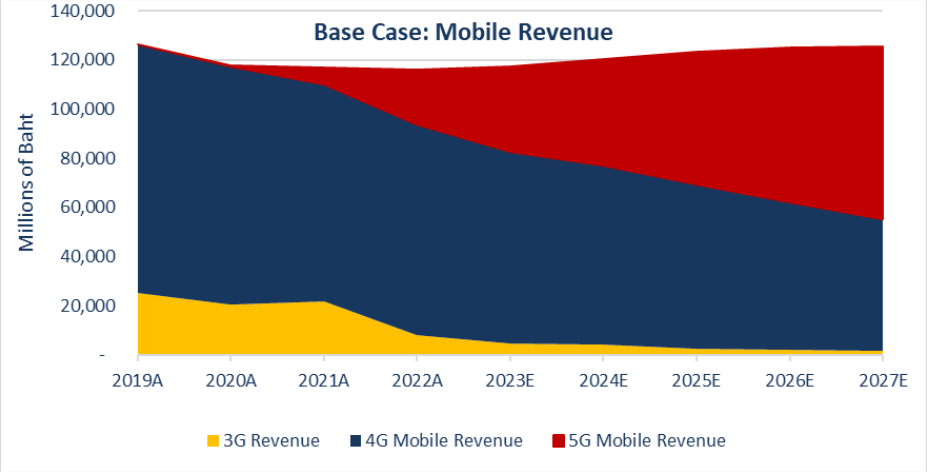
Source: AIS historicals, Thoth Advisory estimates, 2023

Figure 3-7 AIS ARPU trends, 2020A-2027E



Note: AIS has not announced the shutdown timeline for 3G.
Source: AIS historicals, Thoth Advisory estimates, 2023

Figure 3-8 Base Case Mobile Revenue projection 2019-2022A and 2023E-2027E



Source: AIS historicals for topline, Thoth Advisory estimates for technology splits, 2023

Fixed Broadband – An important component of revenue growth

AIS has been providing its home broadband internet services through fiber optic technology under the '**AIS Fibre'** brand since 2015. Leveraging upon the core fibre optic infrastructure of the mobile network, AIS Fibre rapidly grew its network coverage passing over eight million households across all 77 provinces nationwide with over 1.77 million subscribers in 2021 and an estimated 2.2 million at end of 2022.

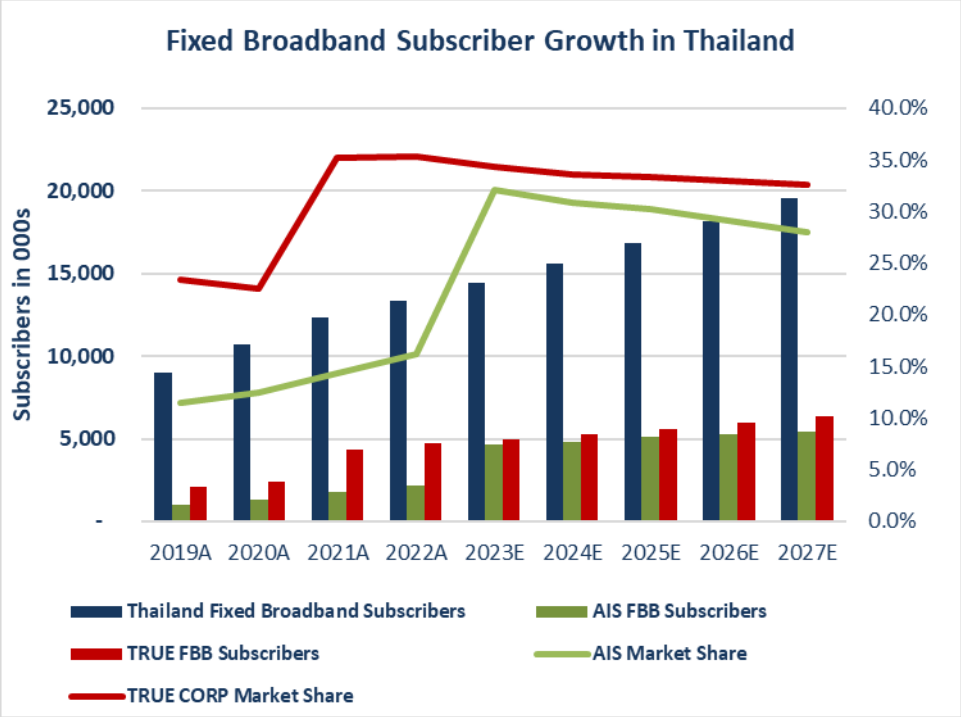
In July 2022, AIS and 3BB (www.3bb.co.th) (also known as **Triple T Broadband Plc**) announced a deal valued at Baht 32.4 billion (US$924 million) that will include the acquisition of 99.87% of 3BB's shares for Baht 19.5 billion and 19% of **Jasmine Broadband Internet Infrastructure** Fund for Baht 12.99

billion. The combined FBB (xDSL and FTTH) business will propel AIS to 4.6 million subscribers on par with TRUE which has 4.7 million subscribers. Of the 2.462 million 3BB subscribers, 958,000 are estimated by Thoth Advisory to be xDSL. One of the motivations apart the obvious market share increase for the acquisition is the higher ARPU that 3BB has achieved: 595 Baht versus AIS's ARPU at 430 Bt.

According to www.peeringdb.com, Triple T Broadband (3BB) has traffic levels between 1-5 Tbps and supports both IPv4 and IPv6. 3BB has public peering exchange points with Equinix (Palo Alto, San Jose, Sydney, Ashburn), DE-CIX (Frankfurt), JPIX, AnyWest, BBIX Thailand, and BKNIX.

Thoth Advisory forecasts that FBB revenue at AIS will grow CAGR 31.1% between 2023-2027E driven by a FBB subscriber growth of 20.3% CAGR. Figure 3-8 presents a Base Case where AIS is not able to surpass market share of FBB relative to TRUE. However, with the momentum propelled by the 3BB acquisition the opportunities will be there for AIS to increase its market share from 2024 onwards.

Figure 3-9 Fixed Broadband Subscriber Growth in Thailand – AIS will need to invest to keep market share growing through 2027E



Source: AIS Historicals, estimates by Thoth Advisory, 2023

Integration with the 3BB metro network will be an important milestone for AIS and this includes the migration and marketing strategy for xDSL. Prior to the acquisition announcement 3BB had indicated it was going to migrate its xDSL subscriber base to fiber within 2-3 years. We note that AIS has also been offering VDSL2 for several years. AIS will also need to be careful to not allow competition to force FBB ARPU's downward – at this stage we note that there are no indications that TRUE CORP would not adopt a pricing strategy to drive ARPUs downward.

3.4. OPEX Analysis

Operating Expenses including depreciation were -3.2% in 2020A, +5.9% in 2021A and +3.6% in 2022A. (See Figure 3-10). With the acquisition of Triple T Broadband (3BB) AIS will be adding approximately 171 new staff.

However, the rising costs of electricity will be a concern for AIS management going forward. In the 3Q22 AIS reported that Network operating expenses increased YoY 10.9% and 6.8% QoQ due to rising utility costs and the increase in the number of 5G BTS. AIS did not disclose utility cost numbers for 4Q22 but the operator did attribute the fall in EBITDA in 2022A of -1.8% to rising utility costs and resumption of increases in marketing costs.

We have done a very rough estimate of the electricity costs shown in Figure 3-10 and are projecting that electricity costs were around 19% in 2021A of total network operating expenses (these include maintenance fees on the equipment) and this could grow to a peak in 2025 of 31.5% and then fall if slightly if/when the 3G network is shuttered (AIS has made no official announcement about the timing of the 3G shutoff).

There are several options that AIS at its disposal to help address the energy challenge such as replacing the 4G 1800 MHz and 2100 MHz base stations with a wideband transceiver base station. This has been done by operators in China with excellent results. Another thing that can be done is to better control the sleep cycles of the base station using microsleep techniques.

Figure 3-10 Summary of Operating Expenses (OPEX)

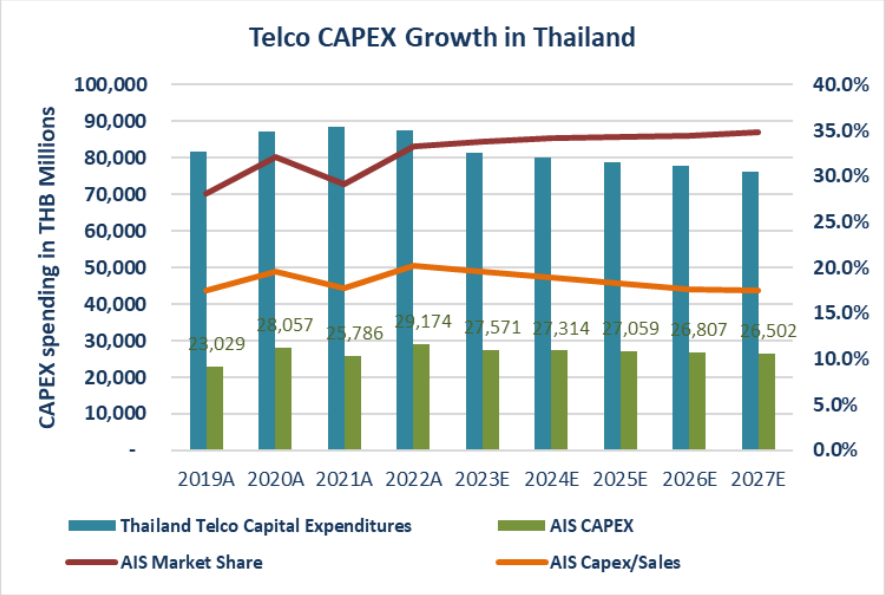
AIS (CONSOLIDATED)		OPERATING EXPENSES									
FY Ending 31 December		2019A	2020A	2021A	2022A	2023E	2024E	2025E	2026E	2027E	CAGR 23-27
OPERATING EXPENSES	[THB M]	(139,639)	(135,177)	(143,120)	(148,267)	(152,677)	(155,220)	(161,114)	(169,914)	(177,027)	3.6%
Growth %	[%]		-3.2%	5.9%	3.6%	3.0%	1.7%	3.8%	5.5%	4.2%	
Selling General & Administration	[THB M]	(27,740)	(24,330)	(21,700)	(22,353)	(22,571)	(23,466)	(24,602)	(25,849)	(27,220)	4.0%
Salaries & Benefits	[THB M]	(19,879)	(17,732)	(15,665)	(15,327)	(15,437)	(15,725)	(16,203)	(16,737)	(17,332)	2.5%
Marketing	[THB M]	(7,861)	(6,598)	(6,002)	(6,769)	(7,135)	(7,741)	(8,399)	(9,113)	(9,887)	7.9%
Growth %	[%]		-16.1%	-9.0%	12.8%	5.4%	8.5%	8.5%	8.5%	8.5%	
Cost of Services	[THB M]	(111,899)	(110,847)	(121,453)	(126,171)	(130,106)	(131,753)	(136,511)	(144,065)	(149,807)	3.5%
Growth %	[%]		-0.9%	9.6%	3.9%	3.1%	1.3%	3.6%	5.5%	4.0%	
Content & Others	[THB M]	(6,025)	(7,904)	(9,017)	(7,740)	(8,011)	(8,277)	(8,552)	(8,837)	(9,131)	3.4%
Networking Operating Costs & TOT Partnership	[THB M]	(30,412)	(18,110)	(19,128)	(19,147)	(19,339)	(20,712)	(22,576)	(24,607)	(26,822)	7.0%
Growth %	[%]		-40.5%	5.6%	0.1%	1.0%	7.1%	9.0%	9.0%	9.0%	
Deprecation Expenses		(37,229)	(50,210)	(51,773)	(52,902)	(55,022)	(53,103)	(53,657)	(56,739)	(57,723)	1.8%
Spectrum License Fees	[THB M]	(5,300)	(5,309)	(5,320)	(5,320)	(5,320)	(5,426)	(5,589)	(5,757)	(5,930)	2.2%
Doubtful/Bad Accounts	[THB M]	(2,521)	(3,401)	(1,982)	(1,966)	(1,966)	(1,966)	(1,966)	(1,966)	(1,966)	0.0%
Cost of SIM and Devices Sales	[THB M]	(30,412)	(29,314)	(36,215)	(39,096)	(40,449)	(42,269)	(44,171)	(46,159)	(48,236)	4.3%
Number of Staff	[X]	12,701	14,103	14,297	14,536	15,001	15,339	15,740	16,210	16,759	2.9%
Average Salary + benefits/Employee	[THB 000]	847	695	686	665	645	652	658	665	672	0.2%
Electricity Costs	[Baht/kWh]	3.50	3.50	3.50	3.85	3.97	4.08	4.21	4.33	0.03	-62.9%
Electricity Costs by Basestation Technology	[THB M]	(2,775)	(3,235)	(3,756)	(4,615)	(5,166)	(5,744)	(6,351)	(6,989)	(7,482)	10.1%
Growth %	[%]		16.6%	16.1%	22.9%	12.0%	11.2%	10.6%	10.1%	7.1%	-21.0%
Energy costs as a % of total network OPEX	[%]	9.1%	17.9%	19.6%	24.1%	26.7%	27.7%	28.1%	28.4%	27.9%	3.0%
3G	[THB M]	787.84	821.87	782.73	854.45	873.34	892.59	912.21	932.20	952.57	2.2%
4G (dual-Band, Single-Band)	[THB M]	1,986.93	2,253.99	2,413.64	2,740.37	2,903.11	3,076.96	3,258.63	3,448.42	3,656.30	5.9%
5G (700 MHz/2600 MHz)	[THB M]	-	158.94	559.23	1,019.85	1,367.25	1,734.57	2,122.70	2,532.56	2,777.44	22.2%
5G (26000 MHz)	[THB M]	-	-	-	-	22.77	39.51	57.24	76.00	95.83	

Source: AIS financial historicals, Thoth Advisory estimates, 2023

3.5. CAPEX and CASH FLOW Analysis

Figure 3-11 shows the historical and projected Capital Expenditures for AIS and the overall market. As can be seen in the figure, Thoth Advisory expects that AIS market share of CAPEX spending will increase slightly as TRUE and DTAC consolidate and rationalize their network assets if and when the merger is completed. Also shown in the figure is the CAPEX/Sales ("CAPEX intensity") trajectory which we believe will remain at the 20% level or slightly under.

Figure 3-11 Telco Capital Expenditures in Thailand



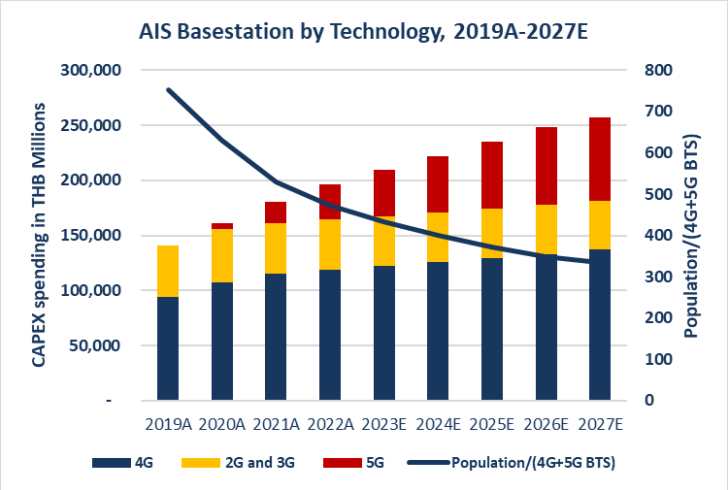
Note: Market share is the market share of total telco capital expenditures
Source: Thoth Advisory, 2023

5G Cell Site and Base station density

Figure 3-12 shows the historical and forecast base station growth at AIS. As of 3Q22, AIS had installed 26K 5G BTS with a population coverage of 76%. When compared to AIS's footprint it appears that if AIS wants to achieve closer to 85%+ coverage of the population with 5G it will need to expand considerably its basestation footprint. In terms of reducing Network OPEX (i.e. electricity and maintenance costs) it will be in AIS's interest to continue to migrate customers from 4G to 5G and at the same time provide incentives to encourage migration to post-paid 5G.

Figure 3-12 also provides a view in terms of the population coverage / (4G+5G BTS) which is a broad indicator of the potential congestion on the network. In advanced markets such as South Korea this parameter will fall below 300 people / (4G+5G BTS).

Figure 3-12 AIS Mobile Subscriber Forecast by Contract Type



Note: Assuming that 3G shutoff is implemented by end of 2024E; population coverage of 5G at 3Q22 was 76%
Source: Thoth Advisory, 2023.

CASH FLOW and CAPEX

Assuming no unforeseen extraordinary liabilities, at the current spectrum licensing level the Free Cash flow appears to be in a sound position. Using 2021A and 2022A, we have computed the following capital structure ratios:

- **EBITDA Margin** = 50.7% in 2021A and 50.5% in 2022A.
- **Net Debt** = Baht 89.4 billion in 2021A and this declined to Baht 84.4 billion in 2022.
- **Net Debt to EBITDA** = 0.98 in 2021A and 0.94 in 2022A; this will remain in the range of 0.80 to 1.0 through 2027E
- **Debt/Equity** = 3.35 in 2021A and 2.93 in 2022A; and this will remain in the range of 2.7-3.0 throughout the forecast period.

The capital structure assumptions for 2023E-2027E in our model are as follows:

- **Capital Expenditures**. Capex will remain in the range of Baht 27-30 billion through 2027E depending on the FOREX movements.
- **Long-term Liabilities**. The level is kept to below Baht 140 billion of which roughly Baht 60 billion are spectrum licenses.
- **Net Debt & Lease Liabilities & Spectrum Liabilities to EBITDA**. This was 2.33 in 2021A and declined to 2.13 in 2022A. We project this will fall to below 1.50 after 2024E.
- **Annual finance costs** will stay under Baht 7,000 billion
- **Spectrum License fees** paid each year remain below Baht 7,000 billion. Currently, AIS operates its mobile business with a total spectrum of 1450 MHz (2x75 MHz on FDD technology and 1300 MHz on TDD technology). 1420 MHz of spectrum licenses are granted by the **NBTC** to **Advanced Wireless Network Co. Ltd. (AWN)**, a subsidiary of AIS, while another 2x15 MHz comes under the partnership agreement between the TOT and AWN. AIS operates its 5G network on 2600 MHz as its primary mid-band for 5G. The **NBTC (National Broadcasting & Telecommunications Commission)** issues telecom licenses for business license type 1, Telecommunication business license type 2, Telecommunication business license type 3, Internet Service Provider Type 1, International Internet Gateway and Internet Exchange License Type 2 with its own network.

In the 5G auctions carried out in Feb 2020, AIS's winning bid was Baht 42.1 billion [US$ 1.35 billion] for 5G spectrum in three bands (See Figure 6-5). The payments are to be made in instalments over a period of 10 years. We are assuming that all of that is funded by debt.

Figure 3-13 Balance Sheet & Cash Flow Summary

AIS (CONSOLIDATED)		BALANCE SHEET & CASH FLOW SUMMARY									
FY Ending 31 December		2019A	2020A	2021A	2022A	2023E	2024E	2025E	2026E	2027E	CAGR 23-27
Total Assets	[THB M]	286,787	347,288	356,222	337,043	319,854	309,301	296,005	288,757	284,672	-3.3%
Long Term Liabilities	[THB M]	115,020	180,668	182,529	154,886	170,115	159,182	135,013	113,358	93,788	-9.5%
Total Liabilities	[THB M]	220,275	274,481	274,397	251,227	262,329	258,503	244,990	220,066	198,212	-4.6%
Total Net Assets	[THB M]	66,512	72,807	81,824	85,814	57,525	50,798	51,016	68,690	86,460	0.2%
Net Debt/Equity Ratio	[X]	1.06	1.19	1.09	0.98	1.85	2.06	2.00	1.23	0.77	-4.8%
Net Debt, Lease Liabilities & Spectrum Liabailites to EBIDTA	[X]	1.38	2.22	2.33	2.13	2.08	1.90	1.75	1.47	1.21	-10.7%
Net Debt/EBITDA Ratio	[X]	0.90	0.97	0.98	0.94	1.08	1.03	0.99	0.81	0.64	-7.5%
Cash Flow from Operations	[THB M]	31,192	27,437	26,924	26,013	29,546	32,751	33,006	32,078	31,655	4.0%
Net Cash flow from Operations	[THB M]	76,627	85,631	86,634	81,404	89,033	91,809	93,901	95,247	95,251	3.2%
Cash Flow from Investing	[THB M]	(26,784)	(54,694)	(45,352)	(42,996)	(70,801)	(38,861)	(38,617)	(37,374)	(37,134)	-2.9%
Cash Flow from Financing	[THB M]	(39,288)	(32,124)	(46,964)	(42,136)	(19,512)	(51,919)	(57,007)	(53,557)	(50,646)	3.7%
Net Cash Flow	[THB M]	19,637	18,420	12,739	9,013	7,733	8,762	7,039	11,354	18,825	15.9%
Cash Flow @ Beginning	[THB M]	9,067	19,637	18,420	12,739	9,013	7,733	8,762	7,039	11,354	-2.3%
Net Change in Cash Balances	[THB M]	10,570	(1,216)	(5,681)	(3,727)	(1,280)	1,029	(1,723)	4,315	7,471	-214.9%
Cash Flow @ Year End	[THB M]	19,637	18,420	12,739	9,013	7,733	8,762	7,039	11,354	18,825	15.9%

Source: AIS historicals, Thoth Advisory estimates, 2023.

Spectrum Licenses

As of 31 December 2022, AIS was holding Baht 186.459 billion [US$ 5.72billion] worth of spectrum licenses (for the list see of licenses see Section 6.5). Accumulated amortization of spectrum assets through 31 Dec 2022 was Baht -66,694 billion putting the depreciated asset value at Baht 131.775 billion. In 2020 and 2022, AIS added Baht 7,145 billion and Baht 21,556 billion worth of spectrum licenses, respectively.

AIS acquired the 2x15 MHz @ 700 MHz band for Baht 17.584 billion [US$ 550 million]. Installments are 10% fee plus VAT or Baht 1.881 billion. AIS (via the subsidiary **Advanced Wireless Network Company Limited** "AWN") was granted the license on 15 Jan 2021. AWN bid and won 1x1200 MHZ @26 GHz n258 band for a cost of Baht 5.345 billion [US$ 167 million]. The costs of spectrum licenses in Thailand are initially recognized by measuring at the cash equivalent price based on the present value of its acquisition cost.

Chapter 4. Consumer Strategy

4.1. Consumer Broadband

AIS developed its broadband FTTP business starting with its fiber network for its 4G RAN network. Within a few years it had grown its subscriber base to over 2.09 million at end of 3Q22. Once the impending acquisition of 3BB is completed it will have 3.711 million subscribers placing it in head-to-head combination with TRUE/DTAC. The revenue outlook is very positive for AIS's consumer broadband business as shown in Figure 4-1. The 958k xDSL subscribers are being acquired with 3BB which has 2,462 broadband subscribers. 3BB has been reported to have had a blended ARPU of 595 Baht which is >20% than AIS's blended ARPU.

In terms of data usage, AIS reported blended data usage at 24.90 GB/Month in 2021A and Thoth Advisory forecast for 2022E it will be 29.60 GB. Pre-paid data monthly data usage is23.50 GB/Month in 2021A and this is expected to grow 20.4% in 2022E.

Figure 4-1 Consumer Broadband Revenue Model

AIS			CONSUMER BROADBAND REVENUE MODEL									
FY Ending 31 December			2019A	2020A	2021A	2022A	2023E	2024E	2025E	2026E	2027E	CAGR 23-27
Consumer Broadband Revenue		[X]	5,722	6,959	8,436	10,064	14,769	16,611	17,491	18,269	18,659	13.1%
	Growth %	[%]		21.6%	21.2%	19.3%	46.8%	12.5%	5.3%	4.5%	2.1%	
FTTH Subscribers		[000]	1,037	1,337	1,772	2,169	3,673	3,930	4,245	4,516	4,748	17.0%
	Growth %	[%]		28.9%	32.5%	22.4%	69.3%	7.0%	8.0%	6.4%	5.1%	
xDSL Subscribers		[000]	-	-	-	-	958.00	890.94	846.39	778.68	716.39	
	Growth %	[%]		0.0%	0.0%	0.0%	0.0%	-7.0%	-5.0%	-8.0%	-8.0%	
Blended ARPU		[THB/Mo]	474	484	447	422	344	293	294	293	289	-7.3%
	Growth %	[%]		2.0%	-7.5%	-5.6%	-18.4%	-14.9%	0.3%	-0.2%	-1.4%	

Source: AIS Historicals, Thoth Advisory estimates, 2023.

AIS is now offering ultra-high speed fiber plans and has also introduced bundling for post-paid AIS mobile subscribers.

Figure 4-2 2023 Fiber plans from AIS

	Monthly Plan (Baht)	CPE	Peak DL & UL Speed (Mbps)	PlayBox Included?	SIM Card Included
PlayBox IPTV	129.00	PlayBox			
Consumer Broadband Plans					
Plan 1	1,399.00	Wi-Fi 6 Router	2000/500	Free 24 Months	
Power4 Advance	1,299.00	Mesh Wi-Fi 6	1000/1000	119 Baht/Month 24 month	
For Post-Paid AIS Customers	799.00	Mesh Wi-Fi 7	1000/1001	119 Baht/Month 24 month	30 GB/Month
Serenade Premium Package	1,099.00	WiFi 6 Router	1500/500	Free 24 Months	
Serenade Package	899.00	2,490 Baht	1000/500	299 Baht/Month	
SME Broadband	599.00	Wi-Fi 6 Router	500/500		

Source: AIS,2023

4.2. Consumer 5G

Published Prices

Figures 4-3 and 4-4 provide published prices for AIS 4G and 5G services. The more expensive plans (>1,000 Baht) come with unlimited data. For the Baht 899 5G plan, the cost of data is 11.24 Baht/GB and in contrast the cost of 4G data is 35.64 Baht/GB. Thus, 5G is effectively priced at <1/3 that of 4G post-paid plan. The post-paid price plans in 2023 for 5G and 4G, respectively, are targeting pre-paid customers to encourage them to migrate to 5G post-paid. Compared to other markets such as Hong Kong the $/GB is comparable for 5G. The unlimited data offer is not necessarily seen in every market in Asia Pacific and in fact most operators have shied away from unlimited plans as they can be easily abused although "fair use" policies are always attached to the contract terms. That said, in the case of AIS "unlimited" means "unlimited data volume" but at a fixed speed.

Figure 4-3 AIS Published 5G price plans (2023)

Post-Paid Plans Baht/month	Data GB/Month	Voice Minutes		Additional SIM cards
		AIS Network	Other Networks	
1,999	Unlimited	Call Free 24 Hours	600	4 SIM (50 GB)
1,699	Unlimited	Call Free 24 Hours	400	3 SIM (50 GB)
1,399	Unlimited	Call Free 24 Hours	200	2 SIM (50 GB)
1,199	Unlimited	Call Free 24 Hours	150	1 SIM (50 GB)
899	80 GB	Call Free 24 Hours	70	2 SIM (50 GB)
699	50 GB	Call Free 24 Hours	50	

Source: AIS, 2023

Figure 4-4 AIS Published 4G price plans (2023 and 2019)

Post-Paid Plans Baht/month	Data GB/Month	Voice Minutes		Throttle Speeds, Time Duration
		AIS Network	Other Networks	
4G 2023 Post-Paid				
499	14 GB	500	500	
399	10 GB	350	350	
299	6 GB	250	250	
249	4 GB	200	200	
199	3 GB	150	150	
4G (Feb. 2019) Post-Paid				
1,999	Unlimited	2000	2000	
1,599	Unlimited	1000	1000	
1,299	Unlimited	850	850	
1,099	Unlimited	650	650	
899	28 GB	400	400	384 kbps
699	18 GB	300	300	384 kbps
599	14 GB	250	250	128 Kbps
499	8 GB	200	200	128 Kbps
399	150	1000	1000	128 Kbps
299	1 GB	100	100	128 Kbps
4G Prepaid (Feb 2019)				

399	5 GB			8 days
899	4 GB			15 days
2799	15 GB			1 Year

Source: AIS, 2023

Comparison with other regional MNOs

Figure 4-5 provides a comparison of AIS's 5G post-paid plans with some of the other regional 5G post-paid plans. For the lower GB plans AIS is more expensive than Digi and Globe but when the data volume goes up to 300 GB AIS's $/GB comes down significantly. This type of strategy works if the post-paid customers do not actually use that large (because of unlimited plans) amount of data. The blended average across 3G/4G/5G for AIS is approximately 30 GB (2022E) and this will grow to >53 GB in 2026E or 16.4% CAGR.

Figure 4-5 Comparison of Post Paid plans with other regional MNOs

	Plan A	Plan B	Plan C	Plan D
Thailand - AIS				
Unlimited Calls?	Y	Y	Y	Y
Data Allowance (GB)	50	80	Unlimited	Unlimited
Monthly Price in THB	699.00	899.00	1399.00	1699.00
Monthly Price in US$	$ 21.33	$ 27.43	$ 42.69	$ 51.85
US$/GB	$ 0.43	$ 0.34	$ 0.14	$ 0.17
Malaysia - Digi				
Unlimited Calls?	Y	Y	Y	Y
Data Allowance (GB)	40	60	105	135
Monthly Price in MYR	60.00	75.00	105.00	135.00
Monthly Price in US$	$14.12	$17.65	$24.71	$31.76
US$/GB	$ 0.35	$ 0.29	$ 0.24	$ 0.24
Philippines - Globe				
Unlimited Calls?	Y	Y	Y	Y
Data Allowance (GB)	40	60	105	135
Monthly Price in PHP	499.00	1799.00	1999.00	2499.00
Monthly Price in US$	$9.16	$33.01	$36.68	$45.86
US$/GB	$ 0.23	$ 0.66	$ 0.61	$ 0.46
Australia - VHA				
Unlimited Calls?	Y	Y	Y	
Data Allowance (GB)	40	60	105	
Monthly Price in A$	A$45.00	A$55.00	A$65.00	
Monthly Price in US$	$32.14	$39.29	$46.43	
US$/GB	$ 0.80	$ 0.26	$ 0.15	

Source: Thoth Advisory, 2023

Consumer 5G Fixed Wireless Access (FWA)

AIS is more focused on 5G FWA for enterprise and in particular SMEs. That said, it could and most likely will offer portable 5G FWA for users who do not want to install fiber in their premises. That said for the existing fixed fiber customers, there is still the potential to upsell 5G FWA as a second line if it can be done as a bundle. As an example, AIS is offering a discounted price for fiber (See Figure 4-1) for existing post-paid AIS mobile customers.

4.3. Digital Services

AIS offers several Digital Services including AIS Play (TV content), AIS 5G Insurance Service, AIS 5G Cloud Gaming service, and the AIS VDO platform offering various services covering free TV and on-demand streaming services with a variety of entertainment content such as movies, series, music, karaoke, games and e-sports. The platform is broadcast via the AIS Play application available on mobile and tablet devices and the AIS Playbox set-top available on AIS Fiber home broadband subscribers.
In terms of content, AIS is the sole authorized Disney+Hotstar partner in Thailand and AIS delivers content from Netflix, CNN, BBC World News, BBC Lifestyle, VIU, BeIN Sports, and free digital and satellite TV channels.
In 2021, AIS integrated 5G technology through its AIS 5G AR/VR application, which utilizes the high-speed and low-latency property of 5G to enhance viewers' virtual reality (VR) experience. The application offers six types of content:

- music, auditory experience with VR 180/360-degree,
- star dating, allowing customers to be up close and personal with the celebrity through VR,
- travel, for trips locally and abroad, 4) wellness, bringing virtual workout classes to home,
- education, widening knowledge on the history and background of important landmarks in Thailand,
- Play News, featuring the 'Reporters on the Ground' special scoops reported through VR technology.

In terms of Digital Services, AIS has taken the approach which we have seen across the region to use excellent fiber bandwidth and coverage as the platform for digital content (TV and movies) service. As a result, the digital content services is an incremental ARPU on top of the basic broadband access. As of January 2023, AIS offered premium 2 Gbps service for 1,399 Baht/month [US$39.90] and a 1 Gbps for 1,299 Baht/month [US$37.08]. Pay TV content is offered via its **Playbox** which combines PLAY and BIU Premium (from HKT). AIS Fibre customers can sign up for AIS Play services which is delivered on the **AIS Play** platform for as low as 129 Baht/month on top of the broadband monthly fee.

Figure 4-6 AIS's Play Pay TV service on AIS Playbox set-top

Source: AIS Financial Reports, 2021 and 2022.

AIS also offers the '**Speed Toggle'** service, a feature allowing users to alter their download and upload speeds online, and a MESH wi-fi service permitting the connection of up to eight devices with better coverage in a large home. Apart from fiber-optic internet services, AIS Fibre also provides its customers with variety of global contents from movies, sports, and entertainment content through its AIS Playbox as well as all-in-one service covering fixed broadband internet, mobile data, world-class content, and unlimited super Wi-Fi.

Super Broadband Network Co.

The **AIS Playbox** service is provided by a wholly owned-subsidiary of AIS, **Super Broadband Network Co.** According to the **Bangkok Post**[2]**,** Super Broadband submitted a request to the Central Intellectual Property and international Trade Core to revoke its order prohibiting the network from broadcasting theQatar World Cup 2022 on its IPTV service. TRUE Corporation had claimed it owns the rights to the broadcast the football tournament on IPTV and on OTT platforms. The action follows a recent NBTC announcement on the "must have" and "must carry" rules which say major sports events like the World Cup must be broadcast for free across all platforms in Thailand, including IPTV. The Sports Authority of Thailand (SAT) is responsible for allocating broadcast rights equally in Thailand.

4.4. Convergence and bundling strategy

As was discussed earlier in Section 4.1 on fixed broadband, AIS has started to develop a bundling strategy around initially its post-paid 4G/5G customer base. In customer's minds it is quite natural to link high-speed FBB with 5G service which we believe was also recognized by AIS's marketing teams.

[2] Bangkok Post, 20 November 2022

Chapter 5. Enterprise Strategy

5.1. Key Takeaways

In 2018 AIS acquired CS Lox Info Public Company Limited in order to start to strengthen its enterprise offerings and capabilities to service the demanding needs of enterprises, large and SME. The Enterprise Business is still relatively small at AIS accounting for only 3.8% of total AIS revenues in 2022. The key services that AIS currently offers include:

- IPLC
- SD-WAN
- 5G FWA for businesses
- Cloud computing and data center co-location services
- XaaS (anything-as-a-service) through a partnership with VMware
- Partnership with Microsoft covering Modern workplace, Azure and solutions for IT Infrastructure.
- Internet of Things
- ICT solutions
- 5G Private Networking and AIS 5G for Business
- AIS SME service including SME Mobile Service, SME Internet Service, SME Digital Marketing, SME IT & Digital Solutions, SME Digital e-Service and SME Special Privileges, and SME Strategic Partnership

Future services that are planned or already in service include:

- 5G private networking
- 5G network slicing
- 5G Fixed Wireless Access for SMEs and businesses
- 5G Mobile Edge Services – these can be linked to 5G private networking sites.

5.2. SD-WAN and Managed Services

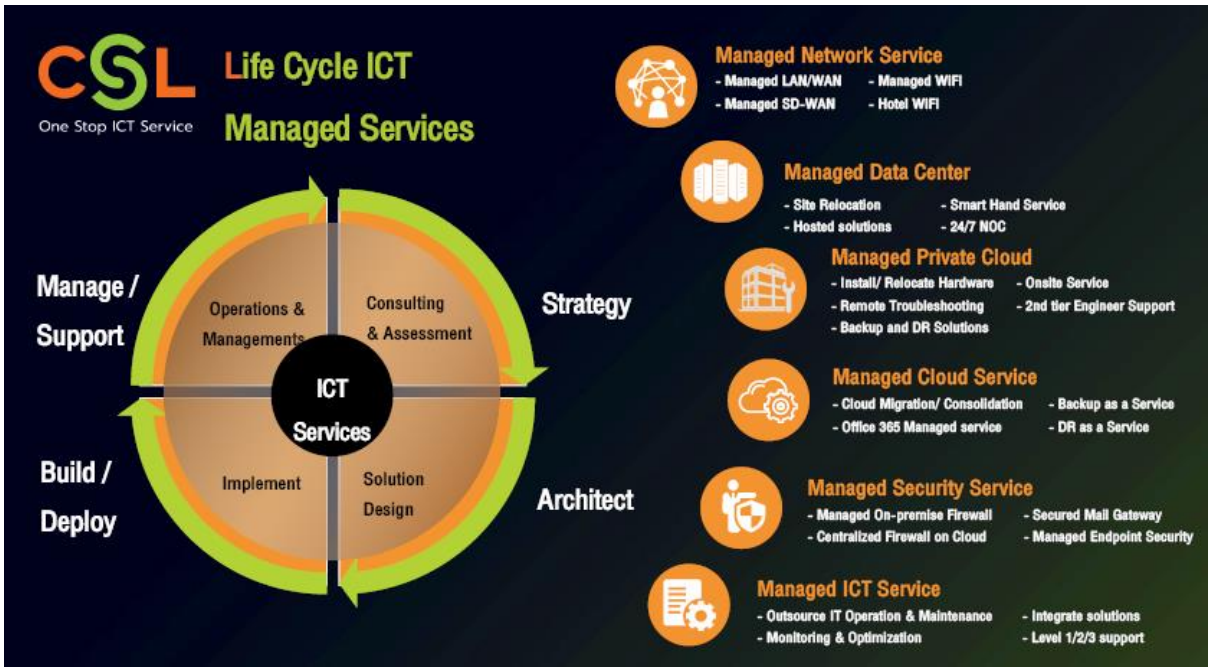
Managed Services is a strategic direction for AIS via CS Loxinfo (CSL), which has an excellent reputation, and can provide managed services to enterprise customers. For example, AIS offers a Domestic Data Circuit (DDC) based on Multiprotocol Label Switching VPN for enterprises with many branches. Maximum speed is up to 10 Gbps and has the ability to provide flexible adjustments to available bandwidth. The DDC circuits are not shared with other companies providing a more secured connectivity.

The AIS Cloud Direct Link for Microsoft Cloud Service enables enterprises to send and receive data to/from Microsoft cloud services in Thailand instead via a special route with private bandwidth pipes; this solution is more stable and secured than normal internet connection.

With respect to SD-WAN, AIS seeks to deliver on the promise of lower costs, manageability, better resiliency, and improved user experience.

SD-WAN solutions have been aggressively marketed in Thailand by technology companies such as Dell, Cisco, VMware, and HPE as the "next gen" network solution to support applications hosted in on-premises data centers, public / private clouds, and SaaS offerings such as Salesforce.com, Workday, Microsoft 365.

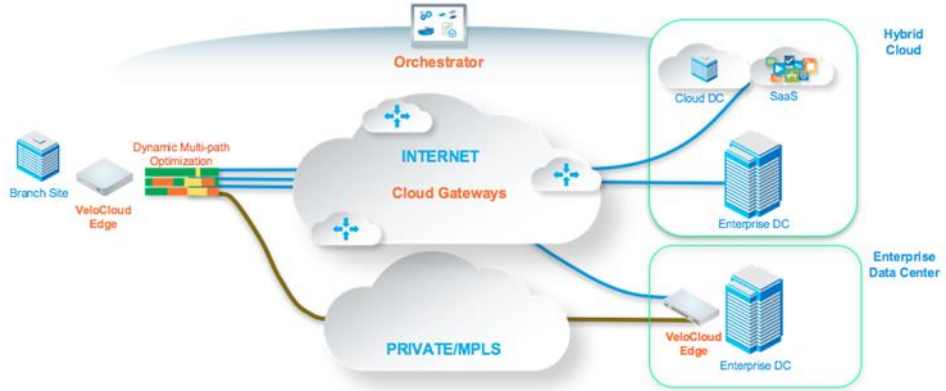
Figure 5-1 Life Cycle ICT Managed Services via CS Loxinfo (CSL)



Source: AIS "Future Enterprise" Chief Enterprise Business Officer, 2022

AIS and **VMware** are long-term strategic partners and VMware has been foundational in helping AIS build capabilities in their cloud solutions. VMware has also been a key technology supplier for AIS's pursuit of SD-WAN with the **VeloCloud offering**[3]. VeloCloud is a cloud network service solution enabling customer sites to have enterprise grade access to legacy and cloud applications over both private networks and Internet broadband. The following figure shows the VeloCloud Software-defined WAN solution components.

Figure 5-2 VMware's VeloCloud adopted by AIS Business



Source: VMware, 2022

[3] VMware paid US$449 million for VeloCloud, that sale was completed at the end of 2017

In addition to SD-WAN, it is also worth noting that:

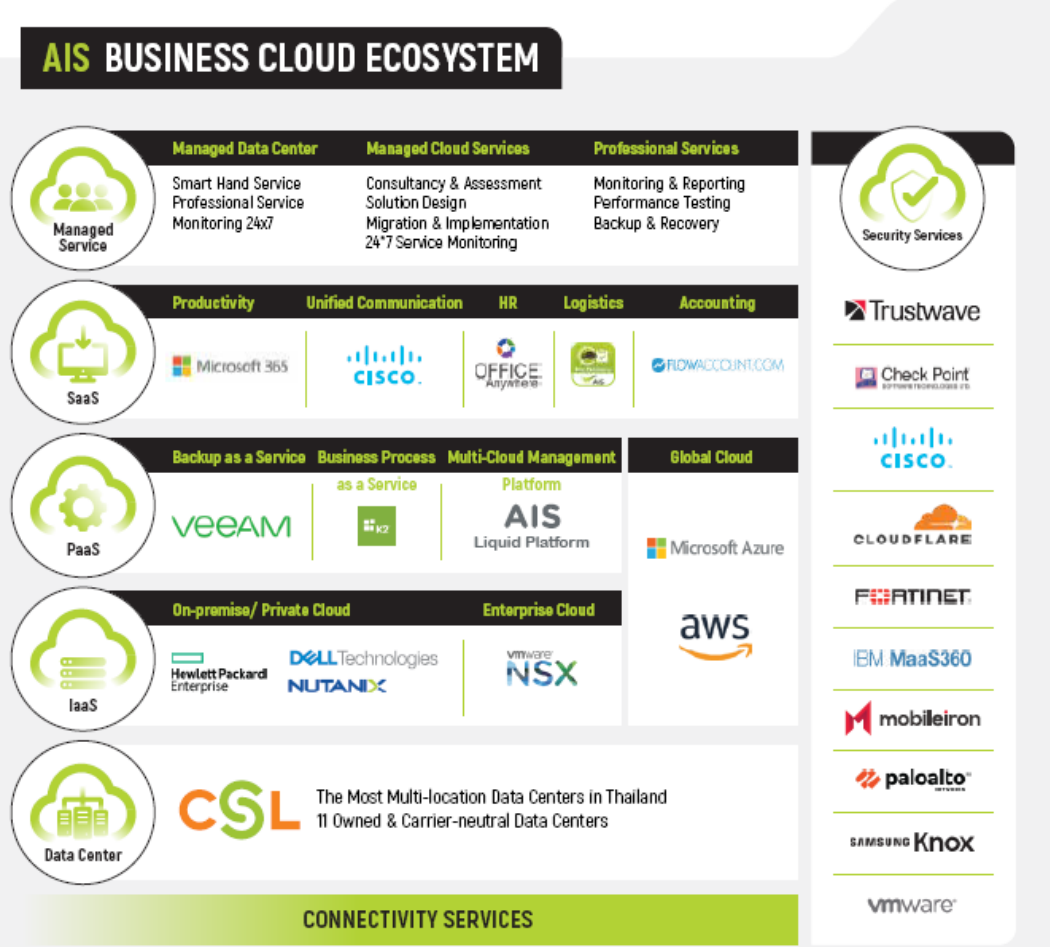
- VMware has been a foundational partner of AIS Business to build and co-sell AIS Enterprise Cloud.
- **AIS Business** is an early adopter of the VMware Sovereign Cloud, which enables enterprises to run sensitive and regulated workloads on a secure, compliant national cloud that meets Thailand's data sovereignty requirements.

5.3. International and Domestic data services

AIS provides international and domestic data services via a wholly-owned subsidiary, **Super Broadband Network Co**. In particular via this subsidiary AIS offers Network operator and telecom service operator i.e. internet service (ISP), Dedicated Leased Line, IPLC & IP VPN, Voice Over IP, and IP Television. A list of its major data services offering include:

- Domestic leased lines
- Fiber broadband access
- Corporate Wi-Fi solutions
- Cloud bandwidth on demand
- ISP service for corporates
- IPLC
- IP transit (wholesale)
- IP VPN
- Hybrid MPLS with 4G/5G connectivity backup
- Cloud direct connect and Azure Express Route
- Cloud Express Connect – connects to AWS, Google, Azure, and Soft Layer
- On-premise private cloud
- Backup as a Service
- Multi-cloud
- UCaaS
- Life Cycle ICT Managed Services – data center, cloud, private cloud, managed security service
- Business process as a Service

Figure 5-3 AIS's Cloud & Data Center Ecosystem



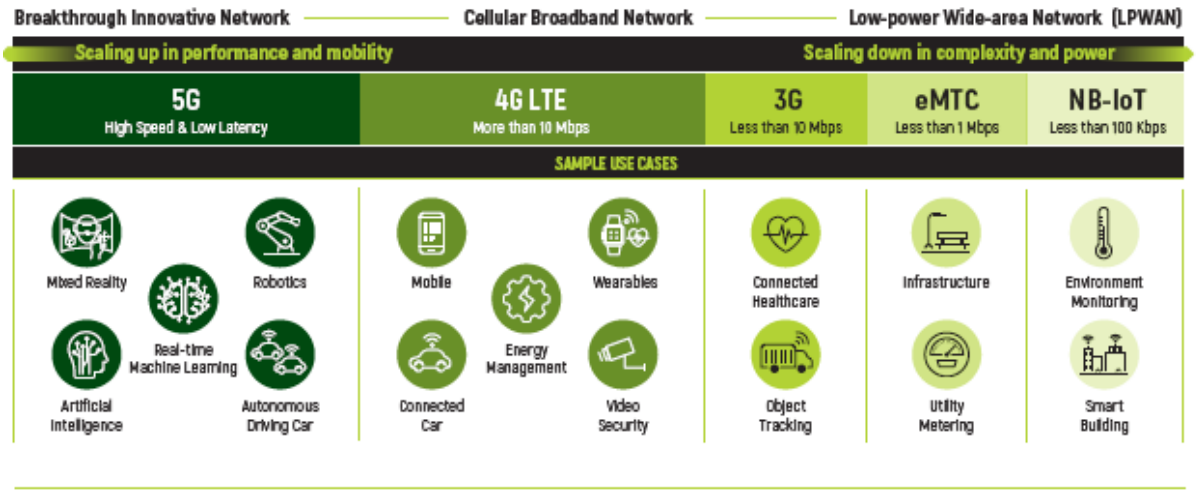
Source: AIS, 2019.

Internet of Things

AIS's foray into IoT dates back to 2017 and by 2018 the company had a total of 70 projects in the pipeline[4]. AIS is promoting IoT for both digital life services and for vertical industries including and smart city stakeholders. As shown in Figure 3-5, AIS surpassed 1 million IoT M2M connections in 2020 and is projected by Thoth Advisory to reach 3.2 million in 2026. AIS started offering NB-IoT services in 2017 and by 2018 it had deployed NB-IoT in all 77 provinces. Moreover, AIS collaborates through the **AIS IoT Alliance Program (AIAP)** and the corporate client base from CSL.

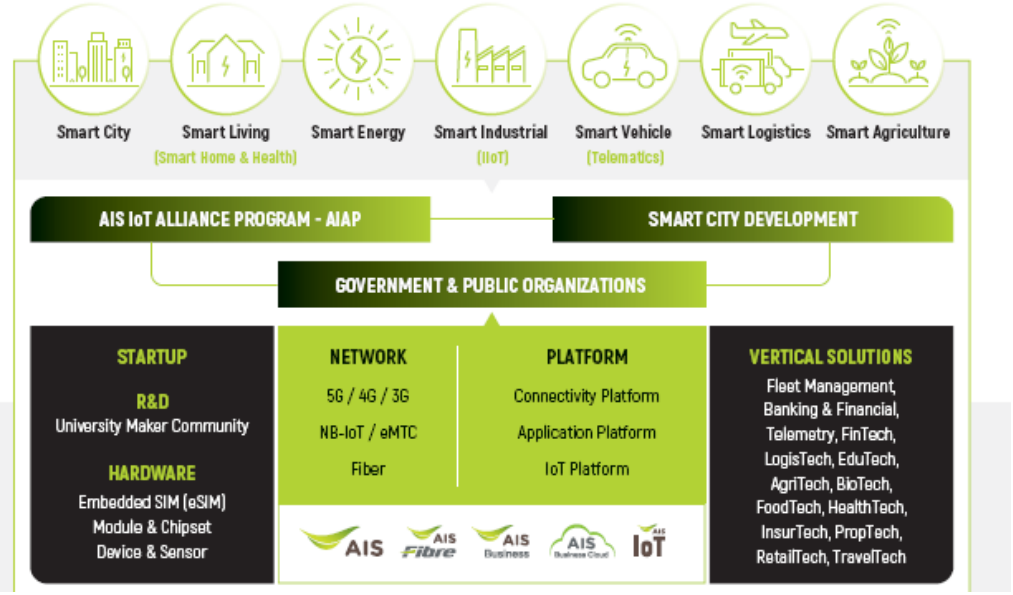
[4] Bangkok Post 15 June 2018

Figure 5-4 AIS mixed technology portfolio for IoT



Source: AIS, 2020

Figure 5-5 AIS ecosystem with AIAP



Source: AIS, 2020.

5.4. Cybersecurity

The Market and AIS' Strategy

Persistent heightened threat levels will keep cybersecurity investments high on the investment priority list of Thai business owners – from enterprises to mid-market to SMB. We note that ransomware continues to be major threat in 2023 (as it was in 2020-2022), but the emergence and potential abuse of *generative AI models*, such as ChatGPT, will increase the risk further still, as the creation of malicious code will increase the frequency and breadth of attacks.

Given the global recessionary environment and every evolving Cyber threat landscape – it is likely that Thai organizations would struggle to invest in the breadth of Cybersecurity products available. This presents AIS a lucrative opportunity to offer Cyber-aaS offerings to help vulnerable organizations. The following Cybersecurity services are needed by organizations large and small to meet the increased threats:

- endpoint security,
- network security,
- web and email security,
- threat detection and incident response,
- data security,
- identity and access management,
- vulnerability and security analytics.

AIS strategy relative to Cybersecurity is to:

- Partner with global solution providers
- Focus on Personal Data Protection Act (PDPA) solution
- Strengthen CSOC (Cyber Security Operations Center) and security service. The CSOC secures the personal data of over 42 million customers

AIS Enterprise Offerings

In pursuit of the market opportunity, AIS has developed a robust MSSP (Managed Security Services Provider) business and provides a "One Stop Cybersecurity Service" for businesses across Thailand. Some of the key investments that AIS has made to address this segment:

- Initial build of a **Cyber Security Operations Center (CSOC)** in 2020. AIS initially partnered with Trustwave, and then expanded in 2021 and announced a partnership with Palo Alto Networks.
- The MSSP team at AIS is staffed with cyber specialists to provide offensive security services, covering Vulnerability Assessment (VA), Penetration Testing (Pentest), and Red Team Assessment (iPentest).
- In mid-2022, AIS hired Pepijn Kok , as their CISO & Head of Cyber Security. A Dutch national, Mr Kok was KPMG's Director of Cyber Security Advisory practice in Thailand.

During the COVID-19 crisis, Thai companies significantly accelerated the adoption of e-commerce, mobile banking and remote working. However, in parallel there was an increase in the breadth and depth of cyber-attacks. This has propelled many Thai organisations to increase their cybersecurity capabilities, many of which can be served by the AIS offerings, purchased as OPEX, instead of building their own on a CAPEX basis.

Figure 5-6 highlights the cybersecurity offerings AIS is taking to market in Thailand in 2023.

Figure 5-6 5G Services provided by the AIS Cyber Security Operations Center (CSOC)

5.5. 5G Fixed Wireless Access (FWA)

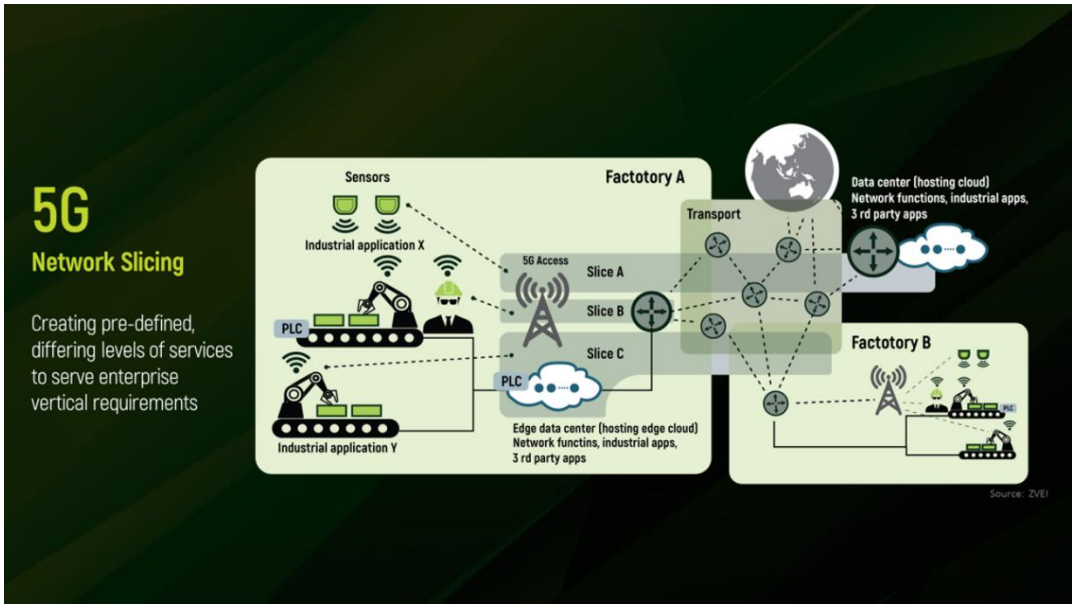
In markets such as Hong Kong where there are a lot of older "walkup" buildings that for poor ROI reasons the telecom operators will often times not invest to bring fiber to the premises. Then there are many professionals working in Hong Kong that for various reasons would prefer having a 5G CPE for FWA due to ease of installation. In NTT DoCoMo's case in Japan the company started marketing a 4.2 Gbps carrier aggregation C-Band (3.5 and 4.8 GHz) portable 5G FWA service. In both the Hong Kong and Japan example, a dense and high-performance makes the 5G FWA very attractive for operators because they can utilize the existing 5G dense network, which incidentally will have loads of capacity for the next few years. AIS has recognized that 5G FWA is a service that can marketing to SMEs to complement its SME offerings in fiber access.

AIS sees 5G FWA as suitable for SME and Enterprise markets and also as good way to increase the ROA (Return on Assets) on the 5G network itself. As a result, AIS is looking at both 5G FWA and 5G private networking as complementary services to offer enterprises such as factories. The key services that AIS is targeting with 5G FWA are:

- 5G FWA Corporate Internet
- 5G FWA Broadband
- 5G FWA MPLS
- 5G FWA SD-WAN
- 5G FWA Plus (network slicing)

Figure 5-7 AIS is developing use cases for FWA and 5G Private Networking

Use case	Technology	Status
Remote control crane	5G private network	On service, commercial negotiation with partner
Autonomous truck	5G private network	Feasibility assessment
Remote maintenance using AR	5G FWA	Engage with customer to develop solutions
Connected Factory	5G private network	On pilot and will be used as a site reference
Remote control excavator	5G private network	Feasibility assessment
Automated production line	5G FWA	On pilot and will be used as a site reference

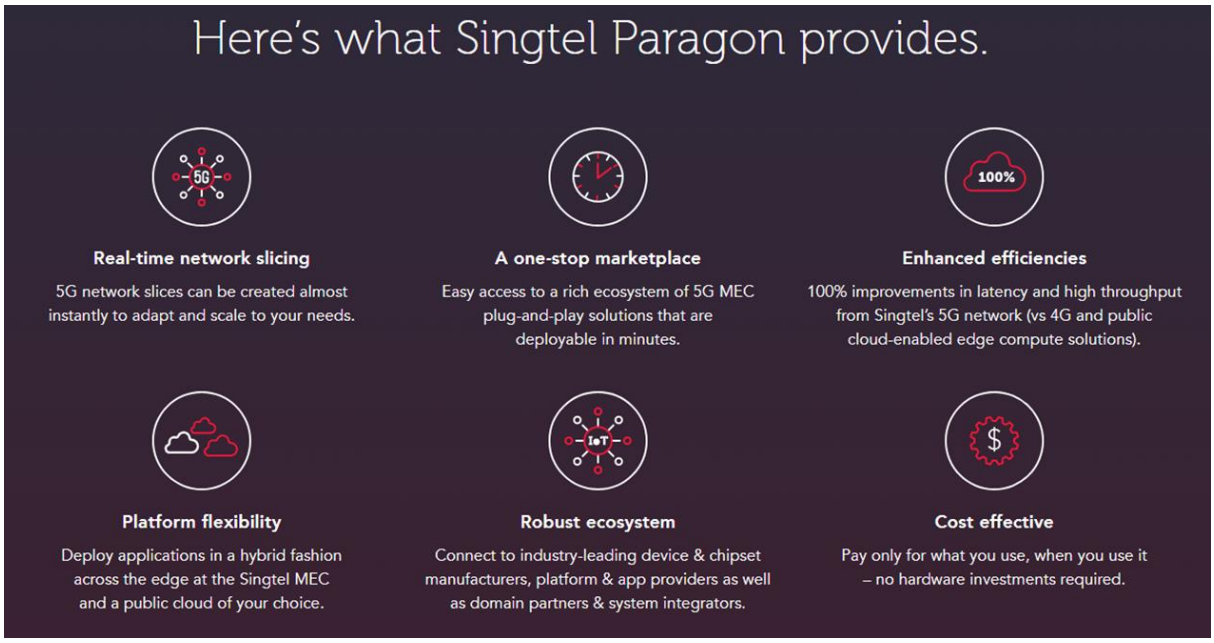


Source: AIS, 4Q20 Investor Presentation, AIS website, 2023.

5.6. 5G Private Network

5G private network is an area that AIS is actively developing and is working to assimilate a portfolio of references across multiple industries including manufacturing, healthcare, smart ports, and mining. Separately, **Singtel** has developed a 5G enterprise platform called **Paragon** which is a unified orchestration platform that brings together the 5G network, multi-access edge computing (MEC) and multiple clouds. The key concept behind Paragon is to offer a Marketplace and Platform to deploy 5G applications similar to the way that Telstra/Packnet developed a SD-WAN on-demand service with orchestration. Thoth Advisory believes since Singtel is a significant shareholder in AIS that the Paragon platform can be introduced int Thailand as well and other markets where Singtel has affiliate companies.

Figure 5-8 Singtel's Paragon platform



Source: Singtel, 2023

5.7. 5G Network Slicing over AIS's public 5G network

Armed with its 5G Standalone Core, AIS is well positioned to carefully start to launch network slicing services over its low-band and mid-band spectrum. Hover, many use cases that require large geographic coverage such as a moving vehicle will be challenging for any operator including AIS so network slicing has to be carefully rolled out to select enterprise customers. Thoth Advisory believes it will take 3 year for commercial networking slicing to reach the level of maturity where enterprises will feel comfortable in betting their operations on slicing. Many of these same companies still operate their critical cloud application on-premise because they do not feel the cloud service companies are able to provide the level of resilience that they need.

5.8. mmWave spectrum

AIS bid and won 1200 MHz of n258 (26 GHz) and has been trialing and investigating the possibilities with mmWave. Thoth Advisory expects that AIS will launch mmWave (band n258 26 GHz). AIS has several different ways it can offer mmWave:

1. **Private Network**. Although in some markets such as the US where the CBRS band is being used albeit with a limited chunk of spectrum, in other markets such as German and Japan, dedicated spectrum in the C-Band and mmWave band is being allocated for private networking which is also referred to as "local 5G". A lot of applications for 5G inside factories revolves around 4K cameras and automated mobile robots that move around the factory floor. It does not take long for mid-band capacity to run out in such an environment. AIS should it choose to do so is well positioned to utilize both mid-band and high-band for indoor private network
2. **Hot-spot/capacity in congested public area** such as transport hubs. If we compare to Japan, which at the end of 2022 had over 22k mmWave basestations the main thing holding AIS back is the availability of dual mode or triple mode (700/2600/26,000 Mhz) handsets. In Japan, the dual-mode handsets used by **NTT DoCoMo** are supplied by **Sony**, **Samsung** and **Sharp**. For example, the Sony 1 IV SO-51C supports both SA and NSA in three 5G bands: n78 (3.7 GHz),

n79 (4.5 GHz) and n257 (28 GHz). Thoth Advisory expects AIS to wait for the mmWave ecosystem to further mature and for dual-mode/triple-mode handsets to become available at a price range that is not exclusively for premium users.

5.9. AR/VR for verticals

Augmented Reality and Virtual Reality (AR/VR) continue to be important investment areas in ICT. Most of the "Big Tech" companies (Google, Microsoft, Meta, Qualcomm, Intel to name a few) are prominent in the market and continue to attract human capital. The technology continues to improve and as the number of 5G internet connections grows, the market will continue to grow.

It is the vison of AIS leadership to be an advocate and market maker in AR/VR for Thai enterprises to engage their customers in unique ways – such as improving experiences in healthcare, remote work, and gaming & entertainment sector. Although the mass market for AR glasses is probably still 2-3 years away as Apple for example shifts focus on Mixed Reality (MR) until the thermal and small form factor challenges can be overcome, it makes sense for a 5G operator such as AIS to begin building and accelerating the AR/VR interest in 2023.

Given the lessons of COVID-19 and population's ready adoption of remote work and telemedicine, AIS views the enterprise AR/VR business a market segment to be pursued. The strategy will be to showcase, support and provide platforms for proven use cases such as:

- create better medical outcomes,
- defense and safety,
- increase collaboration between remote teams,
- provide an immersive and engaging gaming experiences,
- advertising, marketing and product promotion,
- education and training,
- social media applications,
- public services including promotion of tourism
- improving retail sales.

Early Adoption of AR/VR in the Retail Sector in Thailand

Central Department Store, Thailand's leading retailer with a 75 year history, partnered with AIS in 2022 to create an *Augmented Reality shopping experience* via the AIS 5G PLAY AR application. The '**Central AR Personal Shopper'** application is basically a virtual assistant designed to introduce unique items to the shopper. To invoke the personal assistant, AIS customers need to click "AIS 5G x Central 75th Anniversary" banner in the AIS 5G PLAY AR application, then scan an item in the store. The AR Personal Shopper will then greet them and introduce the item on the screen.

Competition in AR/VR

We note that AIS competitor True Corp is investing for the roll-out of AR/VR content which it expects to see gain momentum alongside its' 5G network deployment. True's stated direction is to be developing (&/or funding the development) of original AR/VR content for consumer customers.

Source: www.bangkokpost.com/business/1971343/true-readies-ar-vr-content

Content Collaboration

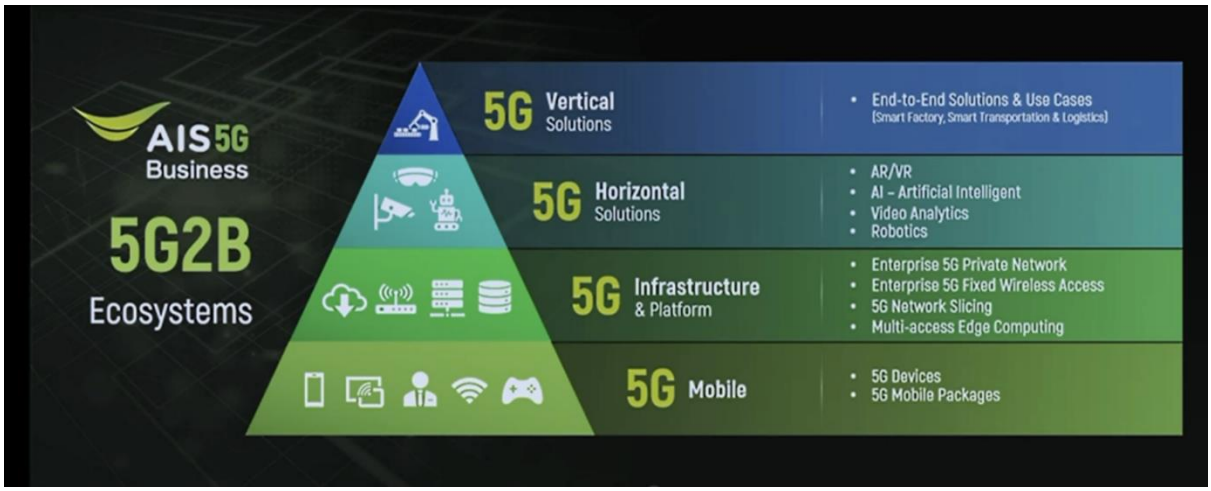
We understand AIS has dealings with Korea's LG – who has been aggressive in developing its own AR and VR content and marketing it to Mobile Service providers in the region. LG has agreements to supply 5G content to AIS as well as China Telecom Corp., Hong Kong Telecommunications Ltd., Japan's KDDI Corp. and Taiwan's Chunghwa Telecom Co.

Source: www.koreatimes.co.kr/www/tech/2021/04/134_306201.html

5.10. 5G Vertical Focus

In addition to 5G technology providing a platform for immersive experiences such as VR and AR that we outlined in Section 5.9, we see significant potential for new services with ultra-reliable, available, low-latency links for remote control of critical infrastructure, vehicles, and medical procedures and IOT. First let's outline the prevailing 5G vertical use cases, then examine IOT.

Figure 5-9 5G Vertical Strategy of AIS



Source: Saran Paloprakan, Head of Mobile and Consumer Products Department

Autonomous Vehicles, Connected Vehicles

The use case here is to leverage the available telematics to improve safety, traffic management and in-car entertainment, including 4K video, real-time navigation and AR for drivers and passengers. Data derived from the vehicle, surrounding infrastructure, surrounding environment can be augmented to provide personalized services in the connected vehicle use case. At its simplest level, decisions about when to travel, which routes to take and where to park will be augmented.

Smart Factories

Smart factories on 5G will help industries increase operational efficiency and productivity.

Smart Cities and Surveillance

Smart Traffic Management will leverage cameras and sensors generate data that city planners and urban authorities can analyze to make informed decisions. A number of cities are already taking advantage of available technologies to create a city traffic monitoring system that helps drivers reach their destination in an optimal time. The system will redirect drivers to avoid traffic jams and to

minimize fuel consumption, and monitor and analyze traffic flows to optimize streetlight use or prevent roads from over-congestion based on rush hour schedules.
Surveillance systems greatly improve public safety. 5G enables new opportunities to access a network of CCTV cameras for analyzing real-time video feeds enables first responders to be better prepared and more effective in assessing a dangerous situation.

Wearables and connected vehicles with cameras can also enable the provision of enhanced criminal insights. Police and first responders will have wearable devices that can provide real-time video feeds and other sensor-related data about their immediate environment. Video feeds can be used for facial recognition about a person's identity and potential criminal justice records.

Site Safety Monitoring.

Aerial intelligence provides a platform for physical asset management in a number of industry sectors. It can turn aerial and ground imagery data into insights for operational and corporate asset management. It can maximize staff safety in sensitive (remote and dangerous) areas with real-time video surveillance and automatic hazard detection.

Healthcare - Telemedicine and Remote Patient Monitoring

As AIS learned during COVID-19, this service can reduce the number of in-person doctor visits by making virtual care more available and effective. Also, with 5G-enabled devices, health care providers can monitor patients remotely and gather real-time data that can be used for preventative care. Innovations in medical device technology will also provide patients with more devices that enable them to measure and monitor their health from home and then be transmitted and analyzed by medical and health care professionals.

Media and Entertainment Consumption

Off-Site Major Events
This use case is for broadcasting at scale to millions of consumers concurrently an 'At Event' fully immersive interaction from a remote viewing location to mobile devices, 4K TVs or AR/VR glasses and headsets.

On-Site Live Events
This use case enables an experience at large-scale event venues, such as theaters, stadiums and ballparks. It provides customers with a variety of options, such as instant replay, choosing a camera feed and AR. Content will be distributed locally using edge technology to localize media and content interactions between customers and the event.

Pervasive IoT

5G is meant to seamlessly connect a massive number of embedded sensors in virtually everything through the ability to scale down in data rates, power, and mobility—providing extremely lean and low-cost connectivity solutions.

Chapter 6. Network Modernization

6.1. Introduction

AIS network organization is organized as three operational business units: mobile, Fixed BB (FBB) and enterprise networks. Each of the three operational business units (Bus) has their own network assets but all three share a common infrastructure (core and access). For example, the optical transport team manages all the aggregation points at cell sites and at fiber splitters.

6.2. Data Center & Cloud Connectivity

Currently Thailand has around 32 DC facilities (most are Tier III) with another 7 coming online in the next several years. NTT operates two Tier III DCs in Thailand. A number of international providers have entered the Thai market including Telehouse, OneAsia Network, and Chindata group. Equinix has yet to enter the Thai market. Alibaba, Google and AWS are all establishing cloud regions in Thailand. AWS is establishing an edge zone in Bangkok. One of the drivers of DC capacity expansion is demand in the heavy discrete manufacturing industries – automotive, electronics and petrochemical and food processing; many of these are located in the Easter Corridor in Thailand.

AIS operates data centers for its own operations and also provides wholesale co-location space to government entities, SMEs and enterprises. AIS divides the Data Centner resources into four regional centers with Bangkok Metropolitan Area (BMA) being one of the regions. Bangkok has three major data centers and one national Network Operations Center (NOC). Presently, AIS has a total of 9 data centers nationwide. However, In October 2021 announced that it was forming a new Data Center company focused on the entire Southeast Asia region beginning with a JV between AIS and **Gulf Energy**. In 2022 AIS, AIS, Singtel and Gulf Energy signed a Joint Development Agreement (JDA) and construction is planned to start in 2023[5]. Singtel is also exploring potential data centers in Indonesia with PT Telkom.

AIS has installed advanced power systems at its DCs. In particular, the power systems feature the following:

- DCs utilizes 2 source & feeder generators that provide the same power output to support the system as a backup in the case that one of the feeder generators malfunctions or is damaged. This backup system ensures the seamless operation of the Data Center at its full potential at all times.
- Fuel storage tanks equipped as part of the overall power backup system are able to supply fuel for both generators for up to 48 hours to prevent power shortages.
- The 2,000KVA emergency backup power system (UPS) on each line is equipped with backup batteries that can support the system for 15 minutes.
- The 300kW rectifier that provides DC current to the system is equipped with backup batteries which can support the system for 3 hours in the case of a power outage.

[5] Bangkok Post 2 February 2022

- DCs are also equipped with a Fault Tolerant backup system on the entire system in order to keep overall operations working seamlessly without interruptions.

The reason for the regional topology strategy is for redundancy and Disaster Recovery (DR). In the other three regions there are two major DCs. Enterprises can get access for OTT connectivity (such as Google connect by IPLC via Singapore), and also co-location space at the regional DCs. It is not just enterprises that use the co-location services in Thailand but universities. Some of the service features of the co-location services targeted at SMEs and enterprises include:

- Service quality guaranteed by ISO 27001 (Information security management), ISO 22301 (business continuity), ISO 20000-1 (Information technology service management), ISO 14001, ISO 27017, ISO 27018, CSA-STAR (cloud security) and SOC 2 Type II
- Environment-friendly structure design.
- A complete carrier-grade data center facilities, and also including both domestic and international connectivity.

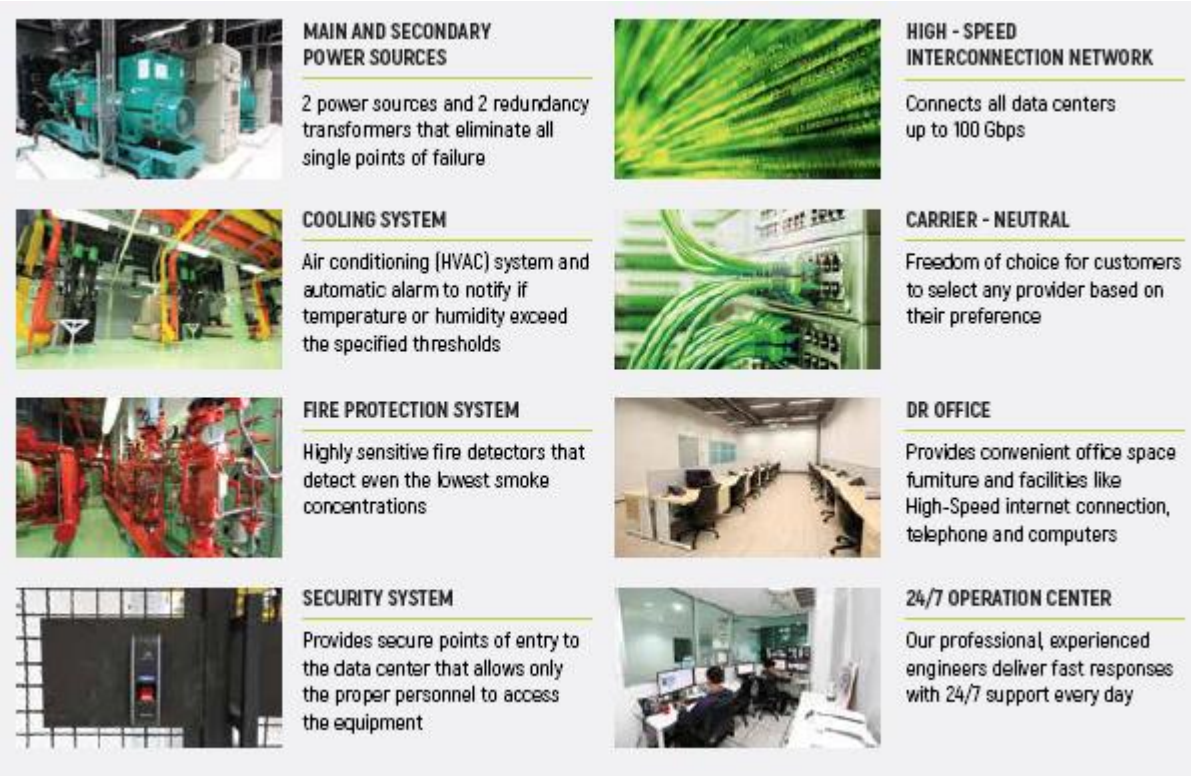
AIS also offers cloud back-up services to SMEs and enterprise.

AIS uses Small Form Factor optical pluggables for its DC Interconnect (DCI). 4G/5G mobile backup is also available to enterprise customers as a backup to the primary fiber access. As of 2020, AIS had more than 5,000 racks across their 9 DCs.

Figure 6-1 AIS+ CSL Data Center Locations

Source: AIS, 2020

Figure 6-2 AIS Data Center Facilities



Source: AIS, 2020

6.3. Internet Exchange and Submarine Capacity

Internet services has its roots in CAT (now merged with TOT and called National Telecommunication Public Company) which operated the CAT NIX (CAT National Internet Exchange). It is now known as **Thailand IX** (TH-IX) and is a Layer 2 IX network with 50 peering+ members including **Triple T Broadband** (also known as **3BB**) which has been acquired by AIS.

AIS operates PoPs in Singapore, Hong Kong, Malaysia, U.K. and US. AIS connects directly to Facebook/Meta, Google, SingTel, and NTT. Besides offering International IP-VPN AIS also hosts **Microsoft Network Infrastructure** (this is used to connect to Azure and Microsoft 365).

6.4. International bandwidth – submarine cables to Singapore

International private leased circuits (IPLC) in Thailand is generally more expensive than in neighbouring countries which is due to the fact that much of the traffic in the region is routed through Singapore and with five cable landing stations (CLS) (such as Changi North) operated by **StarHub**, **Singtel** and others. Most international OTT content arrives in Thailand via the Singapore Internet Exchange (SGIX) and companies such as **Equinix**.

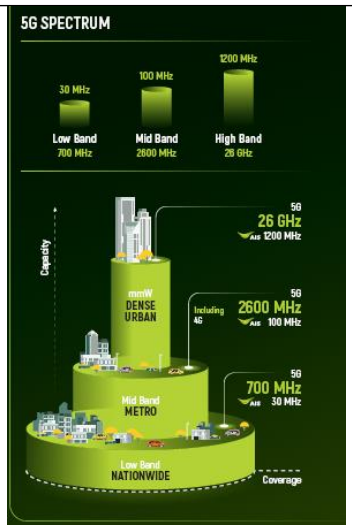
Figure 6-3 AIS Milestones 1986-2020

Source: AIS Business Catalog, 2020

6.5. Mobile RAN

AIS operates its mobile business, and this is even more pronounced with the launch of 5G, around excellent customer experience (CX) which ultimately translates into quality of service. This in turn will help AIS to introduce new 5G services such as mobile gaming and immersive AR/VR experiences.

Figure 6-4 AIS's 5G spectrum strategy



Source: AIS, 2020

Figure 6-5 Spectrum licenses held by AIS

Spectrum License	Grant Date	Grant Period	Expiration
2100 MHz spectrum • Bandwidth of 2x15 MHz • Provide telecommunication network covering at least 50% of population within 2 years and at least 80% of population within 4 years	7 Dec 2012	15 years	6 Dec 2027
900 MHz spectrum • Bandwidth of 2x10 MHz • Provide telecommunication network covering at least 50% of population within 4 years and at least 80% of population within 8 years	1 Jul 2016	15 Years	30 Jun 2031
1800 MHz spectrum • Bandwidth of 2x15 MHz • Provide telecommunication network covering at least 40% of population within 4 years and at least 50% of population within 8 years	26 Nov 2015	18 years	15 Sep 2033
1800 MHz spectrum • Bandwidth of 2x5 MHz • Provide telecommunication network covering at least 40% of population within 4 years and at least 50% of population within 8 years	24 Sep 2018	15 years	15 Sep 2033
2600 MHz spectrum • Bandwidth of 100 MHz • Provide telecommunication network coverage on major economic zone of Thailand as follows; (1) At least 50% geographical coverage of the Eastern Economic Corridor (EEC)[6] area within 1 year, (2) At least 50% population coverage of key cities area including Bangkok Metro area, Chiang Mai, Nakorn Ratchasima, Khonkaen, Songkla and Phuket within 4 years from license granted date. • Provide network based on IMT-2020 (5G) technology of at least 50% geographical coverage of the Eastern Economic Corridor area within 1 year to	21 Feb 2020	15 years	20 Feb 2035

[6] The Eastern Economic Corridor officially the Eastern Special Development Zone, is a special economic zone of three provinces in eastern Thailand. Collectively, these provinces occupy an area of 13,266 km², and in 2016 had an estimated population of over 2.8 million. Bankgok with 10.8 million population and Samut Prakan with 1.33 million people are Associated Areas of the EEC

receive special conditions applied for extended payment term in which 2nd – 7th installment starts in year 5 - year 10.			
700 MHz spectrum • Bandwidth of 2x10 MHz	15 Jan 2021	15 Years	14 Jan 2036
26 GHz spectrum • Bandwidth of 1200 MHz	18 Feb 2021	15 Years	17 Feb 2036
700 MHz spectrum • Bandwidth of 2x5 MHz	1 Apri 2021	15 Years	31 mar 2036

Source: AIS Annual Report, 2021

Multi-Band (Low, Mid and High) Strategy

AIS has been investing steadily in its 3G/4G mobile infrastructure over the past decade leading up to the 5G spectrum auctions in 1Q2022 when it bid and won at a cost of Baht 42.1 billion [US$1.35 billion] spectrum in the 700 MHz, 2600 and 26000 MHz bands. Thoth Advisory estimates that by 2026E the total 5G installed BTS will reach roughly 70,000 BTS from 26,000 at the end of 3Q22. When compared to its 4G installed density over of over 118,000 (estimated as of December 2022), 5G has a way to go still to achieve comparable cover. The introduction of band n28 @ 700 MHz is strategic because it lowers the total CAPEX needed to achieve >90% coverage of the population.

When AIS first launched its 5G service in February 2020, it was Non-Standalone (NSA) on all three bands -700/2600/26,000, and this was followed by Standalone (SA) in July 2020 (the supplier was Huawei). AIS has chosen to operate a multi-band 5G NSA/SA strategy with 2x15 MHz @ 700 MHz (band n28) band, 1x100 MHz @2600 MHz and 1x1200 MHz @ 26 GHz band n258. The 700 MHz band is effectively the coverage layer for AIS and band n7 2600 MHz is for capacity and coverage in the metro areas.

AIS is aiming for 88% coverage of the population by end of 2023 and at the end of 2022E the operator has achieved roughly 78% coverage of population. In 2020 when AIS launched its 5G service it did see a rise of 5G by about 15%. Similar to the way that 5G was launched by the three Korean operators in South Korea, AIS ran a TV advertising campaign promoting AIS as a network to enable mixed reality experiences.

AIS's blended data usage across post-paid and pre-paid accounts at end of 3Q22 was 29.6 GB and the blended data usage for post-paid and pre-paid were 31.9 GB and 28.3 GB, respectively.

In June 2022, AIS and ZTE announced the launching of a 5G Innovation Center.

Sustainability and Energy Consumption in the Mobile RAN

Aa discussed in Section 2.2, AIS has already installed a lot of solar panels (2,744 additional panes at basestations in 2021) for its basestations and has made energy savings and energy reduction important targets for the RAN going forward. AIS has developed seven focus areas regarding sustainable development covering the economy, society and environment:

- Digital Innovation
- Data Privacy and Cyber Security
- Human Capital Development,
- Social Inclusion
- Cyber Wellness and Online Safety

- Climate Actions
- Waste reduction

6.6. Fixed Wireless Access and mmWave spectrum

5G Fixed Wireless Access (FWA) also plays an important role in AIS' enterprise strategy going forward. AIS' 5G FWA utilizes the existing mobile network and fiber backhaul and aggregation so that FWA will not incur specific network costs beyond that of mobile phone users. The data packages will be tailored to SMEs most likely and consumers. In Hong Kong, for example, China Mobile Hong Kong and HKT offer 5G FWA targeting users who live in buildings without elevators (these typically do not have fiber access) and users who simply do not want to pay for fiber installation. HKT for example offers 250 GB per month as its basic 5G FWA data plan. We note that in Hong Kong the average fixed line broadband data usage is on the order of 200 GB fairly evenly splits between Pay TV, surfing and social networking.

6.7. Convergence and Optical Transport

With over 100,000 4G BTS and 26K 5G BTS as of October 2022, AIS's mobile network is vast and provides cellular coverage across all 77 provinces. Although AIS only had 2 million FTTH subscribers at end of 3Q22 as compared to over 45 million mobile subscribers, the traffic on the FBB is higher than that on Mobile even though in terms of revenue contribution mobile is about 10-11X that of combined FBB and enterprise. However, the enterprise business which represents less than 3.8-4.0% of total revenues does not generate significant traffic at this point in its evolution.

AIS has started to deploy 10G optical rings. Segment Routing SRv6 is planned for deployment in the next several years. Currently in Thailand roughly 38% of customers, according to APNIC, are able to get on IPv6 websites and in the case of AIS, approximately 65% of its customers are able to get access to IPv6 websites.

AIS utilizes a mesh architecture for its optical metro and transport/backhaul network. Similar to Japan, 95% of fiber cables are installed over the air. In terms of the technologies deployed, ASON is used and so is Topology Independent Loop (on the IP LAN) but IP+Optical synergy (switchover between optical and IP networks) has not been deployed as of yet.

The transport network team has visibility into the traffic coming from mobile, enterprise and fixed broadband segments and has various policies in place to manage and prepare for capacity upgrades based on the congestion utilization levels reaching prescribed thresholds.

6.8. 5G Packet Core

AIS was the first MNO in Thailand to deploy 5G Standalone (SA) in collaboration with **Huawei**. AIS launched 5G NSA (non-standalone) service in February 2020 using the 700 MHz, 2.6 GHz and 26 GHz bandwidth that it won in the spectrum auction, followed by 5G SA in July 2020 in cooperation with Huawei.

In July of 2021, AIS partnered with Chinese smartphone manufacturer **vivo** to run 5G Standalone (SA) network tests in Thailand. The tests took place in Bangkok and utilized a vivo V21 5G smartphone.

In March 2022, AIS, **Qualcomm** and **ZTE** announced what they claimed to be the world's first 5G NR-DC (New Radio Dual Connectivity) showcase in the field with 2.6 GHz and 26 GHz, achieving 8.5 Gbps peak downlink speed and 2.17 Gbps peak uplink speed with a single mobile device. ZTE noted that this

collaboration combined sub-6 and 5G mmWave frequencies. Moreover, it has also deployed 5G NR carrier aggregation between the 2600 MHz and 700 MHz (B28) bands. AIS has also deployed EN-DC (EUTRAN New Radio Dual Connectivity) which is ENDC technology is a new standard technology of the 5G in networks and smartphones can connectivity simultaneously on the same bandwidth frequency for maximum speed. The higher the frequency, the better performance for a user to experience.

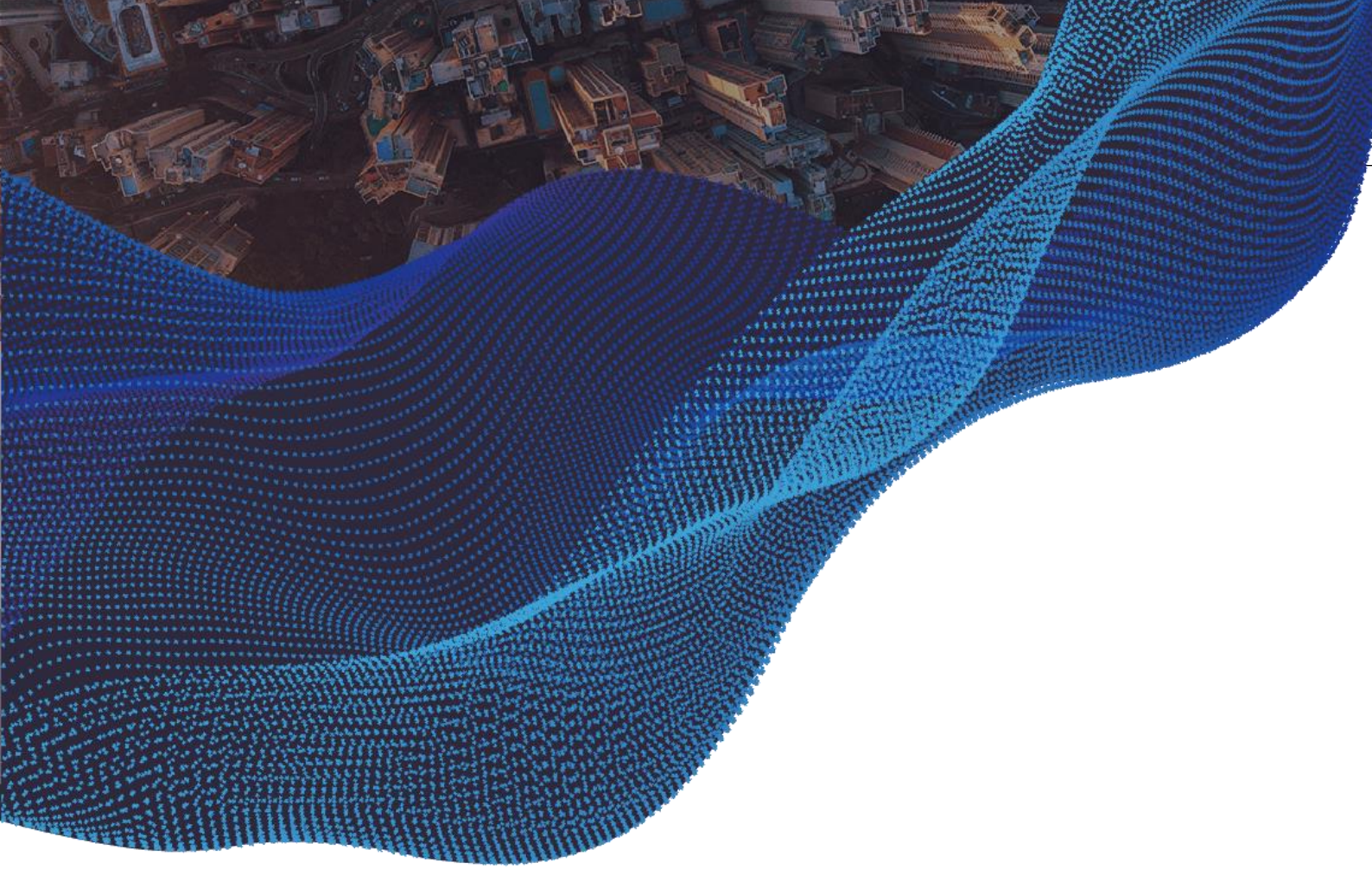
6.9. 5G Multi-Access Edge (MEC)

In order to serve the industrial and enterprise customers, AIS is building a single enterprise platform that aggregates its 5G network with mobile edge (MEC) public cloud and an application ecosystem. Thus, similar to what Verizon discovered in the U.S. when it started delivering private network services to factories and industrial companies that each installation has a unique set of system integration requirements such as the number of 4K cameras and the number of automated mobile robots and automatic guided vehicles (AGVs). Many of the requirements for performance, security and programmability can only be met with on-premise of nearby mobile edge compute resources. For customers that already have fiber access from AIS in various sites but want to deploy 5G private networking in a subset of those sites it becomes much easier if the operator such as AIS can offer a single platform including the MEC.

Chapter 7. Glossary of Terms

ACRONYM	Meaning	Commentary
AIAP	AIS IoT Alliance Program	
AIOPS	AI Operations	
ARPU	Average revenue Per user	
3GPP	3rd Generation Partnership project	
CAPEX	Capital Expenditures	Equipment and facilities (conduits, towers, buildings, structures)
Capex Intensity		Capex/Service Revenue
CPRI and eCPRI	Common Public Radio Interface and enhanced CPRI	
CSL		Formerly CS Loxinfo Company
CSOC	Cyber Security Operations Center	
CX	Customer Experience	
Current Ratio		Total current assets / Total current liabilities
DC	Data Center	
EEC	Eastern Economic Corridor	
EBITDA	Earnings before interest tax depreciation and amortization	
FTTH	Fiber-to-the-home	
IPLC	International Private Leased Circuit	
IP VPN	Internet Protocol Virtual Private Network	
Net Debt/Equity		(Total Debt - Cash) / Book Value of Equity
NBTC	National Broadcasting Telecommunications Commission	
DWDM	Dense Wave Division Multiplex	
EBITDA	Earnings Before Tax Depreciation and Amortization	
LOI	Letter of Intent	
MEC	Mtuli-access Edge Computing	
mMIMO	Massive Multiple Input Multiple Output	
OPEX	Operating Expenses	
O-RAN	Open Radio Access Network	
PoP	Point of Presence	
Quick Ratio		(Cash and cash equivalents + Current investment + A/R Trade) / Total current liabilities
RedCap	Reduced Capability	3GPP 5G New Radio
SD-WAN	Software Defined -WAN	A software-defined wide area network (SD-WAN) is a virtualized service that connects and extends enterprise networks over large geographical distances. WANs use links such as multiprotocol label switching (MPLS), wireless broadband (4G/5G), fixed broadband, virtual private networks (VPNs) and the internet to give users in remote offices access to corporate

		applications, services and resources, allowing them to work regardless of location
UCaaS	Unified Communications as a Service	



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