Case Study

Education
Intel® Processors

Advancing Malaysia's Digital Education Landscape

Intel enabled the creation of a 5G Digital School Library in Penang that made digital learning resources accessible to thousands of K-12 students across the state through an AI-enabled on-premise edge solution.

INSPIRING INNOVATION
PENANG
SCIENCE CLUSTER

> "This 5G Digital Library project with 5G interconnectivity is a significant infrastructure milestone for our Penang schools. Teachers and students can now leverage online resources for more effective teaching and learning while enjoying fast response and high availability with the hybrid model."
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> **Peng Ee Ooi**
> CEO
> Penang Science Cluster

The rapid growth of cloud and edge computing and the surging interest in artificial intelligence (AI) and 5G has transformed education, enabling remote learning and digitally driven educational experiences for millions worldwide. This shift, marked by accessibility and freedom from physical classroom studies, fosters creativity and growth among students, becoming a catalyst for national talent development and global competitiveness.

In the Asia-Pacific and Japan region, particularly Malaysia and Indonesia, the younger demographic and vibrant economy embrace digitally-enabled education as a game changer for fostering innovation.

Despite ongoing efforts, several obstacles continue to impede the advancement of digital learning experiences on a global scale. These include limited internet infrastructure coverage, inadequate device access, and a skillset gap among educators, hindering the seamless progression of digital learning experiences.

Overcoming these challenges needs a digital solution that can go beyond the scope of the usual server-based digital libraries and broadband connectivity. For the 5G Digital School Library project in Penang, Intel helped its collaborators and the state government create a unique on-premise edge solution. The pillars of this digital solution are:

- The latest 5G and cloud technologies
- Ease of access
- Simplicity of use and management

Many educational solutions currently utilize cloud-based platforms and repositories as the central hub for distributing learning materials and content to end-user devices, such as student devices, teacher laptops, or interactive smart boards, via the Internet. However, this cloud-centric model is not without its drawbacks. The reliance on a cloud-only infrastructure often overlooks several critical factors:

- **Bandwidth Limitations:** Not all locations have access to high-speed internet, which can hinder the distribution of content.

- **Network Reliability:** The possibility of network outages can disrupt access to learning materials.

The 5G Digital School Library solution adopts a hybrid platform approach to address these limitations and here's how it differentiates itself:

- **Content Storage Flexibility:** Learning resources and content are stored both at the edge (locally) and in the cloud. The decision of where to store depends on factors such as content sensitivity and the need for high availability.

- **Pre-Caching for High Availability:** By pre-caching content at the edge, the solution ensures that materials are available even during periods of limited or no internet connectivity.

- **Ease of Content Management and Platform:** The hybrid model solution here also simplifies the management of learning content, making it more accessible to users regardless of their technical expertise for ease of adoption. It also allows pre-cached content access locally and remotely.

Figure 1 depicts the architecture of the 5G Digital School Library. This initiative is made possible by a collaborative ecosystem comprised of Intel, Penang Science Cluster, 88 Captains and other stakeholders who share a common goal; enhancing the learning experience for Penang's students through the use of advanced technology. This goal would be accomplished through an on-site edge computing solution that includes a server for content access and multiple edge devices for each school. The content access server facilitates content caching and provides uninterrupted access to teachers and students.

Demo Digital Library

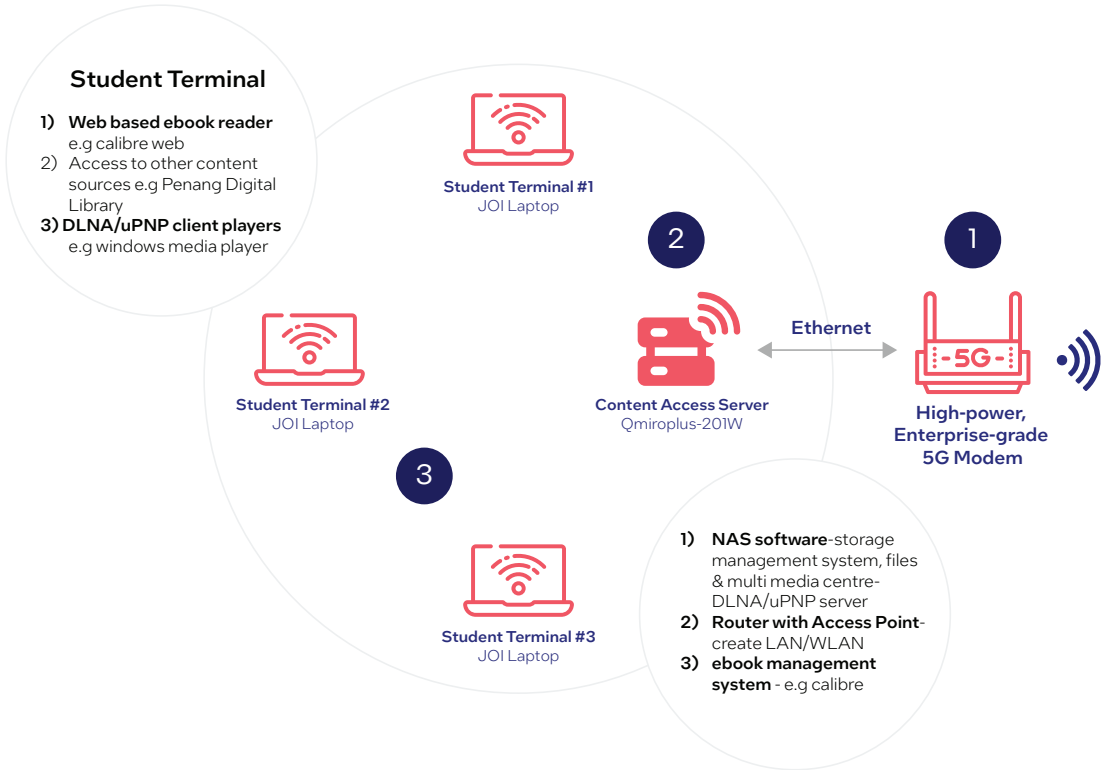

Figure 1: An overview of the on-premise edge solution that serves as a single 5G Digital School Library. An instance of this solution has been implemented across 88 schools in Penang.

Here's an overview of the solution:

- The on-premise edge solution centers on a Content Access Server (CAS), which maintains a 5G connection to a variety of online educational platforms and internet-based educational resources. Additionally, the CAS functions as a local centralized hub for students and teachers to access pre-cached learning materials locally and remotely.

- This hybrid approach, utilizing 5G technology, effectively addresses challenges related to bandwidth and internet connectivity, which are common barriers to delivering digital education in remote and underserved areas. By harnessing the power of 5G, these areas can bypass the limitations of traditional fiber optic infrastructure in underserved areas and access educational content from the CAS, even in the absence of an internet connection.

- The students and teachers' devices used in this setup are computers equipped with high-performance processors that enable the running of a wide array of educational applications and tasks.

Taking a student-centric approach to the on-premise edge solution

Since the solution was aimed at a relatively younger audience, Penang Science Cluster, the implementer of this solution, sought out stakeholders with the empathy and drive to improve lives through cutting-edge, user-centric technology. Hence, Intel Malaysia was selected as a technical consultant for this initiative.

88 Captains, a non-profit and N50 partner that works for the advancement of Malaysia's students, also brought together leading organizations such as SNS Network Technology Bhd., and Yes by YTL Communications Sdn. Bhd., as well as OCBC Bank, a leading Malaysian financial institution.

The technical stakeholders, including Intel Malaysia, had a background in providing innovative solutions spanning 5G, Cloud, Edge and high-speed computing at scale that provided ease of access and use to the end users.

To kick off the project, 88 Captains and JPNPP (Jabatan Pendidikan Negeri Pulau Pinang), the Penang State Education Department[1] identified 88 pioneer schools across Penang. Each of the selected schools would be provided with a start-up kit comprising a high-powered, enterprise-grade 5G modem, a Content Access Server (CAS) which can store up to several thousand ebooks, and 3 new laptops. This would enable every student to freely access their school's own Digital Library anytime and anywhere, without being constrained by the limitations of traditional classroom learning.

Scaling the solution to serve thousands of students

Intel Malaysia provided state-of-the-art implementation of the end-to-end school digital library architecture. With cutting-edge technologies delivering the processing power required at every stage of this on-premise edge solution, Intel delivered critical components that this entire system needed to succeed at scale.

SNS Network Technology Bhd is an ICT solutions provider with a 25-year history of providing devices and solutions to end consumers, government agencies, educational institutions, and corporate businesses in Malaysia. SNS Network Technology Bhd. provided students and teachers across Penang with 264 Joi laptops[2] powered by Intel® Celeron® processors with Intel® HD Graphics. These ICT devices would help both students and educators access the digital library safely and securely.

Connecting the entire solution, from the on-premise storage to the devices at the edge was Yes by YTL Communications Sdn. Bhd. Malaysia's leading 5G network. Yes deployed Malaysia's first 5G wireless broadband service along with 88 high-powered, enterprise-grade 5G modems, which were sponsored by OCBC Bank. This level of high-speed connectivity served to enhance the effectiveness of the on-premise edge solution.

Intel has partnered with Python Resources, a company specializing in Edge and cloud learning resources, to enhance the storage and access capabilities of digital e-books on an on-premise platform. This platform is built on Intel® CPUs and cloud services, providing a strong

infrastructure that supports Network Attached Storage (NAS) with fault-tolerant features. It also incorporates an open-source e-book management system. The performance and reliability of the platform are powered by Intel vPro® and Intel® Core™ series processors, ensuring a powerful and robust system for users.

Key Intel technologies that made this solution a reality

The Intel processors were chosen for the on-premise solution considering their compatibility with the platform, they were chosen for their ability to deliver secure, stable and reliable performance. These factors are critical to delivering an uninterrupted and streamlined learning experience in a collaborative environment, which is the ultimate goal of today's digital education infrastructure.

In terms of technical capabilities these processors delivered:

Performance at scale:
The incorporation of Intel vPro® and Intel® Core™ series processors brings purpose-built integrated accelerators and advanced security technologies to the forefront. These processors are designed to support the most demanding workloads, ensuring fast-growing workloads in educational settings receive the performance boost they require.

Security and reliability across environments:
Intel's commitment to security and reliability is evident in the array of features integrated into its processors. Intel® Active Management Technology (Intel® AMT), a feature of Intel vPro® technology, offers a wide range of built-in capabilities and plug-ins for management and security applications. These capabilities and plug-ins allow users or administrators to better discover, heal, and protect all network computing assets thereby achieving security at scale at every step of this on-premise edge solution.

Empowering education in Penang and beyond

The '5G Digital School Library Program' and the on-premise edge solution have ushered in a new era of digitally-enabled learning. The solution has not only made a tangible impact on students' learning experiences in Penang but has also advanced Malaysia's educational and learning infrastructure.

The implementation of the on-premise edge solution ensured that students gained uninterrupted access to a wealth of educational resources. It has addressed the limitations of traditional physical libraries and allowed students to learn at their own pace, anytime and anywhere. Thanks to its success at scale, similar libraries shall be set up for students across other states in Malaysia.

Of the 88 schools surveyed, all reported positive experiences and would recommend Yes 5G to other schools. The survey highlights exceptional performance in speed and service/support, reflecting high overall satisfaction. The impressive performance of Yes 5G services has enabled the schools to fully utilize the Internet, facilitating enhanced teaching and ensuring equitable internet access for all students. This underscores YTL Communications' commitment to advancing digital education experiences.

To date, the '5G Digital School Library Program' successfully enabled ~50% of Penang's rural schools[3] with internet access. In doing so, it has enabled almost 200,000 K-12 students[4] to access updated knowledge and expand their horizons. Above all, this solution isn't just about providing students with a digital mode of learning, instead, it is more about bringing them on par with the rest of the world in terms of digital literacy, digital accessibility and opportunities for upskilling and personal development. Spurred on by the success of this project, the government of Malaysia has also sped up the deployment and rollout of 5G infrastructure across Penang. In collaboration with Digital Nasional Berhad (DNB), an undertaking from the Ministry of Finance, the Penang State Government is committed to ensuring 80% of 5G network coverage across Penang by the end of 2023[5].

These steps tie into the Malaysian government's strategic initiative to upgrade its digital infrastructure and groom home-grown digital talent. In doing so, it will stay in step with the rest of the Asia-Pacific and Japan region, which is emerging as a global powerhouse for digital transformation initiatives.

Conclusion

Beyond the numbers, this collaboration reflects a shared long-term vision for education.

As a result of the deployment of this solution and its continued efforts and commitment to reduce the digital gap among students in Malaysia, 88 Captains was recently invited to become a partner organization of N50, an international NGO dedicated to empowering disadvantaged communities across the globe to gain access to the digital world.

Intel's commitment to such collaborations and forward-thinking technology solutions demonstrates a dedication to shaping the future of education. Collaborations such as these stand out as a compelling example of how efforts among solution providers, technology manufacturers, and local organizations can effectively bridge the digital divide in education and significantly improve students' learning experiences.

Sources:

1. Penang State Education Department
2. SNS Network Technology Bhd.
3. Intel
4. Portal Rasmi Jabatan Pendidikan Negeri
5. Penang's 5G network coverage to reach over 80 per cent by year-end, says deputy communications minister | Malay Mail