VOLUME 3

SINGAPORE SEMICONDUCTOR VOICE

MCI (P) 057/10/2020

Gearing Up for 5G Technology

SSLA 4TH RUN COMPLETED

GIGABIT WIRELESS WIDEBAND FOR 5G APPLICATIONS

SEMICONDUCTOR TRADEWINDS

BEYOND SMART HARD WORK AND GREAT IDEAS

SSIA
Singapore Semiconductor Industry Association

SSIA
Singapore Semiconductor Industry Association

SSIA SUMMIT AND SEMICONDUCTOR DINNER 2019

Marina Bay Sands | 10 October 2019

Embracing The Mobility Transformation

SAVE THE DATE

BE THE SPONSOR

https://ssia.org.sg/ssia-summit-and-semiconductor-dinner-2019/

FOREWORD BY EXECUTIVE DIRECTOR

Workforce development for our industry has been one of SSIA's focus over the past months. We have been busy giving talks at secondary schools to bring awareness of our industry not only to young students but also their parents and teachers. We are heartened to have received support from different companies for this effort through Tech88 initiatives. Besides attracting new talents, SSIA also focuses on the current talent pool by conducting relevant courses such as the Operations Excellence Course for peers in the industry. This course, conducted by Mr. Sandeep Kulkarni, an industry veteran, is not only designed for staff of MNCs but is also supporting SMEs in exposing their talents to methodologies that are adopted by reputable MNCs. Please keep a lookout for more upcoming courses.

We are also speaking to different institutions about expanding the choice of courses and further reducing the cost of each course. This will allow companies to select relevant courses applicable to their businesses at an affordable price, in turn, will help enhance their staff's skills and knowledge about the business and the industry. On the other hand, we have also successfully conducted the 4th run of the Singapore Semiconductor Leadership Accelerator Program (SSLA), which continues to prepare leaders of our industry to face an ever-competitive business landscape. In line with our direction to focus on workforce development, SSIA will be announcing more initiatives in the coming months.

Workforce development strategies are forward-looking and will support the industry in the long run. However, in the short term, we have noticed the impact of the US-China trade war is felt across the globe. The semiconductor industry here and in the region is not spared. Despite this, the industry is not slowing down in driving initiatives that focus on productivity improvement and innovating their products and service offerings. We see this from the attendance at our events, such as the SSIA Automation Supplier Day, where we have a record number of participants compared to the previous years.

SSIA will continue to organize relevant activities and initiatives which are in line with the Industrial Transformation Map (ITM) together with our industry partners and government agencies. We should see the glass half full in light of the current business downturn and take it as an opportunity to prepare ourselves for the upturn. As such, SSIA will be launching the Summit with the theme of "Embracing the Mobility Transformation" in October 2019. It will focus on introducing automotive production technologies and trends to the industry. This will be crucial to prepare the businesses from both MNCs and most importantly, SMEs, in knowing what it takes to move into the automotive business. Besides, we heard the call from the industry for a gala dinner during our annual industry survey, therefore, we will end this year's Summit with a networking dinner. This will be the largest SSIA event of the year with huge participation from the industry. Those who are interested to support this flagship event, do reach out to us at secretariat@ssia.org.sg.

Hope you all enjoy the 3rd edition of the Voice and we will continue to publish this publication every two months. We are seeking sponsorship, in the form of advertisement or advertorial to keep us running operationally, too. Semiconductor Voice will be effective in publicizing your organization, products or services as it has an extensive outreach to the industry. Please contact the Secretariat for more information.

EDITORIAL TEAM

EXECUTIVE DIRECTOR
Ang Wee Seng
weeseng@ssia.org.sg

PROJECT MANAGER
Daphne Leong
daphne@ssia.org.sg

PROJECT MANAGER
Delia Cheung
delia@ssia.org.sg

MARKETING & COMMUNICATIONS MANAGER
Gillian Cheng
gillian@ssia.org.sg

HR MANAGER
Patsy Tan
patsy@ssia.org.sg

PROJECT EXECUTIVE
Rebecca Foo
rebecca@ssia.org.sg

EXECUTIVE ASSISTANT
Cindy Chong
cindy@ssia.org.sg

PUBLISHING AGENT
Print & Print Pte Ltd

contents

INDUSTRY

PEOPLE

AUTOMATION SUPPLIER DAY 2019

A New Platform For Semiconductor Industry Players To Explore Automation Solutions

Automation has been a major growth driver for the semiconductor industry in the transformation of industry 4.0 and wide-ranging applications of artificial intelligence are emerging rapidly in semiconductor manufacturing. As a key partner for the Electronics Industry Transformation lead by Economic Development Board (EDB) of Singapore, Singapore Semiconductor Industry Association (SSIA) held its annual Automation Supplier Day at One Farrer Hotel on 23 May 2019, providing the semiconductor industry peers a new approach to gain insights into the latest automation solutions in the industry. The event has attracted 160 participants from 62 corporates in Singapore and the region.

Automation solution showcase at SSIA Automation Supplier Day

Growing Opportunities In The Industry

"The event was aimed at facilitating business matching and development for companies. We can see increased participation from both MNC and SME companies this year despite a downturn in the industry over the past quarters. This has shown there are still many opportunities within the semiconductor industry, especially with regards to activities in improving operations' effectiveness and productivity," said Mr. Ang Wee Seng, Executive Director, SSIA.

Speakers from Hewlett-Packard Singapore Company, Beckhoff Automation Pte Ltd, Infineon Technologies, Dream Technology System Pte Ltd and A*Star have been invited to share on the roadmap, technologies, opportunities and challenges in Industry 4.0. The event was then divided into 4 breakout sessions with sub-themes of Preventive Maintenance, Visual Inspection, Logistics and Automation in the afternoon.

Mr. David Chia, Managing Director of Beckhoff Automation Pte. Ltd. said, "In the drive towards higher manufacturing productivity, we are witnessing more companies developing and executing their digitization plans. The biggest challenges for digitization are funding, technology standards and talents. Companies should collaborate more to create a common standard since there are more to gain from standardization than competition. Governments across the region should help in the funding of digitization initiatives because this is very important for SMEs."

Mr. David Chia

Mr. Ang Wee Seng

Right Business Matching and Networking Platform

Local and foreign suppliers of automation products and services were also invited to the event to showcase how IoT, big data analytics and machine learning can intelligently improve manufacturing performance and productivity improvement. Participants comprising end users and suppliers of automation solutions have utilized the online platform of the event apps to build meaningful connections. Over 50 meetings and networking sessions between potential customers and suppliers have been scheduled during the event.

"We believe collaboration is key for the industry to thrive on the Industry 4.0 transformation and an engaging platform is a prerequisite. At the Automation Supplier Day this year, we focus on bringing the right companies on board to participate at the same time encouraging networking and establishing relationships

between end users and suppliers. We hope the event will grow the electronics and semiconductor industry in Singapore," said Mr. Ang.

Mr Jayachandiran

Mr Jeffery Pan

Mr James Yip (right) receiving the token of appreciation from Mr. Ang Wee Seng

Mr Chan W.E.

Mr Robert Ronald

EVENT HIGHLIGHTS

SMART Manufacturing Journey – What you need to know?
Robert Ronald, Master Program Manager, Strategy & Planning, Inkjet Supplies Operations, Hewlett-Packard Singapore Company

Next Steps Towards Industry 4.0
David Chia, Managing Director, Beckhoff Automation Pte Ltd

Opportunities in the Industry 4.0 transformation Era
Jayachandiran, Senior Project Manager, Infineon Technologies

Virtual Commissioning with NX MCD and PLCSim Advanced
Chan W.E., Technology Director, Dream Technology System Pte Ltd

A*STAR Collaborative Commerce Marketplace
James Yip, Senior Industry Development Manager, A*Star

The Operation and Technology Roadmap program
Jeffrey Pan, OTR lead facilitator, A*Star

Breakout Discussion:

Track 1 – Cost-effective Solutions To Apply AI For Predicting Failure & Quality Control

Track 2 - AI Solutions To Tackle, Track & Analyse Complex Data

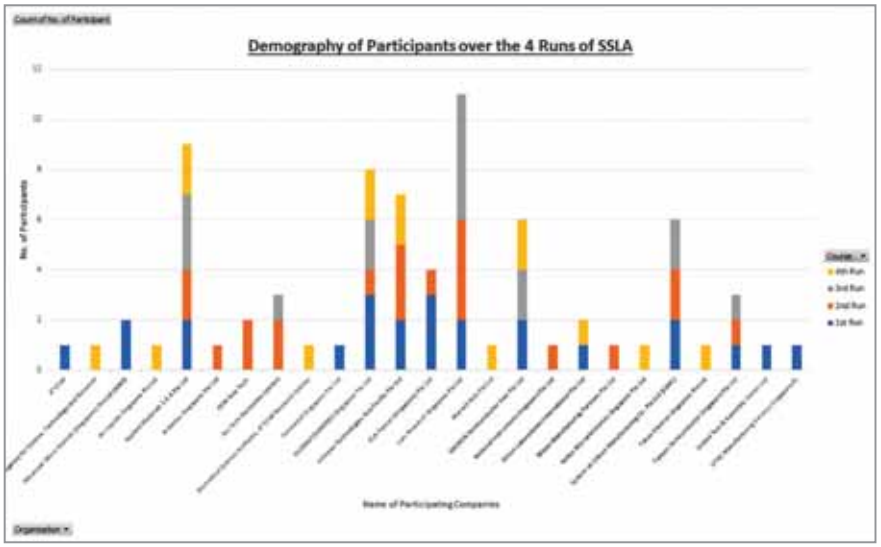
Breakout discussion

SSLA 4TH RUN COMPLETED

The 4th run of Singapore Semiconductor Leadership Accelerator (SSLA) program was completed on 30 May 2019. SSLA was launched in 2017 under the SkillsFuture Leadership Development Program and has been co-developed by SSIA and Human Capital Leadership Institute (HCLI). Though many companies, especially MNCs, have already developed their internal existing leadership courses, SSLA is a unique course to them since it offers an immersive hands-on learning experience with special emphasis and a strong focus on the semiconductor industry. Speakers with extensive experience in the industry have been invited to share their experience and learning while the networking session in the course has provided a chance for participants and the senior leaders to connect with each other. There were only participants from MNCs in the first two runs. Having received positive feedback from participants and their companies, the course has also attracted participants from SMEs in its 3rd and 4th run. Till date, 76 participants from 25 companies have attended this course.

Class of SSLA 4th Run

Interactive activities and classroom sharing



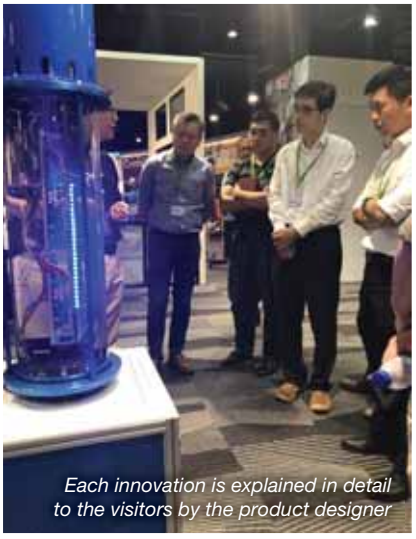
Though the course structure is consistent in each run, modules will be fine-tuned to cater to the needs of each run of participants. For example, the session of communication skills has been extended for high and mid-level managers in order to help them achieve better results through strategic communication with their direct reports and cascading information effectively. There are also specific programs for every run as participants have found them providing inspirational experience. Visiting the 3M Innovation Centre is one of such programs.

Visiting 3M Innovation Centre

On the second day of Module 2, participants of Run 4 visited the 3M Customer Technical Center (CTC) in Yishun. Representatives shared with participants the history of the company and its core technologies and innovations behind its products. The CTC compromises of 15 showroom areas – all equipped with interactive samples, simulating the real-life applications of these solutions. Their products range from industrial products such as filtration, cooling system, polishing abrasion; to healthcare supplies such as medical devices and bandages; to office supplies such as our all-time favourite Post-it tabs; to even something close to our hearts such as household products like hooks, scrubs and mops. As an integral part of 3M's culture, employees are encouraged to give ideas or even dive into research to solve customers' needs regardless of job titles or country borders. All of these initiatives have shown the passion to inspire innovations which impressed SSLA participants most.

Group photo taken as a memento to the 3M visit


A briefing about 3M history and their innovation journey


Each innovation is explained in detail to the visitors by the product designer

Networking Session

On the last day of Module 2, each of the SSLA participants was awarded a certificate of achievement by SSIA Executive Director Ang Wee Seng. The graduation ceremony was followed by a cozy networking session at a bar. Other than SSLA graduates, senior leaders from the industry, representatives from HCLI, SSIA board members as well as government partners including EDB and WSG also joined this session. All had a good time and an enjoyable evening.


Networking Session

Testimonials from participants:

"Had read on 3M innovation before, but having the opportunity to get first-hand information was priceless"

– Christophe Bouquet, Director of Singapore Development Centre, Infineon Technologies Asia Pacific Pte Ltd

"I was impressed by Bill Cornwell who strongly emphasised the importance of critical thinking skills and how each of us can learn from each other."

– Rick Chua, Director of Materials Management, Worldwide Operations


A cosy evening for all SSLA participants and guests

OPERATIONAL EXCELLENCE COURSE

Singapore Semiconductor Industry Association (SSIA) organised the Operational Excellence Course on 4th to 5th July 2019 at Lifelong Learning Insitute. These days, many companies are facing a very challenging business landscape in ever-changing global politics and market demand. Stiff global competition, operating cost pressure and high expectation for quality force them to relook into how they define the conventional operational excellence of their business.

There are several factors that drive excellence because it can never be achieved by accident. During the 2-day course, the Instructor, Mr. Sandeep Kulkarni, has introduced how these various factors interact with each other and how to achieve excellence with the right combination of them through various real-life examples. Some of these factors include proper project management methodologies, strong teamwork culture, solid execution, error avoidance, good communications and most importantly, the right leadership traits to bring these all together.

More Holistic View Of Operational Excellence

17 participants comprised of engineers, project managers and business development managers from the industry joined the course and many said the course helped them understand operational excellence in a more holistic view. Alvin Terredano Ocampo, Principal Engineer from GlobalFoudries said, "Having the right mindset is the most important factor to be excellent in work. The course has introduced many real-life examples to illustrate this and the operational excellence philosophy." Tang Hui Ying, Engineer from GlobalFoudries, said, "I am interested in the topics of project management, risk management and the components leading to operational excellence. Overall, it is an effective and useful course to help me excel in my work."


Class photo of the Operational Excellence Course


Participants of the course


Mr Sandeep Kulkarni

The course helped participants understand Operational Excellence in a holistic way

Due to the overwhelming response from the industry in the first run, SSIA will be conducting the second run of this course planned for September 2019. Please email to secretariat@ssia.org.sg if you are interested in the next run.

INTERVIEW WITH BOARD MEMBER

Jerome Tjia is the Honorary Secretary of the new Board of Singapore Semiconductor Industry Association (SSIA). He has been working in the semiconductor and electronics industry for 30 years and he heads the Singapore Development Centre of Infineon Technologies.

This is a crucial time for both SSIA and the industry, going through major transformation to drive the industry forward. What excites you about coming on board SSIA at a time like this?

I have witnessed SSIA growing from strength to strength over the years since my involvement from 2009. It has been an honour to be part of its transformation from a small newly-established association, to one that commands wide representation across the Singapore semiconductor industry.

Today, SSIA is working closer than ever with EDB as a key partner to realise the Electronics Industry Transformation Map (ITM), an integrated roadmap that maps out restructuring efforts and industry-focused growth strategies supported by four pillars: productivity, jobs & skills, innovation, and trade and internationalisation. I cannot think of a better time to be part of the new Board and I look forward to working with fellow industry leaders to sustain our industry's growth and competiveness.

As a senior leader in the semiconductor industry, how do you see your expertise and experience being utilised in your new role?

I am glad that one of the pillars of ITM is innovation, which is outlined as strategies to leverage R&D to develop new products and services. This is very relevant to my professional background as my extensive industry experience lies primarily in R&D for integrated circuit design. As the Head of Infineon Technologies' largest Development Center in Asia, I am responsible for product development activities spanning across diverse functions in our business lines.

Today, Singapore has more than 30 IC design centres, a testament of the key role R&D plays in Singapore's rich semiconductor ecosystem. As a member of the new Board, I look forward to representing the diverse views of Singapore's vibrant R&D community, and fostering lasting industry partnerships.

The new Board comprises of other senior leaders from the industry with their own expertise and experience. How do you see this enabling the capability of SSIA in terms of reaching its goals?

The new Board embraces different expertise, experience and gender diversity. We have industry veterans from MNCs and SMEs across the entire semiconductor value chain, with extensive experience in R&D, general management and operations. I am confident that this lends richer perspectives, ensures inclusivity and guarantees continuing relevance in SSIA's good work in steering the industry amidst the many challenges brought about by digitalization.

In your opinion, how important are collaborations for a trade association such as SSIA and how can we build on partnerships to create a cohesive electronics and semiconductor community in Singapore that can thrive?

I believe collaboration is essential in any organisation. At Infineon, we just opened our first global Co-Innovation Space at our Asia Pacific Headquarters in Singapore last year to co-innovate with start-ups on new disruptive end applications that will drive our digital transformation.

SSIA has limited resources as a non-profit trade association. Therefore, gaining the support of all parties in achieving shared goals is an important step. It is clear to me that the growing achievements and extending reach of SSIA over the years is built on collaborations.

A new and diverse Board made out of industry veterans is a great turning point in SSIA's journey. Today, we are in an excellent position to drive joint initiatives, and better support Singapore's Electronics Industry Transformation Map (ITM).

What's your personal aspiration and how do you see that aligning with your new role as officer bearers of SSIA board?

I look forward to giving back to the industry with a stronger R&D representation in my role at SSIA. I feel this is essential as we step up our efforts to transform the electronics sector and embrace digitalization. At the same time, I aim to foster university engagement as a member of the Departmental Consultative Committee of the National University of Singapore, and the Advisory Committee of Republic Polytechnic .

I believe talent development begins very early in our schools. As a fast-paced industry that is intrinsically tied to global market shifts and emerging technologies, we need a skilled and highly reactive workforce that is quick to take up new technologies in a completely new economic environment.

SSIA HR ROUNDTABLE - A TWO-WAY DISCUSSION ON HR INITIATIVES

The year 2018 marked a significant year for Singapore Semiconductor Industry Association (SSIA) as it revised its constitution to better support the mission to drive the Electronics Industry Transformation Map (ITM) for this sector. One of the major focuses for 2019 is workforce development and retention for our industry. Initiatives such as SSIA HR Roundtable has become an important platform to help understand the needs of the industry when it comes to human capital. At the same time, it is a platform where SSIA communicates to the industry on initiatives and activities the Association is working on or are already in place.

The 2nd run of SSIA HR Roundtable was held in Grand Copthorne Waterfront Hotel on 30 May 2019, bringing together over 20 HR leaders from 17 companies. It was conducted in a two-way discussion on key topics. SSIA Executive Director, Ang Wee Seng, gave an update of recent initiatives and activities organised by SSIA in his opening speech, followed by representatives from Workforce Singapore giving an introduction on the Career Trial Program. Participants of the HR Roundtable actively provided feedback on how the program could better help companies attract the right talents for the electronics and semiconductor sector. JTC representatives were also invited to share their visions in creating tomorrow's industry spaces and the upcoming collaborative event jointly organised with SSIA. Participants had a good time in networking, too. The SSIA HR Roundtable will be held regularly to allow HR professionals from the industry to meet and discuss human resource initiatives in order to benefit from the insights and experience of one another. The next HR Roundtable will be held in August 2019.

Ang Wee Seng giving his opening speech at SSIA HR Roundtable

Ashley Yap from WSG introducing the Career Trial program

Participants had a good time in networking

Regine Teng (left) and Cindy Lim (right) from JTC presenting JTC's new visions on building a vibrant and collaborative industry ecosystem

SCHOOL OUTREACH - WOODLANDS RING SECONDARY SCHOOL

In a multi-dimensional and multi-rooted economy like Singapore where there are opportunities available for bright graduates in almost all areas, it's important to educate younger masses to appreciate and understand the challenging and exciting work that awaits them in the semiconductor industry. One of these initiatives launched by SSIA is the School Outreach Program, in which SSIA hopes to facilitate sharing sessions with professionals from the electronics and semiconductor industry sharing their vision and experience in the sector with secondary students.

On 31 May 2019, Singapore Semiconductor Industry Association Executive Director Ang Wee Seng was invited as the speaker to talk about the career prospect in engineering at the Career Day of Woodlands Ring Secondary School. Parents were also invited to attend the talk so that they can get more updated information to guide their children on future career planning. As a semiconductor industry veteran with over 20 years of experience, Wee Seng has shown a good example to demonstrate how a science student can fit in and contribute to the semiconductor industry. Both students and parents were curious and responded with many interesting questions. Some of them were keen to know which subject they should focus on to become an engineer whereas some were concerned about the starting pay and the career prospects of an engineer.

Positive Feedback From Students

Fira, a Sec 5 student in Woodlands Ring Secondary School, felt excited after attending the talk. "I am clearer of the path for engineering after I have participated in this career talk. As Singapore is now more towards technology-based, I really want to pursue my career in this field," said she.

Fira

Vinay Vanjre Ravi, a Sec 4 student, said, "I know more about the opportunities of becoming an engineer. It's a very good talk as you know the skills required and different aspects to make you a successful person in the future."

Vinay Vanjre Ravi and his father

SSIA hopes to facilitate more such sessions with different secondary schools and will be working closely with the Education and Career Guidance coaches from MOE, as part of its TECH 88 initiative. Schools who are interested in hosting similar talks can send an email to secretariat@ssia.org.sg.

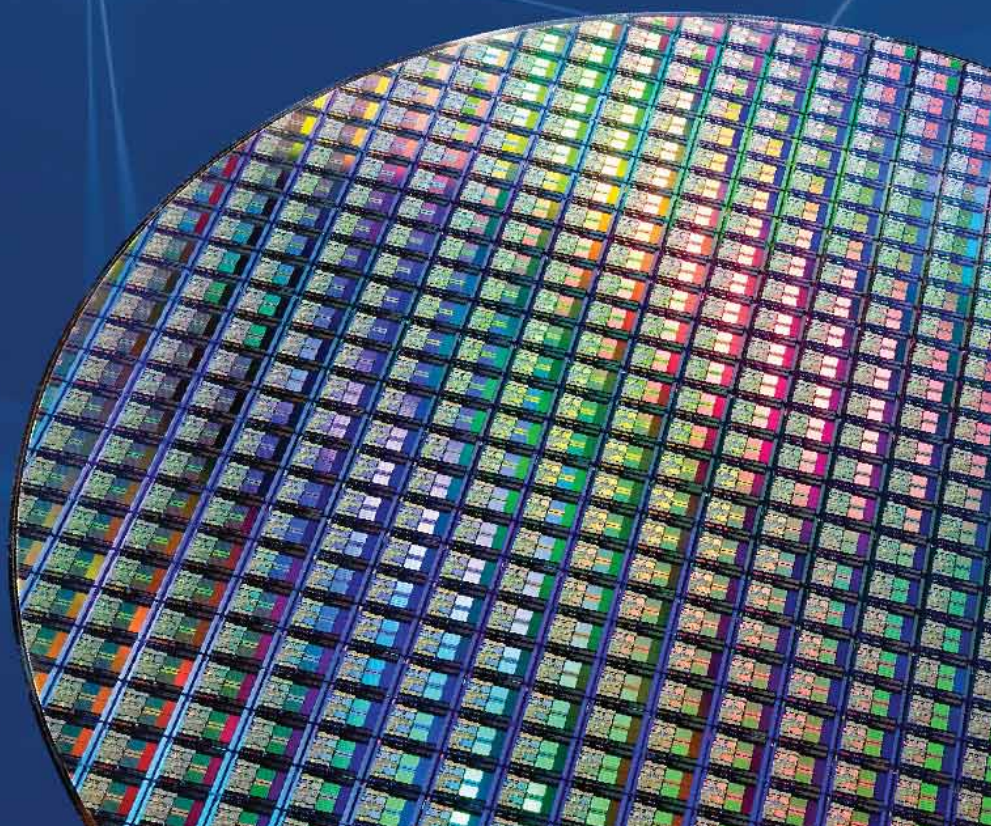
VISIT MODEL FACTORY@ARTC

To help member companies understand how they can leverage automation and digitalisation to boost competitiveness and develop new business solutions, Singapore Semiconductor Industry Association (SSIA) and Singapore Industrial Automation Association (SIAA) jointly organised a Joint Members' Visit to Model Factory@ARTC on 26 June 2019. A model of a factory of the future, the Model Factory @ ARTC is a part of A*STAR's Model Factories Initiative to support the industry in its digital transformation journey. The Model Factory@ARTC focuses on disruptive technologies, primarily Industry 4.0 technologies, that can transform factories and industrial operations to be more efficient and competitive. It offers a state-of-the-art manufacturing facility equipped with industrial machines and digital systems through an initial partnership of over 20 industry and public sector research partners. SSIA members who are interested in visiting ARTC Model Factory can email secretariat@ssia.org.sg


Photo Source: A *STAR website

GLOBALFOUNDRIES®

Changing *the industry that's* ***Changing*** *the world*



GEARING UP FOR 5G TECHNOLOGY

5G, the newest version of the mobile network technology which is said to be 10 times faster than 4G, is expected to be the new enabler for many market segments, including mobile phones, automotive, virtual reality and IoT. The semiconductor industry will be one of the key industries leading the charge when it comes to improving the technology to permit greater bandwidth and lower latency in different applications. The new technology is anticipated to be a major revenue driver for the semiconductor and electronics industry over the next few years.

Singapore Semiconductor Industry Meet 2019

5G is the next generation of mobile broadband and has been close to a decade in the making. This technology will soon replace or at least augment the 4G LTE network as 5G is going to allow faster download and upload speeds. Introduction of the 5G network is finally becoming a reality, with several countries like South Korea, China, and the United States starting to roll out implementation of such network, and many more countries have already had implementation plans in place. 5G will be a driver for the semiconductor industry in the coming years.

Singapore Semiconductor Industry Association (SSIA) held its first Singapore Semiconductor Industry Meet at the Sheraton Towers on 23rd July 2019. Previously known as the Members Meet, the event this year was opened to all members of the semiconductor industry to better update everyone on activities and initiatives of the Association which may benefit companies looking for opportunities to upgrade or promote their products and services.

The full house event, with participants from MNCs, SMEs, government agencies and educational institutions, also heard from industry experts on 5G, such as Dr. Carlos Mazure, Chairman & Executive Director of the SOI industry Consortium and Mr Gobinath Vanan of National Instruments ASEAN & ANZ, on the growth for 5G technologies and predictions for the 5G sector. The night ended with the SSIA staple of good food, good drinks, and good company - bringing members and non-members together to discuss updates from the evening and possibilities for future collaborations.

EVENT HIGHLIGHTS

5G Ecosystem: Accelerating the SOI Industry Growth
by Dr Carlos Mazure,
Chairman & Executive Director of SOI Industry Consortium
EVP, Advisor to CEO of Soitec

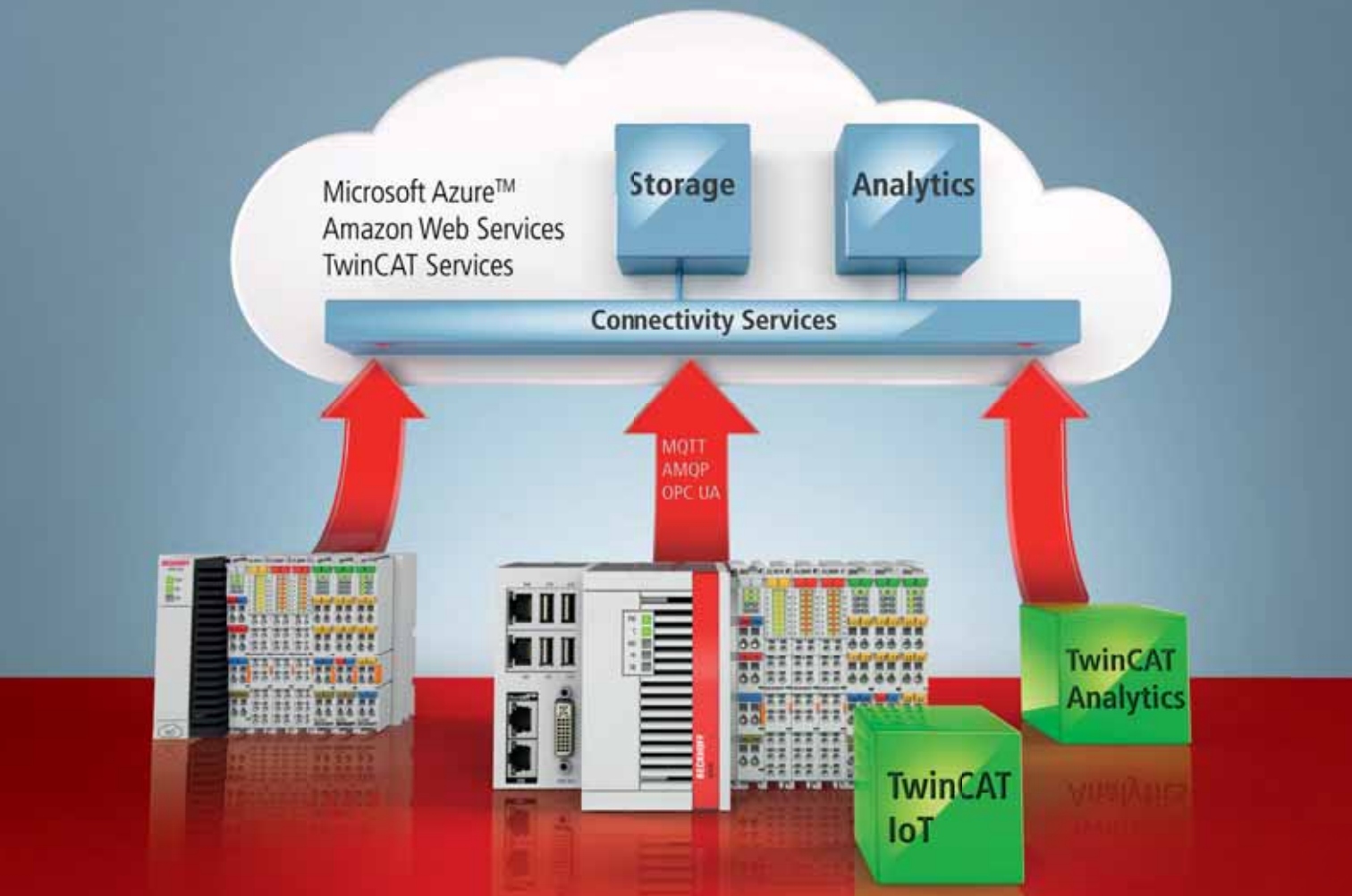
Overcoming Test Challenges of 5G New Radio
by Gobinath Tamil Vanan,
Field Marketing Manager of National Instruments ASEAN & ANZ

Key Challenges in 5G NR
by Glenn Vandevoorde,
Chief Executive Officer of arQana Technologies

5G: The Digital Customer Journey
by Neelesh Maglani,
Strategic Pursuits Lead & Chief Technologist of HP Enterprises

Starry – Happy Interneting
by Pankaj Gulati
Head – International Growth of Starry Inc.

Machine control for Industrie 4.0 with TwinCAT



www.beckhoff.com.sg/Industrie40

Beckhoff provides the ideal foundational technologies for Industrie 4.0 and Internet of Things (IoT) applications via standard PC-based control. With the TwinCAT engineering and control software, machine control systems can be extended to support big data applications, cloud communication, predictive maintenance, as well as comprehensive analytical functions to increase production efficiency. As a system-integrated solution, TwinCAT IoT supports standardised protocols for cloud communication and enables the easy integration of cloud services right from the machine engineering stage. In addition to fault analysis and predictive maintenance, TwinCAT Analytics offers numerous opportunities to optimise machines and systems in terms of energy consumption and process sequences.

Beckhoff Automation Pte. Ltd.
#05-07/08 Nordic European Centre
Singapore 609927
Phone: + 65 / 6697 6220
sales@beckhoff.com.sg

New Automation Technology **BECKHOFF**

GIGABIT WIRELESS WIDEBAND FOR 5G APPLICATIONS

Wireless transmission with more than one Gigabit-per-second (Gbps) data rate is becoming essential due to increased connectivity between different devices [1]. In order to cope with the exponential increase of wireless devices and data rates to provide, the network infrastructure is becoming more complex and denser. As a result, the network infrastructure will be endowed with an unprecedented degree of intelligence, integrating with the environment and offering fast, secure, and reliable communications. Objects like lamp posts, road signs, buildings, vehicles, drones, robots, trains and watercrafts will be equipped with intelligent devices able to detect electromagnetic signals, perform computations and store data.

Although individual user experience is improved, the system capacity remains basically unchanged. It is also harder to achieve high data rate applications below a 6-GHz band due to spectrum scarcity. Therefore, the millimeter-wave (MMW) band has drawn increasing interest over recent years for enabling such a high-speed wireless transmission because of the enormous raw bandwidth that is available like 5G technology [2].

Combining cutting-edge network technology and MMW integrated circuit design, 5G technology offers connections that are multitudes faster than current connections with low latency (1ms or less) and high speed (> 1Gbps) for massive Internet of Things (IoT), tactile internet, drones and robotics. It will transform the way we live, play, work and travel while delivering more performance, efficiency and comfort. New products, systems, services, business models and entire industries will be born as 5G technology provides a huge leap forward in speed, capacity and connectivity.

At the Singapore University of Technology and Design (SUTD), a group of researchers has successfully developed a MMW transceiver System-on-Chip (SoC) for 5G technology. The microchip consists of a transmitter, a receiver, a frequency synthesizer and some digital reconfiguration control blocks. It incorporates both time division half-duplex and full-duplex multiplexing mode which is reconfigurable by digital control. The chipset can be interfaced as single-ended 50-Ω matched at RF front-end and differential quadrature 100-Ω matched baseband interface to support long distance gigabit data rate wireless communication.

System Architecture

The MMW transceiver SoC consists of the transmitter and receiver chain which are both using sub-harmonic mixer (SHM) frequency translation architecture as shown in Figure 1.

Both the up-conversion and the down-conversion SHMs are provided with the differential quadrature local oscillator signal generated from a common phase lock loop sub-system and a differential quadrature hybrid coupler. Most of the building blocks are biased using the internal compact bandgap reference that provides a stable current source. The baseband processor is interfaced with the microchip using the receiver and transmitter digitally controlled variable gain amplifiers (VGA). The RF front-end from the antenna are interfaced to the receiver at the low noise amplifier (LNA) input and the power amplifier (PA) output. Figure 2a presents the overall system layout which comprises 3 sub-systems with each having a pre-defined functionality namely a receiver (RX), a transmitter (TX), and a phase-locked loop (PLL). The microchip is integrated on a printed circuit board (PCB) with the built-in antenna as shown in Figure 2b that can support four non-overlapping channels, each 2.16-GHz bandwidth. Figure 2c shows the evaluation board for full system performance measurement, verification and validation.

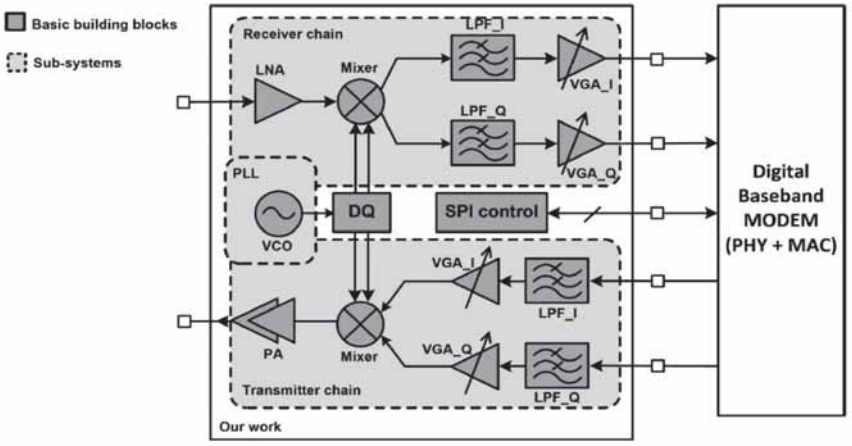


Figure 1. MMW transceiver SoC with sub-systems and building blocks.

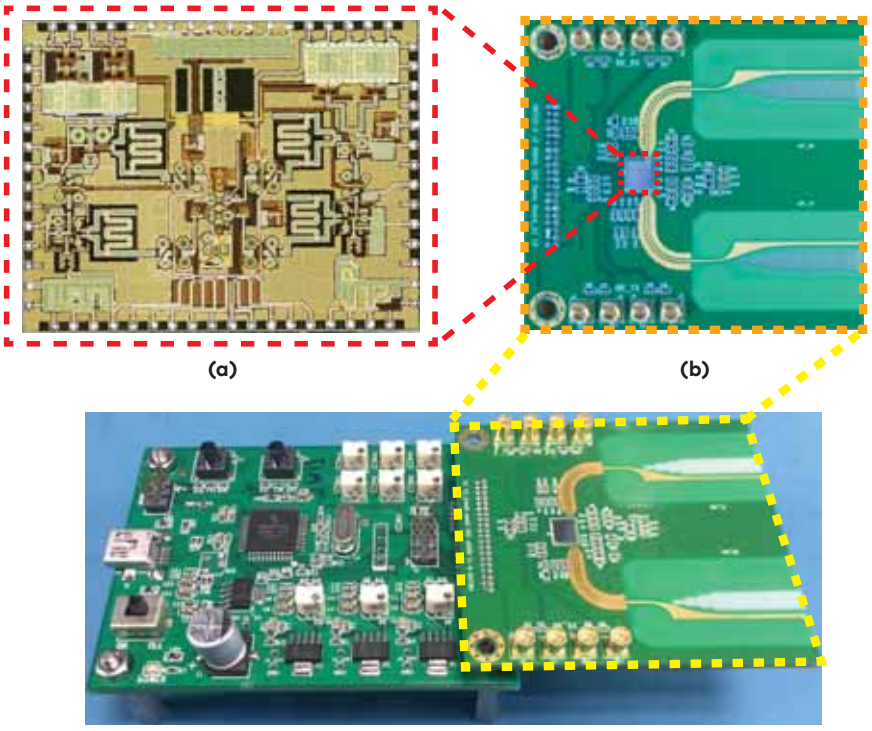


Figure 2a. Layout of microchip, b. Microchip with antenna and PCB, and c. Evaluation board.

Potential Applications

a) Building-to-building communication

The building-to-building application, as shown in Figure 3, is one of the main targets for this microchip. Basically, it provides a low-cost and high-speed communication link between two separate buildings without any building renovation and cable laying works. In addition, the application can create a highly stable and secure point-to-point standalone physical link outside of the existing network.

b) Broadband infrastructure

The broadband connection to a remote district needs special fiber planning which may cost much more than normal fiber laying in the city area. The broadband server provider may consider using this microchip to extent the broadband link coverage. This solution can also help to upgrade existing system bandwidth for higher data rate requirements.

c) Wireless surveillance system

This microchip can provide wireless broadband connection up to 1,000 metres. For example, it can cover wireless camera network in a larger area with difficult terrain that has no existing communication network. Also, the secure interconnection is suitable for a wireless surveillance system. The wider bandwidth can support high definition, high speed and complex camera network implementations.

Figure 3. Building-to-building application.

References

[1] Kaixue Ma and Kiat Seng Yeo, "Low-Power Wireless Communication Circuits and Systems: 60GHz and Beyond", Pan Stanford Publishing, ISBN 9789814745963 - CAT# N11848, 2018.

[2] Kiat Seng Yeo, Chirn Chye Boon, Xiang Yi and Fanyi Meng, "CMOS Millimeter-Wave Integrated Circuits for Next Generation Wireless Communication Systems", World Scientific Publishing (Singapore), International Edition, 2019.

ABOUT THE AUTHOR

Professor YEO Kiat Seng
Singapore University of Technology and Design

5G – THE HIGH-SPEED MOBILE NETWORK OF THE FUTURE

The next development stage of the mobile network is 5G. This new technology allows a significantly higher data capacity and extremely fast response times. This opens up completely new potential applications for a fully connected society.

The super-fast 5G mobile wireless standard forms the basis for the connected Gigabit society. In particular, it will stimulate applications that are especially demanding when it comes to exchanging data. In a smart city, for example, 5G can provide motorists with congestion and accident warnings as well as information on where to find a free parking space. Vehicles can communicate with one another or with the infrastructure – with fast and reliable data transmission acting as a driver for highly automated motoring. Even software updates with new functions for the car can be performed in seconds by means of a mobile radio interface.

Industry 4.0 is another example of an important 5G application. With its networked value creation and supply chains, widescale sensor monitoring of production systems and interacting robots, Industry 4.0 is reliant on effective communication.

Super-fast mobile communications will make the use of media more individual, flexible and versatile in future too. Take a concert or football match, for example, where several thousand people can access the mobile Internet at the same time. They can follow the event interactively in real time as well as from a variety of different perspectives in 4K/8K Super HD on the smartphone. 5G offers a data capacity that is 100 times greater than LTE and data transmission rates that are more than a thousand times faster. Thanks to barely perceptible latencies, the cellular standard allows a lightning-fast response in the network and uses less power in the process. These impressive performances are the result of four innovations.

What advantages does 5G offer?

The mobile standard 5G will offer a transmission rate that is around 100 times faster than that of LTE with data rate of up to 10 gigabits per second. Even videos in 4K format can be loaded at lightning speed. Downloading the content of a DVD takes less than five seconds. Delays, such as are commonplace in video telephony, will be a thing of the past. Telemedicine applications will thus be possible, in which a surgeon carries out operations over the internet. At the same time, the new 5G network will permit greater bandwidths, thus allowing a large number of users to be supplied faster simultaneously and receive higher quality. That means 5G will be far more stable and reliable.

When can we expect 5G to be rolled out?

There are enormous technical and financial challenges to be faced when it comes to developing new cellular infrastructure. While initial applications exist at present, they are still more so at the pilot stage. For example, South Korea demonstrated initial 5G millimeter wave applications at the Winter Olympics in 2018. The first four radio cells throughout Europe went into operation in Berlin in 2017, which transmit live and in a real-life environment over 5G. In the U.S., Verizon announced that it planned to launch pilot projects with 28 GHz millimeter waves in 2018. AT&T intends to start tests with 5G transmissions in the 39 GHz range in 2019 in several cities in the U.S. It will be some years yet though before there will be extensive availability. By 2025, for example, Europe should have a well-developed 5G network in place in major cities, according to targets set by the EU Council of Ministers.

Use Cases: 5G in everyday life

After work in the smart city

The drawback in finishing work late, however, is that there's hardly anywhere to park in the streets. Imagine one area is part of a pilot project. The streetlights are fitted with radar sensors and radio frequency identification (RFID) chips. They detect whether there's an empty parking space nearby and pass this information to a central server via the mobile network.

A corresponding app is installed in the car. It shows on the navigation system where there are places to park under which streetlights. In fact, the driver doesn't need to look for long and can park just around 150 yards from home.

New car overnight

If a car drives completely autonomously in a traffic jam, the driver might think "A computer on wheels" when the dealer explains all the functions to him.

When the driver switches off the engine, a message appears on the display: The car manufacturer is offering a new software update with a raft of new functions to make driving even safer and more convenient. It isn't necessary to take the car to the workshop for it. Just like with a mobile phone, you can download the update via the car's mobile interface – the so-called telematics unit. Security chips help that only authorized service providers can access the car.

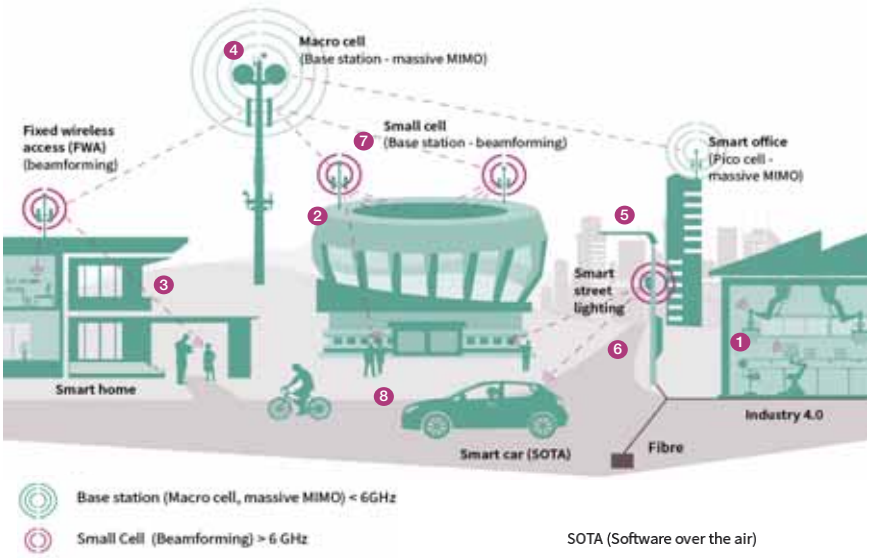
Thanks to the high-speed 5G network, the new software version should take no longer than 20 minutes to load and install. Since the driver doesn't need the car until the next morning, he confirms the update. He gets out and locks the car while the update is already being loaded. The updated user guide will be automatically sent straight to his smartphone in a few seconds. That means he can learn more about the new functions right away. Early the next morning, he can then use his car's enhanced functionality.

Always on the ball

Imagine you are in the soccer stadium and you have your smartphone in your hand. You watch what's happening on the pitch, but you keep checking the display. A major national TV station is broadcasting the game live on the internet.

You can follow the game on the pitch in front of you, but also at the same time on your mobile phone, which shows the action from different camera angles, and with as good as no delay thanks to the high-speed 5G network. With a small wireless loudspeaker in your ear, you can listen to the station's commentary simultaneously. It's becoming a real trend at big events.

Smart and connected - the communication of tomorrow with 5G



1. **100 times faster transmission:** Thanks to 5G, devices send and receive data in real time – which is vital for the smart factory (Industry 4.0) and a compelling user experience in everyday applications.

2. **1,000 times greater data capacity:** A large number of concurrent users can send and receive data quickly and reliably. Users can benefit from 5G at large events in particular.

3. **50 billion connected devices by 2020:** The refrigerator in the smart home is connected wirelessly with the internet, while the WLAN router and TV can be programmed remotely. 5G will pave the way for the Internet of Things.

4. **Reliable network:** 5G ensures stable connections, even at 600 km/h in a train and at the periphery of the range covered by mobile radio cells.

5. **Smart connection:** In the smart city, 5G means that signals are directed straight to the devices they are intended for.

6. **High security requirements:** The advent of 5G means more data will be transferred to even more devices. All devices and data must be protected against unauthorized access.

7. **Lower power consumption:** A special feature of 5G is the far higher number of transmitters. They search for the mobile receiving device and send signals only as and when needed; once a connection is no longer required, it is terminated. That saves a lot of electricity.

8. **Low latency:** 5G allows data transmission practically without delays. The aim is to achieve response times of one millisecond and hence communication virtually in real time. That's important for critical applications such as connected cars, Industry 4.0 or telemedicine.

Source of contents:
Infineon Technologies

BRINGING SAFER, FASTER, SMARTER 5G

Before 5G commercialization really comes, the competition is already fierce. In this 5G war, many countries and companies are striving to develop 5G capacities internally while keeping an eye on the external competition. Huawei is one of the early players entering the 5G era. Despite facing external pressure, Huawei 5G solutions are widely recognized in the industry and the number of their contracts has been increasing continuously. Till June 2019, Huawei has gained over 50 5G commercial contracts and shipped over 150,000 5G base stations to different countries. Today, more than thousands of employees of Huawei are engaged in 5G product development. Following this, from 2009 to 2019, Huawei has invested almost US$4 billion into 5G technology and product development.

Latest Innovation From Huawei

With 100 MHz, Huawei's 5G can achieve a cell throughput of more than 14 Gbps for a single sector, which is a leading edge of 5G performance. At the same time, strong capacity can be further enhanced by powerful transmission equipment.

If optical fiber is available, one only needs to install a blade which is attached to the fibre, to bring the bandwidth up to 200Gbps. Carriers can also use the microwave in scenarios where optical fiber deployment is unfeasible. However, the bandwidth of traditional microwave is only 1 Gbps. To address this problem, Huawei has launched its latest innovation in its 5G Microwave product line - the "1+2" 5G Microwave Architecture which can boost that bandwidth to 20 Gbps. With this "1 dual-band antenna plus 2 RF units" architecture, Huawei 5G

The "1+2" 5G Microwave Architecture

Microwave can provide up to 20+Gbps capacity for all backhaul scenarios, at the same time achieving 50% saving on tower space and engineering cost, setting new benchmarks for ultra-high capacity and hardware simplification in the microwave domain.

Besides, with the launch of Huawei's 5G smartphones and the CPE (Customer Premise Equipment) that provides ultra-high-speed broadband and intelligent Dual-Link features, Huawei is able to provide end-to-end 5G solutions. The Huawei 5G CPE Pro has utilised its proprietary Balong 5000—the world's first 5G multimode modem chipset which enables the router to be the first to support commercial application of 4G and 5G dual-modes, as well as NSA & SA dual-mode.

Proven In Field Tests & Commercial Use

The two charts on the left of Figure 1 shows the results from China's IMT-2020 phase 3 tests which has included more than 20 companies. It has shown that Huawei was far ahead of the game when it came to single site throughput. The third chart compares the speeds of the commercial 5G networks deployed by several vendors which were real customer networks. On Huawei 5G, single user speed reached 1.3 Gbps.

CPE (Customer Premise Equipment)

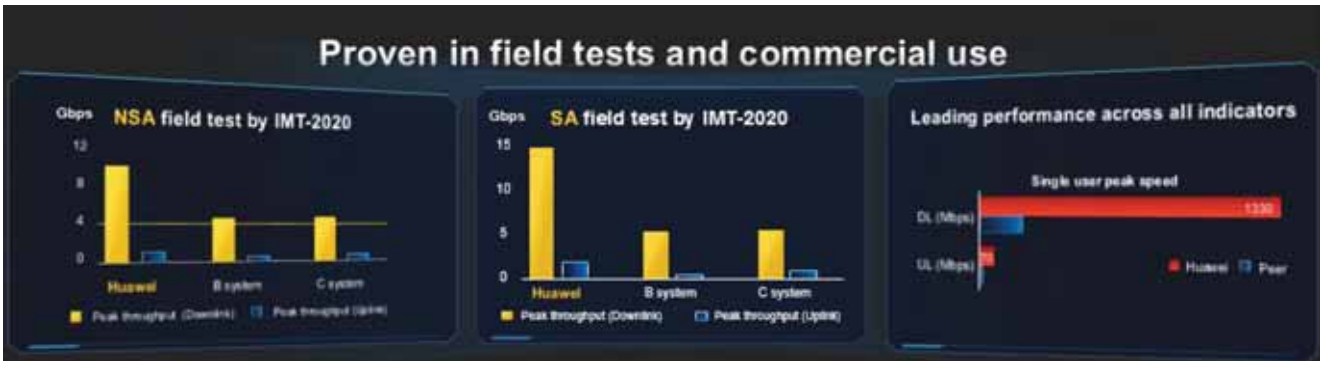


Figure 1. Results from China's IMT-2020 phase 3 tests

Innovation Is In The Details

With the performance algorithm, Huawei can improve cell throughput by 3 times. Its 5G chips can support 64 channels for hardware, claiming the highest in the industry. It has also increased the computing power of these chips by 2.5 times. For microwave, it can support 10 times greater transmission bandwidth than other solutions in the market.

If 64T antennas are made with old techniques, one 5G antenna would be bigger than the size of a door. Can you imagine installing that? It would possibly be blown down if being installed on a beach. To address this issue, Huawei has made the new Active Antenna Units (AAUs) with lighter covers and new materials reducing the number of components by 99 percent and weight by 40 percent. These new AAUs support all RATs and frequency bands and integrate active and passive antennas. They only have the width of a backpack but are so strong that it survived the grade-15 typhoons happened in Shenzhen last year. They could be installed directly on a 4G site, or even on a lamp pole, which has greatly reduced the capital and operating expenses of carriers. In Europe, where space is limited, telecom carriers could save $10,000 Euros on-site rental for every site, every year.

In October 2018, Huawei launched two powerful AI chips: Ascend 910 and Ascend 310. They could be used to bring intelligence to all scenarios and reduce computing power costs for carrier networks. Building on these chips, Huawei has developed many algorithms and models for carrier networks. With AI, they can now increase resource efficiency, make operation and maintenance easier, as well as reduce power consumption in telecom networks.

Best Technology & Greater Security

Security in 5G networks should not be ignored. Huawei has connected more than three billion people around the world and maintained a solid track record in security throughout. Security is a shared responsibility while the whole industry needs to come together to develop standardized cybersecurity requirements.

5G is a step-by-step, fast-paced development. Huawei has earned unique advantages in 5G and is still making continuous efforts, bringing huge changes to people's lives and all industries.

Source of contents:
Huawei International Pte. Ltd.

New Active Antenna Units (AAUs)

KEEP PACE WITH AGGRESSIVE 5G MARKET DEMANDS

National Instruments' Guide to 5G Semiconductor Test

TWith the formalization of the 3GPP Release 15 specifications, engineers are increasingly engaged in active development of 5G New Radio (5G-NR) RFICs. With wider bandwidth than previous 4G/4.5G/4.9G technology, now at 3.3 - 4.2 GHz and 4.3 - 5.0 GHz, and new waveforms, 5G-NR presents unique test challenges. In this paper, we will share on typical test configurations and test results for 5G RF power amplifiers and front-end modules (FEM).

To understand the three broad use cases that 5G wireless technology seeks to transform, consider a typical morning office commute in a 5G-connected car just a few years down the road. The vehicle is constantly exchanging position, behaviour, and system status information with nearby vehicles, the surrounding highway infrastructure, and traffic control centres. Doing so in a fast and reliable manner augments the car's awareness of its surroundings and allows the driver to turn the steering, accelerating, and braking functions over to the car's semiautonomous driving system. He can now focus on the morning's first conference call.

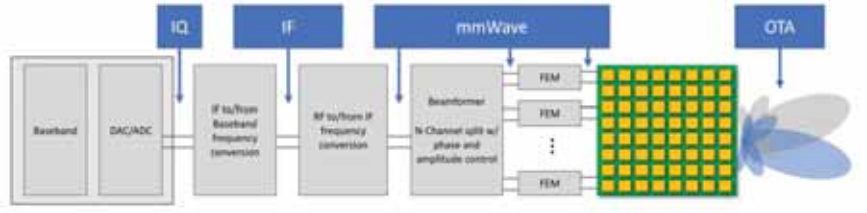
The driver's colleagues are trying to find the root cause of a turbine malfunction. He puts on his augmented reality (AR) set, and a wireless 4K video feed of an airplane turbine overlaid with sensor data and gauge readings fills his screen. Collaborating in real time with a group of engineers in three different countries, the team guides a technician to isolate one of the components and recommends a troubleshooting procedure.

Current 5G Use Case Focus

A few minutes later, when his intelligent-highway exit comes up, the driver takes back control of the car, switches over to a low-bandwidth voice-only connection, and drives into work. The car guides him to the closest available parking spot with an electric charging station. The parking sensor at that spot detects his car and updates the parking availability information on the network. When he plugs in the car to charge, the charging terminal establishes a low-data-rate connection to verify his account and process payment.

The situation described above can only be achieved with some major improvements to our existing infrastructure. Enhanced Mobile Broadband (eMBB) seeks to significantly improve the data rate, latency, user density, capacity, and coverage of mobile broadband access to allow the live streaming of AR/VR applications, even in more crowded environments such as the intelligent highway the driver uses. Ultra-Reliable Low-Latency Communication (URLLC) enables users and devices to communicate bidirectionally with other devices while generating minimal latency and guaranteeing high network availability. Finally, Massive Machine-Type Communication (mMTC) makes it possible for many low-cost, low-power, long-life devices to support applications such as embedded highway sensors, parking sensors, and smart utility meters.

New 5G devices for mmWave operation present different test points, operating at different frequencies and with different interfaces.

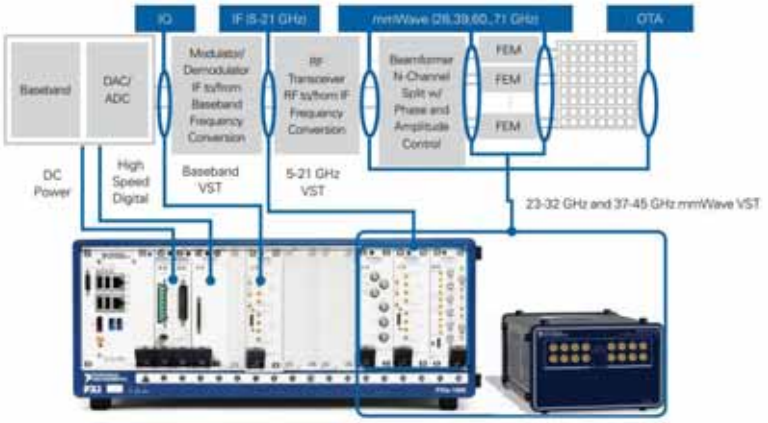


mmWave 5G Test Insertion Points

- **Baseband transceivers:** normally operate with high bandwidth IQ waveforms, both single-ended and differential. Engineers benefit from highly linear test instrumentation and the latest 5G waveform generation, and analysis capabilities to verify not only their baseband conversion circuits, but also to test critical functionality of their firmware stacks.
- **Quadrature modulators:** can employ many different up/down conversion frequency plans to translate those baseband IQ signals into intermediate frequency (IF) signals.

- **RF transceivers:** if the specific radio architecture requires a separate IF to mmWave and from mmWave to IF conversion, these RF transceivers must check for proper filtering of unwanted images, phase noise effects, signal conditioning, flatness, and proper implementation of the frequency plan.
- **Beamformers:** Engineers must check for the gain, linearity, phase control, efficiency, and noise performance of each path, both in the transmit and receive direction. Additionally, they must assess the cross-talk characteristics, and the power and phase differences between paths. Test instruments for beamformers must simplify connectivity to these beamformers with duplex, multichannel, dynamic port switching, and signal routing.
- **Front-end modules:** designed for driving higher power into antenna arrays, these devices need test solutions with high dynamic range, linearity, and bandwidth. Engineers need to measure the AM-AM and AM-PM characteristics of the power amplifiers, their non-linear performance, noise, and power efficiency.
- **Antenna integration:** Engineers need to ensure that the RF paths are properly connected to the antenna array. The connection between the RF SiP and the antenna must ensure low insertion loss and good impedance matching, while the antenna placement needs to be controlled for optimum radiation performance. Then, engineers need to validate the beam steering performance of the antenna systems over the air.

To achieve some of the ambitious key performance indicators of 5G enhanced mobile broadband—surpassing 20 Gb/s in downlink and supporting 10,000X more traffic—the 5G standard specifies wideband operation at two different basic frequency ranges, with varying channel bandwidths. It seeks to reuse many existing and some new cellular and unlicensed bands from around 400 MHz up to 7.125 GHz (FR1) and from 24 GHz to 52.6 GHz (mmWave FR2).



5G Test Bench and Production ATE for mmWave Applications

Although RF engineers have been working with specialized and expensive test systems for mmWave in industries such as aerospace and military, this represents unexplored territory for the mass-market cellular industry. Engineers face the challenge of integrating, scaling, and optimizing their setups for automated device validation. They need to configure a greater number of test benches for new device types with cost-effective test equipment that provides high linearity; tight amplitude and phase accuracy over very large bandwidths; low phase noise; extensive frequency coverage for multiband devices; and the ability to test for coexistence with other wireless standards. To adapt to rapidly evolving test requirements, they need modular, software-based test and measurement benches with large frequency coverage.

The Recommended Solution

The PXI Vector Signal Transceiver (VST) combines an RF and baseband vector signal analyser and generator with 1 GHz of instantaneous RF or complex I/Q bandwidth. Utilizing their large bandwidth, VSTs can readily power 5G test benches and cover a variety of challenging test cases, including digital predistortion of carrier-aggregated 5G waveforms, as well as intraband and interband coexistence of 4G and 5G.

The mmWave VST supports a wide range of frequencies and can test at IF (5-21 GHz) and RF (23-44 GHz) with a single instrument, giving engineers the flexibility to interface with many new types of DUTs and test emerging technologies with a single system. Every mmWave VST supports integrated, calibrated switching to expand port count without significant capital investment or increased system complexity, while multiple mmWave VSTs can be integrated in a single PXI system to further increase bench capabilities for emerging technologies such as MIMO and phased arrays.

Conclusion

The rapid development of high bandwidth 5G technologies has introduced significant challenges for testing and measuring new device RF performance. Although test and measurement systems must be designed to test current AiP devices, they also must be adaptable to deal with future beamforming and OTA testing requirements. The NI platform of modular hardware and flexible software empowers engineers to take advantage of new instrument features to speed up and streamline the characterization, validation, and production test of 5G devices.

ABOUT THE AUTHOR

Gobinath Tamil Vanan
Field Marketing Manager,
Semiconductor & Core Test
National Instruments

ANTENNA DESIGN FOR 5G COMMUNICATIONS

With the rollout of the 5th generation mobile network around the corner, technology exploration is in full swing. The new 5G requirements (e.g. 1000x increase in capacity, 10x higher data rates, etc.) will create opportunities for diverse new applications, including automotive, healthcare, industrial and gaming. But to make these requirements technically feasible, higher communication frequencies are needed. For example, the 26 and 28 GHz frequency bands have been allocated for Europe and the USA respectively – more than 10x higher than typical 4G frequencies. Other advancements will include carrier aggregation to increase bandwidth and the use of massive MIMO antenna arrays to separate users through beamforming and spatial multiplexing.

Driving Innovation Through Simulation

The combination of these technological developments will create new challenges that impact design methodologies applied to mobile and base station antennas currently. Higher gain antennas will be needed to sustain communications in the millimeter wavelength band due to the increase in propagation losses. While this can be achieved by using multi-element antenna arrays, it comes at the cost of increased design complexity, reduced beam width, and sophisticated feed circuits.

Simulation will pave the way for the innovation of these new antenna designs through rigorous optimization and tradeoff analysis. Altair's FEKO™ is a comprehensive electromagnetic simulation suite ideal for these types of designs: offering MoM, FEM and FDTD solvers for preliminary antenna simulations, and specialized tools for efficient simulation of large array antennas.

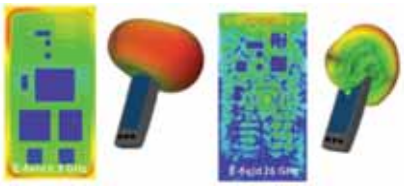


Figure 1: Much higher mobile antenna gain can be achieved by using antenna arrays (right), but will results in a narrower beam antenna pattern.

Mobile Devices

In a mobile phone, antenna real estate is typically a very limited commodity, and in most cases, a tradeoff between antenna size and performance is made. In the millimeter band, the antenna footprint will be much smaller; optimization of the antenna geometry will ensure the best antenna performance is achieved for the space that is allocated and also for higher order MIMO configurations.

At these frequencies, the mobile device is also tens of wavelengths in size and the antenna integration process now becomes more like an antenna placement problem – an area where FEKO is well known to excel. When considering MIMO strategies, it is also easier to achieve good isolation between the MIMO elements due to the larger spatial separation that can be achieved at higher frequencies. Similarly, it is more straightforward to achieve good pattern diversity strategies.

Base Station

FEKO's high performance solvers and specialized toolsets are well suited for the simulation of massive MIMO antenna arrays for 5G base stations. During the design of these arrays, a 2×2 subsection can be optimized to achieve the good matching, maximize gain and minimize isolation with neighboring elements –a very efficient approach to minimize the nearest neighbor coupling. The design can then be extrapolated up to the large array configurations for final analysis. Farming of the optimization tasks enables these multi-variable and multi-goal objectives to be solved in only a few hours. Analysis of the full array geometry can be efficiently solved with FEKO's FDTD or MLFMM method: while FDTD is extremely efficient (1.5 hrs for

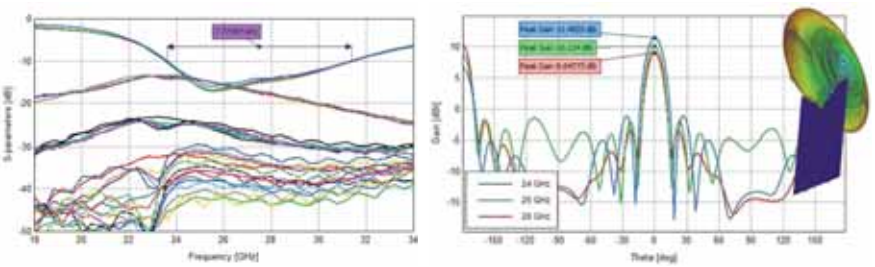


Figure 2: Design of an 8-element linear array for a mobile device - a wideband antenna element is used for the array, resulting in a design with ~ 10 dBi peak gain and 7.8 GHz bandwidth, which is suitable to cover both the EU and USA operation.

16×16 planar array), MLFMM might also be a good choice depending on the specific antenna geometry.

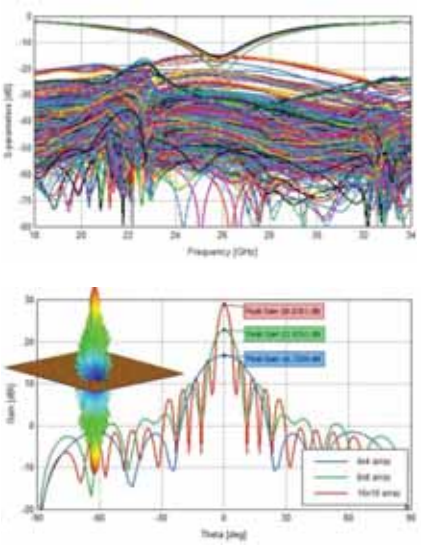


Figure 3: By extrapolating the optimized 2x2 array, a 16x16 design with 2 GHz bandwidth, less than - 15 dB isolation and peak gain of 28.8 dBi is created. The antenna gain (right) for 4x4, 8x8, 16x16 array configurations at 26 GHz is also shown - demostrating how the beam-width decreases as the number of array elements increase.

The 5G Channel and Network Deployment

The mobile and base station antenna patterns that are simulated in FEKO, can be used in WinProp™ for high-level system analysis of the 5G radio network coverage and to determine channel statistics for urban, rural, and indoor scenarios.

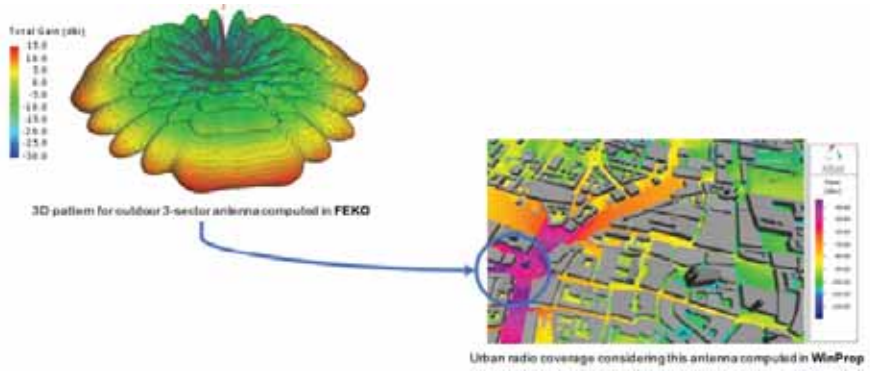


Figure 4: Antenna radiation patterns computed in FEKO can be used in WinProp for coverage analysis and network planning

WinProp is already extensively used for 4G/LTE network planning. However, the use cases for 5G networks will be even more relevant largely due to the different factors that occur in the millimeter band. These include higher path loss from atmospheric absorption and rainfall, minimal penetration into walls and stronger effects due to surface roughness.

In addition to being able to calculate the angular and delay spread, WinProp also provides a platform to analyze and compare the performance of different MIMO configurations while taking beamforming into account.

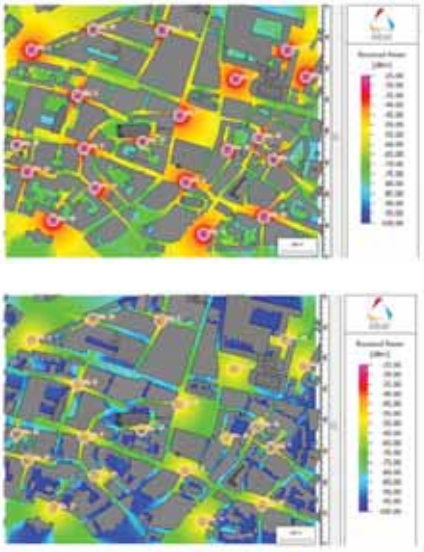


Figure 5: An area with 20 sites operating at 3.5 GHz (left) provide sufficient coverage, while the same scenario at 26 GHz (right) shows many areas where the signal strength is too weak.

The Road to 5G

While some of the challenges that lie ahead to meet the 5G requirements may still seem daunting, simulation can already be used today to develop understanding and explore innovative solutions. FEKO offers comprehensive solutions for device and base station antenna design, while WinProp will determine the requirements for successful network deployment.

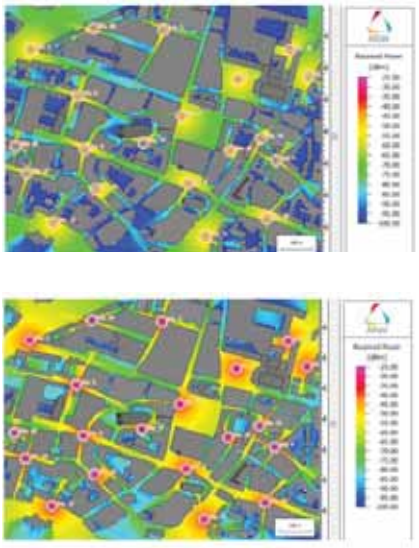


Figure 6: The effect of taking beam-forming into account (right) at 26 GHz is shown. A distance of about 200m between sites might be sufficient for 5G deployment for his scenario.

Sources adapted from: http://innovationintelligence.com/antenna-design-for-5g-communications/; https://ytd2525.wordpress.com/2017/06/07/antenna-design-for-5g-communications/

ABOUT THE AUTHOR

DesignTech Technologies Singapore Pte. Ltd.

REALIZING 5G NEW RADIO MASSIVE MIMO SYSTEMS

The 5th generation wireless access networks are being defined to meet the perpetual growth in demand for capacity and address new use cases and applications in 2020 and beyond. 3gpp has approved standalone (SA) and non-standalone Release 15, 5G specifications. 5G New Radio (NR) targets up to 10Gb/s peak data rates per user to offer enhanced mobile broadband (eMBB) services, which represents roughly 100x improvement over the 4th generation wireless network. Massive MIMO, or a large array of antennas, is the keystone technology for realizing this improvement, specifically suited for underutilized TDD bands below 6GHz such as band 40 (2.3GHz), band 41 (2.5GHz), band 42 (3.5GHz), band 43 (3.7 GHz) and emerging new 5G bands including the unlicensed bands. Massive MIMO systems enable dynamic digital beamforming to implement user by user beams to theoretically offer full cell capacity to each user, which otherwise is shared amongst users on a time and frequency basis. There is no change required in the existing user equipment to benefit from massive MIMO enabled cell towers. The promise of massive MIMO is so appealing that many of the operators do not want to wait for the 5G NR ecosystem to be ready and are considering its deployment on 4G equipment. However, these benefits come with a set of challenges. The larger footprint and higher power and cost due to a multifold increase in system complexity in implementing massive MIMO radios is a major hurdle. Integration of the analog signal chain with digital front end (DFE) devices in the radio along with a substantial increase in the signal processing and computing power is needed to overcome these challenges.

Massive MIMO and Beamforming

Beamforming is not a new concept and has been around in the cellular market as Active Antenna Systems (AAS) that use static beamforming in the radio as a tradeoff to contain the system cost and complexity. Active antenna systems are applicable in coverage limited networks but today's congested networks need dynamic digital beamforming to get full benefits of spectral efficiency improvements. Massive MIMO with full digital beamforming adds spatial dimension in addition to frequency and time to significantly boost spectral efficiency. The resulting SNR (Signal to Noise Ratio) improvements brought about by the array gain and orthogonality of multiple beams means the same time and frequency allocations can be reused by multiple users.

Massive MIMO system: Base station dis-aggregation and functional partitioning

The complexity associated with the massive MIMO architecture mandates dis-aggregation of the base station to support new functional partitions to manage in-system connectivity bandwidth. For example, in a 100MHz 64T64R antenna array system, the bandwidth between baseband and radio functions is 230 Gbps assuming that the baseband and radio functions are implemented using one device each. In reality, systems use multiple devices to implement either 8T8R or 16T16R array DFE radio function modules resulting in more than doubling in-system connectivity bandwidth requirements. Figure 2 describes conceptual diagram of a massive MIMO radio system. Digital radio processing blocks implement 8T8R or 16T16R DFE functions with integrated analog to digital (ADC) and digital to analog (DAC) converters. This is a must-have to eliminate the JESD204B connectivity links required for interfacing digital and analog domains in order to lower system footprint, power and cost. The beamforming device brings Layer 1 baseband functionality to radio to substantially reduce connectivity bandwidth requirements with the higher layer baseband functions that can now potentially be virtualized in the mobile edge compute. Integration, flexibility and higher compute are three critical requirements to optimally implement massive MIMO systems and evolve associated beamforming and DFE algorithms to continually improve performance, cost and power.

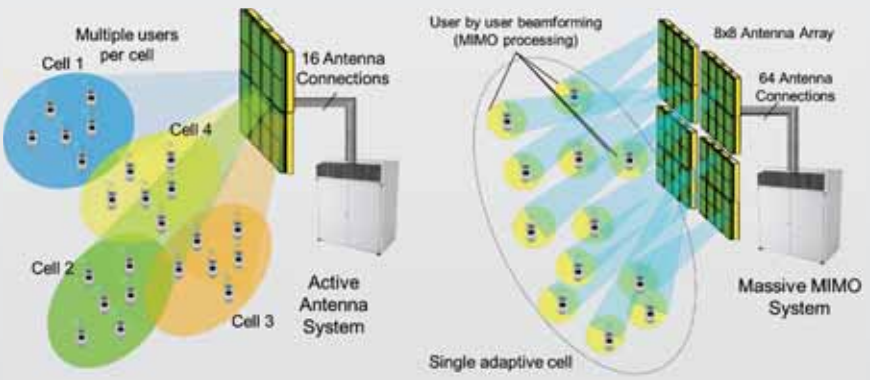


Figure 1: Active Antenna Systems and Massive MIMO

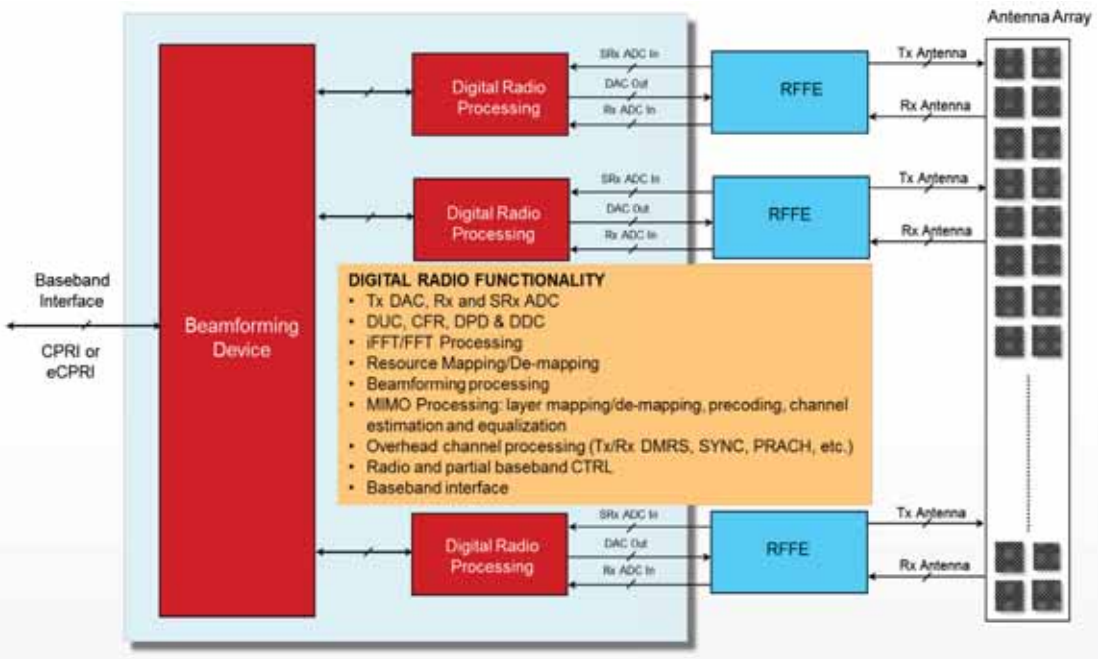


Figure 2: Conceptual massive MIMO architecture

Xilinx Zynq UltraScale+ RFSoCs for 5G NR Massive MIMO

A 5G NR Massive MIMO implementation requires a large number of active signal chains in the radio to connect to each antenna or a subset of antennas in the array. These active signal chains which traditionally comprise data converters, filters, mixers, power amplifier and low noise amplifier can lead to a significant increase in power, form factor and cost of the system. The large number of active signal chains in Massive MIMO system results in an increase in system power and footprint making it difficult to realize commercially viable systems. The costs associated with moving data between the RF Front-Ends (RFFE) and the Digital Front End (DFE) is one of the key challenges that must be resolved in 5G—at the software, hardware, and system level.

In order to address this challenge, Xilinx has replaced multiple ADCs and DACs along with many other RF components on the board by integrating direct RF-sampling data converters into the existing 16nm FinFET Multi-Processing SoC (MPSoC) family of products designed and deployed for radio applications. This newly introduced SoC device family called "Zynq UltraScale+RFSoC" monolithically integrates RF sampling data converter technology to provide a fully hardware and software programmable wide bandwidth platform for radio systems. Based on an ARM-class processing subsystem merged with FPGA programmable logic, the architecture features 12-bit, 4GSPS RF-sampling ADCs, and 14-bit, 6.4GSPS direct RF DACs, along with optimized digital down-conversion and up-conversion signal processing.

Moving RF into the digital domain by integrating RF-sampling data converter technology not only overcomes power, space, and cost disadvantages but also enables implementation of wide bandwidth and multi-band systems. Analog RF in the existing radio systems is typically designed to create relaxed discrete data converter specifications. In addition, discrete data converters and analog RF components use older process nodes and are typically optimized for narrow bandwidths. This results in analog RF solution to be expensive in size, power and cost for wide bandwidth MIMO and massive MIMO radio systems. Integrating high speed data converters, 6.4GSPS direct RF DACs and 4GSPS RF-sampling ADCs, allows digital RF to be flexible, low power and wide bandwidth, ideally suited for building MIMO and Massive MIMO systems with lower footprint, power and cost.

16nm FinFET Technology Enables Digital-RF Implementation

Monolithic integration of high speed RF components benefits from excellent analog transistor characteristics in 16nm FinFET process. The ON resistance of the transistor is extremely low which allows implementation of wide bandwidth RF sampling signal switches with high precision. This enables integration of cost and power efficient high-speed comparators, amplifiers, clocking circuits and digitally assisted analog calibration logic with excellent characteristics. The digital implementation in 16nm FinFET versus 65nm (typically used for analog RF components) results in more than 10x area reduction and 4x power reduction. Xilinx has innovated ideal design solutions to implement power integrity, digital calibration loops for high precision and robust isolation strategies.

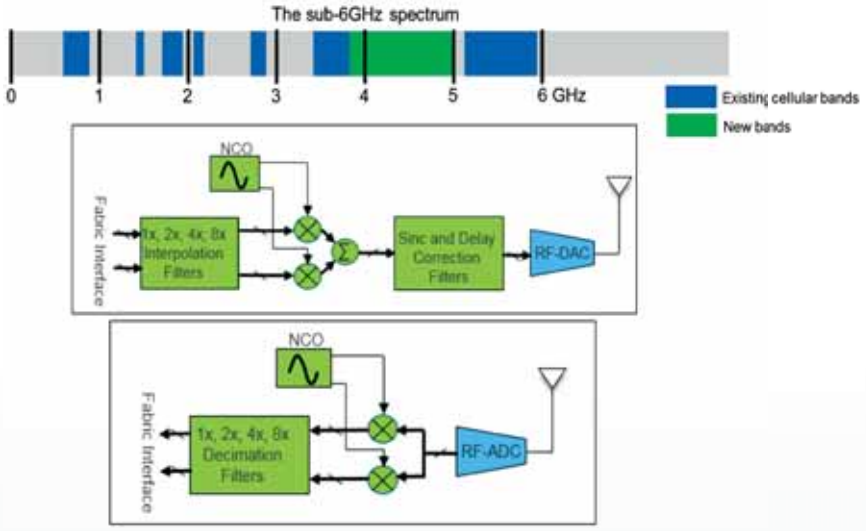


Figure 3: Zynq UltraScale + RFSoC digital-RF resources

The digital-RF resources integrated in Zynq UltraScale+ RFSoC comprise of multiple channels of 6.4GSPS DACs and 4GSPS ADCs, integrated low phase noise PLLs and full complex mixers – 48 bit numerically controlled oscillators (NCO) per each DAC and ADC. The RF data converter arrays come with 1x, 2x, 4x, 8x interpolation and decimation filters and implement flexible FPGA fabric interface. In addition, the direct RF-DAC block implements Quadrature modulation correction (QMC) and Sin x/x (Sinc) correction filters.

Massive MIMO System Implementation on Zynq UltraScale+ RFSoC

Figure 4 shown below illustrates typical massive MIMO radio implementation using one of the RFSoC devices. The RFSoC has 33Gbps transceivers with hardened 100G Ethernet MAC/PCS with an RS-FEC that can be leveraged depending on the flavor of fronthaul interface, be it 25G CPRI or the eCPRI protocol. Partial L1 functionality such as iFFT/FFT transforms and associated physical random access channel processing can be moved to the radio for 50% bandwidth reduction (and cost & power savings) between radio and baseband unit. RFSoC devices provide rich high performance low power DSP resources to implement digital front end comprising digital up conversion, crest factor reduction, digital pre-distortion, passive intermodulation correction, equalization and down conversion. Appropriate interpolation filters on the transmit path and decimation filters on the receive path are used to run RF-DAC and RF-ADC at high clock frequencies, independent of the FPGA fabric frequencies, for better frequency planning. With careful frequency planning, multiple bands such as band 1 and band 3 for FDD massive MIMO and band 38, 40, 41 and bands 42 and 43 for TDD massive MIMO can be simultaneously supported leveraging the wide bandwidth of the integrated RF signal chain. RFSoC has quad-core ARM Cortex-A53 multiprocessor cores running up to 1.5GHz along with dual-core real time ARM Cortex-R5 multiprocessor cores running at 533MHz. This is significant compute resource for computing pre-distortion coefficients and performing system control, RF calibration and general operation and maintenance functions. The programmable logic coupled with on chip compute can be used to support open source APIs to future proof the radio system for software defined networking where radios can be configured dynamically based on the customer demand. Machine learning algorithms can be efficiently implemented in the fabric to automate management of increasing numbers of fragmented spectrum bands, spectrum sharing and hosting mobile virtual network operators (MVNO).

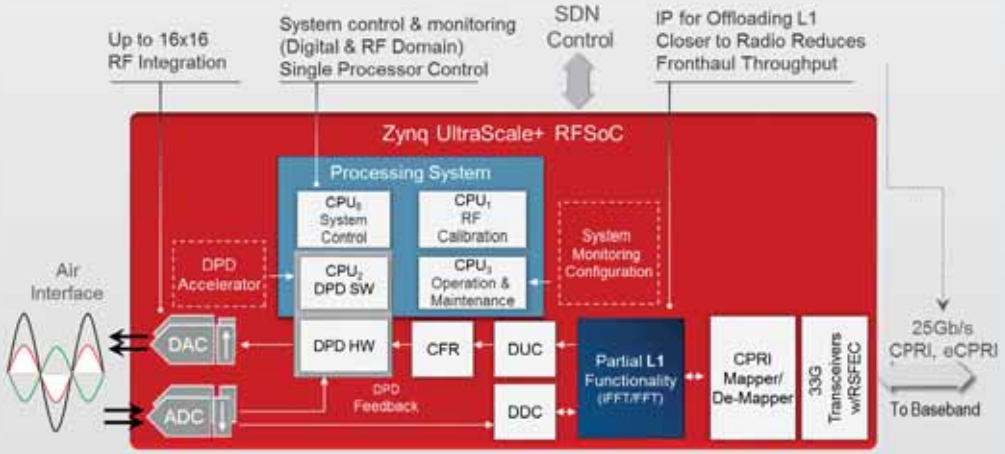


Figure 4: Massive MIMO radio implementation on RFSoC with partial L1 functionality offload

To enable integration, Xilinx provides a library of state of the art DFE (digital front end) IP for CFR (Crest Factor reduction) and DPD (digital pre-distortion) along with DFE subsystem reference design and DFE demonstration kits for 4G, LTE-Pro and 5G applications. In order to demonstrate system performance on an RFSoC, Xilinx Zynq UltraScale+ ZCU111 evaluation board using ZU28DR device is connected to XRF3 Xilinx RF front end daughter card with two transmit and two multiplexed receive paths to support PA feedback as well (as shown in Figure 5). With this board setup and connecting a single PA to one DAC/ADC pair, a quick port of DFE reference design (v2.1) from an existing Xilinx 16nm MPSoC device was accomplished, leveraging fabric commonality between the RFSoC and 16nm SoC for design reuse. In this, Xilinx CFR IP was operating at 245.76 MSps (achieving 3% EVM at 7.5dB PAPR with TM3.1a signals) and DPD IP at 491.52 MSps (DAC/ADC operating in 2nd Nyquist using 3.93216 GSps clocks and 8x interpolation/decimation), with a composite signal 2c LTE20 + 1c LTE20 within instantaneous bandwidth of 160 MHz. The PA output is 45 dBm or 32 watts. After running DPD, the achieved ACP (shown on the right side of the Figure 5) is 54.91 dBc and upper ACP is -55.14 dBc that complies with sufficient margin for the LTE spectrum emission mask requirements.

The New Technology

Xilinx Zynq UltraScale+ RFSoCs monolithically integrate high speed wide bandwidth RF-sampling data converters with fabric rich in-digital signal processing and compute resources to address diverse multiband requirements for 5G NR and LTE-Advanced Pro MIMO and massive MIMO radio system implementations. This technology addresses the challenges of massive MIMO by significantly reducing system footprint, power and cost. The inherent programmability of the RFSoC devices and re-use of existing solutions enables faster time to market while allowing simple field updates to comply with emerging standards and newer algorithms and PA technology.

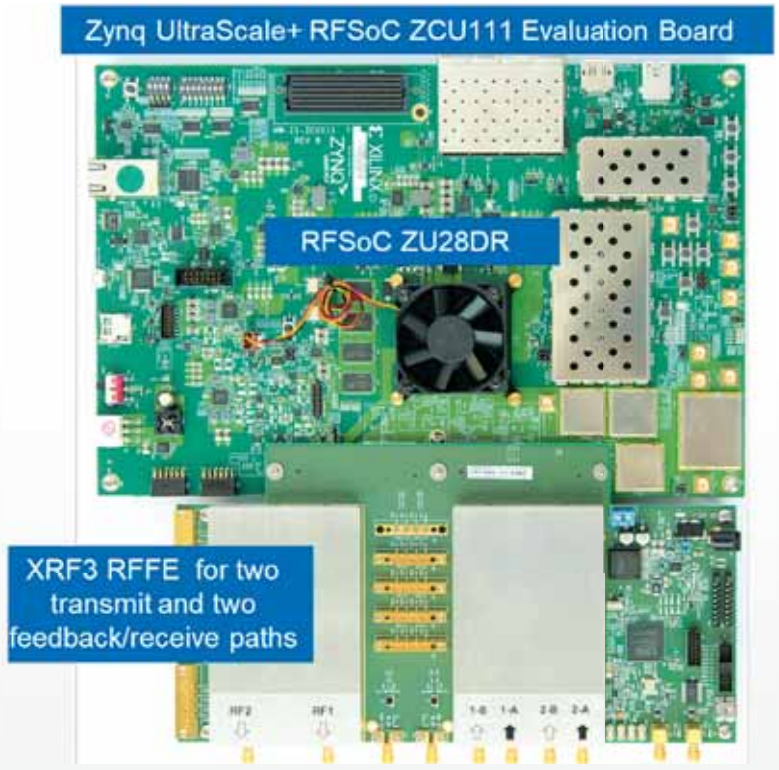


Figure 5: ZCU111 evaluation board based RFSoC setup for 2c LTE20 + 1c LTE with IBW of 160MHz

For more information, visit www.xilinx.com/rfsoc.

ABOUT THE AUTHOR

Paul Newson, Hemang Parekh, Harpinder Matharu

SEMICONDUCTOR TRADEWINDS May/June 2019

Chip Sales Suffered Largest Quarterly Decline In 35 Years

May began with negative earnings reports almost across the board for semiconductor segment, with IC semi conductor companies and foundries reporting the lowest revenues in a long time as the impact of the US China trade war hit. Global chip sales in Q1 declined 15.5% QoQ, the largest quarterly decline in the last 35 years according to The World Semiconductor Trade Statistics (WSTS) organization. The China economic slowdown, the US-China trade war and weak smartphone demand were the main causes. The only bright spot was from the optoelectronics segment, which cited improved sales from 5G and power device segments.

For the silicon IC, segment most companies announced revenue down between 5% to 25% quarter on quarter, blaming the China economic slowdown and the weak smartphone market. Intel revenue was down 14%, STM was down 22%, Broadcom was down 4.7% Qualcomm down 4.6% and TI down 5.1%. Only Infineon was up 1% QoQ citing strong auto and digital security markets.

The memory segment was worst hit by high inventories and low prices. Samsung revenue was down 12% QoQ , Micron down 19% and SK Hynix down a massive 27% QoQ.

For foundries Q1 was also very bad. TSMC was down 24.5% reporting its lowest revenue since Q2 2017, with other foundries revenues similarly decreased. UMC was down 8.3%, Vanguard down 10.4% and SMIC down 19.5%. The test and assembly subcons also reported similar results with ASE down 15% and Amkor down 17% QoQ.

For equipment suppliers, the start of 2019 has also been very bad with SEMI reporting consecutive months of decline in worldwide billings from January through to March inclusive. Applied Materials revenue was down 5.7% in the most recent quarter ending May, ASML down 29% QoQ and LAM was down 3%.

Only some optoelectronics companies fared better, with Cree up 22% growth, citing a strong SiC market for power semiconductors, II-VI was up 16% on strong 5G demand and Emcore was also up 16.7%.

The market situation seemed to be starting to turn around in Q2, with the major wafer foundries and test and assembly subcons reporting May as the best month of the year so far and SEMI reporting worldwide equipment billings increasing slightly in April and May.

US ban on Huawei

However, it all changed on 15 May 2019 when Huawei and 70 of its affiliates were placed on the US Governments "Entity List", which bans companies from selling parts and components with >25% US originated technology to Huawei. This ban was temporarily reprieved for 90 days on 20 May 2019, but many tech companies immediately implemented the ban. Google was the first company to announce that they would stop supplying Huawei, then ARM also announced it had stopped working with Huawei followed by almost all US semiconductor stopping shipments. Some major overseas companies also

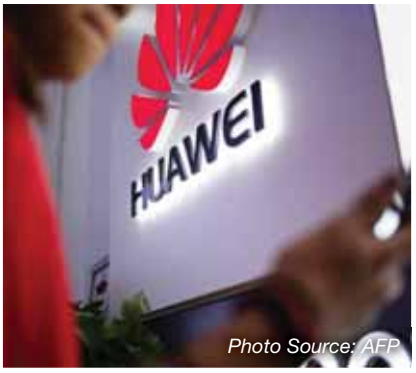


Photo Source: AFP

announced they had stopped shipments. The impact of the ban is huge not just on Huawei who have said their revenue will be impacted by around US$30bn this year and next but also on the Huawei supply chain, severely impacting the revenue of US and other companies who have in the past relied on Huawei for up to 15% of their revenue. Broadcom recently lowered its quarterly guidance by $2bn as a result of the Huawei ban, Micron is reported to get 15% of its revenue from Huawei and announced it will cut capex and wafer starts. Other companies that have lowered their quarterly guidance's recently citing the Huawei ban impact are Skyworks, Qorvo, Lumentum & IQE.

Before US's ban on Huawei and the US prior policy to persuade countries not to use Huawei's 5G infrastructure, Huawei was leading the 5G race to install new 5G networks. After the ban one big beneficiary is Finnish company Nokia who claims to have taken the lead from Huawei on 5G contracts, claiming 42 5G awarded contracts vs 40 for Huawei and 19 for Swedish company Erikson. Despite the ban Philippine telco Globe Telecom announced recently it will roll out SE Asia first 5G wireless network

using Huawei infrastructure next month.

Then on 21 June 2019 US added 5 more Chinese supercomputing related companies to its entity list banning sales by US companies to these companies. The companies are Wuxi Jiangnan Institute of Computing Technology, which is involved in supercomputing. Others added to the list are Sugon, a manufacturer of super computers, Chengdu Haiguang Integrated Circuit, Chengdu Haiguang Microelectronics Technology, and Higon which has a joint venture with AMD to build server chips.

Hopefully we have reached the bottom and the situation will improve from here after the meeting between Chinese President Xi Jinping and US President Donald Trump on the side-lines of the G20 Summit in Japan on 29 June 2019, where they agreed to resume trade talks and Trump announced that he will not impose new tariffs on China for now and will also allow US companies to sell to Huawei.

Company News

Connectivity has been the common theme behind a lot of recent acquisitions in the industry with companies looking for WiFi and Bluetooth connectivity IP to support their automotive and IoT applications. There have been 4 major deals so far this year. In June On Semi concluded its deal to buy WiFi chip supplier Quantenna Communications for just over $1bn cash. At the end of May, NXP announced it will acquire Marvell's WIFI and Bluetooth connectivity division for $1.76bn, and most recently Infineon announced it has agreed to acquire Cypress Semiconductor for $10bn. This comes on top of a deal earlier in the year for Nvidia to purchase networking IC vendor Mellanox

Photo Source: AFP

Technologies for $6.9bn.

In other acquisition news, GlobalFoundires has completed it's 3 part reorganization strategy by selling its Singapore 200mm Fab 3E to Vanguard International Semiconductor for $236 million, then selling it's US Eastkill 300mm Fab 10 to On Semi for $430 million, and finally selling its ASIC unit Avera to Marvell for $650 million. Elsewhere Soitec will acquire Belgium GaN wafer producer EpiGaN for $33 million, and Emcore acquired sensor manufacturer Systron Donner Inertial for US$25.8 million.
So what's next. All the major market researches are now projecting global semiconductor chip sales will fall this year on average around -12%, but remember this comes on the back of a record year in 2018. SEMI is predicting that equipment sales will drop -19% this year before starting to recover with growth of 20% in 2020. A lot depends on how quickly US and China resolve the trade war, following the agreement to restart trade talks in a meeting on the sidelines of the G20 summit in Japan.

ABOUT THE AUTHOR

Mark Dyson
Director Procurement, External Manufacturing, & Product Engineering at Denselight Semiconductors Pte Ltd, Singapore

INNOVATORS UNDER 35 ASIA PACIFIC

The Most Prestigious Recognition from MIT Technology Review

The quest to improve the way we work and live is an ever progressive one, where scientists and researchers are paving the way for humanity to make the next great leap forward.

Since 1999, MIT Technology Review has honoured the young innovators whose inventions and research we find most exciting through the Innovators Under 35 competition.

Innovators Under 35 is a list of technologists, entrepreneurs and scientists, all under the age of 35, whose work is changing our world. The list recognises the development of new technology or the creative application of existing technologies to solve global problems in industries such as biomedicine, computing, communications, energy, materials, software, transportation and internet.

Tesla's JB Straubel, Facebook's Mark Zuckerberg, Google's Sergey Brin and Larry Page, Spotify's Daniel Ek, and A*STAR's Jackie Ying, among others, are all part of the honour roll of outstanding Innovators Under 35.

Searching for the Next Innovators Under 35

Going onto its seventh year in 2020, the Innovators Under 35 Asia Pacific edition is expanding the shortlist of scientists and entrepreneurs from the original list of 10 to 20. In 2019, close to 200 nominations were received from across Southeast Asia, Australia, New Zealand and Taiwan, with applications open to Hong Kong SAR for the first time. Sixty young Innovators Under 35 have been honoured since the competition was established in 2014.

"We are expanding the list of honourees to give more innovators the chance to shine. Asia Pacific has a massive geographic reach and expanding the list will allow more scientists and entrepreneurs to be honoured for one of the most prestigious awards that will help them accelerate their careers," said Antoinette Matthews of MIT Technology Review in Cambridge, MA.

A renowned jury of experts will select 20 of the best innovators to present their breakthrough technologies at MIT Technology Review's EmTech Asia on 25 – 26 February 2020, gaining unparalleled media coverage and access to an audience of accomplished innovators, investors and entrepreneurs. Nominations for the Innovators Under 35 Asia Pacific edition will close on 12 September 2019. Applicants can self-nominate or be nominated by others at www.emtechasia.com/innovatorsunder35

Technology That Matters @ EmTech Asia

Technology impacts every sector. In recent years, Artificial Intelligence has made breaking strides to ingrain itself into almost every industry and discipline on the planet. Precision medicine points to a future where medicine and data converge, all whilst climate change threatens our way of life as we know it. Emtech Asia seeks to discover the emerging technologies that will drive the new global economy and change our society. EmTech is where technology, business and culture converge.

EmTech Asia is co-organised by MIT Technology Review, the world's oldest and most respected technology publication since 1899, and Koelnmesse, one of the world's largest trade fair companies since 1924. Singapore Semiconductor Industry is honoured to be the event's supporting partner again this year.

Connecting the best from academia and industry to collaborate, EmTech Asia creates a platform for scientists with the capability to change the world to meet investors to commercialise ideas and tech executives to distribute it globally.

Two exhilarating days of networking and learning bring together the brightest minds in artificial intelligence, materials science, biomedicine, immersive media, space (and much more) from around the world to share breakthrough research and discoveries.

Three overarching themes – Our Digital Life, Becoming Cyborgs: The Future of Health, and Tech for Humanity – will address major global issues, hopes and aspirations for our future, along with 30 inspiring speakers who are leaders in their field and 20 Innovators Under 35.

Illustrious past speakers have led technology development and acquisition at organisations like Applied Materials, Baidu, Dolby Labs, Facebook, Google Deepmind, Lockheed Martin, McLaren Applied Tech, MIT, NASA JPL, NVIDIA, Sony Computer Science Labs, Tencent and more.

EVENT INFORMATION

EmTech Asia - 7th Annual Edition
25 – 26 February 2020
Marina Bay Sands, Singapore

www.emtechasia.com

COST OPTIMIZATION
A Semiconductor Manufacturing Critical Process

Overview of the Semiconductor Industry

In recent years, the increasing demand in electronics applications - such as Smart Phones, Gaming, Internet of Things, Artificial Intelligence, Autonomous Vehicles, Big Data, 5G, biotechnology, Industry 4.0 and so on has spurred the continuous expansion and technology advancement of the semiconductor industry. While more and more organizations are trying to get a slice of the pie in the industry, most companies realized that it is a tough market to invest in. The high level of competition in the semiconductor industry, coupled with short product life cycles, is so difficult to obtain or sustain a decent profit margin. As such, initial investments and operational costs need to be carefully planned and continuously optimised for profit sustainability.

The entry barrier of semiconductor manufacturing has been very high for the last two decades. The start-up of an advanced Fab that produces 50K 300mm WPM now would require up to USD 15B or 20B in investment. Even acquiring an old 200mm Fab with the old equipment and facilities would require at least half a billion in investment to have decent returns. That is why it is necessary to take cost consideration into the business strategy planning right from the start before the company could be successful.

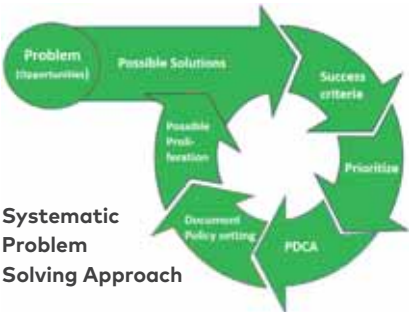
Many companies only go into cost reduction when the market is bad, trying to squeeze a small percentage of the cost reduction to cross over the difficult period. These companies always see the efforts backfire when the market recovers. Usually, even when the market recovers from the cyclical down cycle, these companies' profitability always drops far behind their competitors. A survey done by a reputable consultant company shows that only 10% of the cost reduction efforts were able to be sustained for more than three years. Most of the efforts were not sustainable for whatever reasons companies claimed. Therefore, the right cost optimization only refers to effective, systematic and sustainable cost reduction efforts.

Opportunities on Cost Optimisation for Semiconductor Manufacturing

Whether it is an SME or big MNC, during the product development phase (product could mean services as well, for example, parts cleaning businesses), the number one focus is always the time to deliver to market. Therefore, the focus will be doing it right the first time, ensuring prototypes get the best materials, the longest and safest process to have the best quality outcome. We even start with more materials for contingency purposes. The idea is, we can always make them cheaper once we secure the business. Again, due to the short life cycle of most products as mentioned, once the product is proven acceptable by the customers, they will immediately go into mass production ramping phase. There will be a totally new set of problems for the high-volume production ramp. Many a time, these new problems mean the company must pump in more money to resolve them. Therefore, instead of reducing the cost, more spending is needed.

A new Fab now would normally take up one and a half years to complete the whole installation, but upon installation, the Fab would take another five to ten years to optimise the costs. This depends on whether the fab has kept the "cost" in mind when planning for the new Fab and if the company has a cost-conscious culture.

Similarly, for tool suppliers, when they are designing these complicated tools for their users, they are faced with the same problem: the time crunch to deliver to the market ahead of the competition and satisfying



Systematic Problem Solving Approach

technology needs in advance. They also have in mind, the continuous residual gain from the tools after they are being put to the production lines. Hence, the cost will again be the least consideration in mind during the development. The cost effectiveness of the tools is normally the least important objective for the suppliers. To ensure the sustainability of good process performance, many parts of the tools are recommended to be changed after a short period of running. This is especially so when most of the production processes are different from the "golden" process used to set up by the suppliers when they design these tools. It is often not a fair argument with suppliers when this excuse is given. A lot of time, the

suppliers also do not have high volume run experience and so, lots of improvement can only be done after the experience gained from the ramping phase. That is why it is normally quite difficult to get suppliers' involvement in cost optimization.

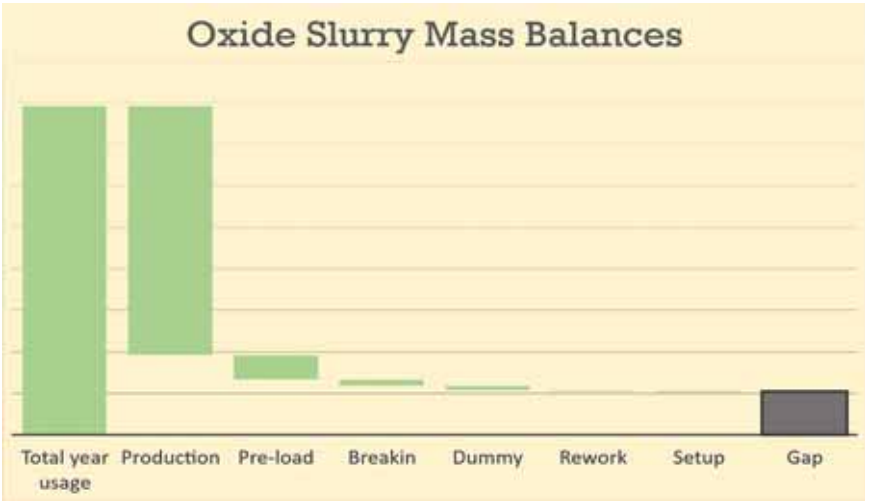
Most of the tool suppliers also work with third parties for chemicals and gases needed for the process. They might not need to understand these commodities fully. Therefore, again, it requires users themselves to have both knowledge of the materials as well as the tool for these materials' consumption optimization.

We all share the same mother nature and conserving the limited resources we have in the world should be a shared responsibility. It is necessary for all companies, big or small, to minimize the wastage of these resources. Working with SSIA, we once formed a consortium on energy savings. Key participating semiconductor companies had shared openly how each of them was saving their energy thus reducing carbon footprint. This is the reason why a course 'Cost Optimization' is called for. This course will be specifically designed for both SMEs and MNCs in the semiconductor industry and it will cover technical knowledge that allow immediate benefits through targeting the low hanging fruits first from all our past learnings.

Key Focus For Cost Optimization

The most significant expenses the semiconductor industry sees are from materials, machines maintenance and utilities. Each of these cost elements and the techniques commonly used to optimize them should be seriously considered.

Material Cost: These include the raw material and all the bulk and special chemicals, bulk and special gases required for the processes. Some of these materials are scarce resources, leading to shortages and strong competition in securing them. Others cause harm to the environment and are therefore likely to be phased out or more heavily regulated by the authorities. All these would, in turn, cause material costs to skyrocket.



Example on why material spending optimization is important. Materials can be wasted due to poor planning.

Tools Upkeep Spending: While each supplier spends lots of research and development work to deliver tools that help the manufactures with their processes, their focus will always be on the tool's precisions, controls of quality and productivity. While good cost optimization not only helps to reduce maintenance costs, but it also helps to improve the qualities and productivity as well.

6Rs Savings Methodology

Energy and Utilities Cost: With the requirements of high-level cleanliness and a stringent health and safety environment, coupled with complex machinery, the energy utilization in this industry is normally high.

For more proven practices and techniques on cost optimisation, the coming SSIA course 'Cost Optimization' will give you more insights.

ABOUT THE AUTHOR:

CT Chung

CT Chung has been working in the semiconductor industry for the past 35 years. He worked in MNCs like General Electrics, GlobalFoudries and Applied Materials previously, and was involved in 5 Fabs start-up in GlobalFoudries from tool evaluation till the production phase. He helped to establish the Cost of Ownerships Model for the company during the Chartered days. In the last 5 years of serving GlobalFoudries, he was the Head of Program Management Office that led Cost Optimization program to extend the company's profitability.

Photo Source: Blackberry QNX

GES JOINS THE BLACKBERRY QNX CHANNEL PARTNER PROGRAM

To support design and development of secure, mission-critical embedded solutions using BlackBerry QNX and BlackBerry Certicom technologies, Gopalam Embedded Systems (GES), a leading provider of hardware and software development solutions for embedded realtime systems announced in May 2019 that it will offer BlackBerry's QNX software and services to its broad embedded customer base in the ASEAN region. GES joins the BlackBerry Channel Partner Program, a worldwide network of value-added integrators and distributors, and reseller experts trained on QNX technologies.

Under the agreement, GES will resell BlackBerry QNX products and services, including the popular QNX Neutrino RTOS, QNX OS for Safety, QNX OS for Medical and various other QNX offerings. This, combined with its technical expertise and competency in Embedded Systems Tools, RTOS and Middleware, will enable GES to build upon BlackBerry QNX's embedded technologies, provide integration services and design, and develop safety critical solutions for GES' customers in the ASEAN region.

"Leveraging BlackBerry's ultra-reliable, ISO 26262, ASIL-D certified QNX software will help GES' customers to build reliable, scalable, secure and high-performance applications for automotive, medical, industrial automation, power generation and data networking markets," said Gurunatham G V, CEO, GES. "The BlackBerry QNX Channel Partner Program provides GES an opportunity to strengthen its existing synergetic tools ecosystem with QNX's Operating Systems and Middleware offerings."

"BlackBerry is pleased to welcome GES as a distributor to our growing Channel Partner Program," said Kaivan Karimi, SVP and Head of Sales, BlackBerry Technology Solutions, BlackBerry. "The BlackBerry QNX operating system and GES' product engineering capabilities make for a formidable combination that will lead to many innovative solutions for our shared global customers while helping to increase our footprint in the booming ASEAN market."

With a robust ecosystem of tools and development solutions from leading vendors across the world, GES supports the entire development life-cycle of embedded systems from design, development, debugging to verification and validation. GES caters to a broad range of needs across various verticals including automotive, aerospace, defense, education, electronics design/manufacturing, energy, industrial automation, instrumentation, medical devices, military, semiconductor and telecom/datacom.

The BlackBerry QNX Channel Program allows partners to assist in customer deployment of BlackBerry QNX's embedded technologies for secure and mission-critical solutions by accelerating product time to market.

ABOUT THE AUTHOR

Gurunatham G V
CEO, Gopalam Embedded Systems

SSIA WELCOMES NEW MEMBERS

amtri

Component Technology

GVT MANUFACTURING SOLUTIONS

NAGASE Bringing it all together

ADDING VALUE TO SEMICONDUCTOR INDUSTRY

AGV/AMR autonomous mobile robot material handler

CEI Limited AGV/AMR – Autonomous mobile robot material handler

AGVs (Automated Guided Vehicles) have been used to move things around on behalf of humans for over half a century until recently a more sophisticated, flexible, and cost-effective internal logistics technology, AMRs (Autonomous Mobile Robots), has been introduced to automate internal transportation tasks.

While always working closely with customers, listening to their needs and wants and looking at the next "thing" to do, CEI Limited embarked on a journey to develop its own AGV/AMR – autonomous mobile robot material handler.

AGV/AMR – Autonomous Mobile Robot with Integrated Robot Arm

With the support of an important customer, CEI Limited has designed and built its very own AGV/AMR base and integrate it with a 6 degrees of freedom collaborative robot arm. The robot arm is fitted with an end effector (designed by CEI Limited) for lifting and placing SMIF (Standard Mechanical Interface) pod for 8" wafers. The AGV/AMR can transport 2 pods at a time.

The AGV/AMR is able to autonomously perform the complete task of a human worker – pick, transport and place the SMIF pods, thereby greatly increasing tool utilisation time, eliminating costly handling mistakes by human workers and free the human workers for more value-added tasks.

The AGV/AMR is built to operate in the tight aisle of a semiconductor manufacturing environment with a cleanroom class of Federal Standard 209 class 100 or ISO class 5. It is fully autonomous with WIFI communication and using LIDAR (Light Detection and Ranging) sensors for navigation and obstacle and collision avoidance. With the aid of a map of the manufacturing floor and with dynamic path planning, a smooth continuous trajectory of the mobile robot is ensured. The AGV/AMR can travel to a maximum speed of 800 mm per seconds. The AGV/AMR has a zero turning radius, that is basically turning on its spot thereby requiring the minimum space for maneuvering. The AGV/AMR also has a proprietary fleet management software that can manage up to a fleet of 70 AGV/AMRs.

The AGV/AMR is built to comply with CE and SEMI S2/S8 standards. It has all the necessary safety features for a safe, accident-free operation along with human workers.

End effector attached to robot arm – designed by CEI

The AGV/AMR runs on LiFePo4 battery. It can operate for 8 hours and requires 4 hours to be fully charged. It can be programmed for opportunistic charging (autonomously docking to a charging station to charge its battery when no task is assigned) or the battery can be hot-swap with a fully pre-charged battery.

CEI Limited has since, been working with various customers on each of their unique application needs and helping the customers on their material handling requirements. This is CEI Limited unique strength – willingness to bend over to provide customization to meet customers' needs and wants.

AGV/AMR Base Unit

About CEI

CEI Limited is headquartered in Singapore with manufacturing sites in Singapore, Batam (Indonesia), and Ho Chi Minh City (Vietnam). The Company is listed on the main board of the Singapore Exchange Securities Trading Limited since March 2000.

CEI Limited provides printed circuit board and box-build/equipment assembly, cable harness assembly, design and build its own proprietary equipment for automated wafer transfer using robotics and customized automation systems.

The Company is ISO9001, ISO13485, ISO14001, AS9100, Nadcap, UL508A and UL817 certified.

Proprietary Equipment Division - Design and build its own brand of equipment and customized automation systems

CEI Limited design and build its own brand of equipment to meet the semiconductor manufacturing industry needs for automation, hands off production, with a focus on wafer handling using robotics.

Today CEI Limited has a range of equipment such as Equipment Front-End Module (EFEM), Wafer Sorter/Packing and Unpacking systems, Wafer UV Eraser Systems, Wafer Macro & Micro Inspection Systems, 3rd Optical Inspection Systems and AGV/AMR – autonomous mobile robot material handler. Besides standard equipment, CEI Limited also take on customized automation project, working closely with customers equipment team to realize their automation needs.

CEI Limited engineering team has vast experience in automated transfer of wafers using robotics with various diameters (4" to 12"), thickness (3 mils to 29 mils) and warp (up to 4mm). All equipment has user friendly Man Machine Interface (MMI) in English/ Chinese which is selectable.

CEI Limited equipment are built to comply with CE, SEMI S2/S8 standards and option for SECS/GEM for communication with factory MES. All the equipment can be use in a cleanroom environment of cleanroom class of Federal Standard 209 class 100 or ISO class 5.

Besides standard equipment, CEI Limited also take on customized automation project, working closely with customers equipment team to realize their automation needs.

Article by **CEI Limited**

Control Panel on AGV/AMR showing a factory map

Cultural Transformation in the Digital World

The Singapore Management University's Executive Development team recently embarked on a study to gain a deeper understanding of what digitalisation meant to companies in Asia and beyond and how this is being perceived by C-Suite leaders. It appears that while many leaders are struggling to cope with the digital wave phenomenon, only a few have been able to embrace it fully, and almost none have been able to get ahead of it, proactively.

1. Cultural barriers, not technological gaps, trip digital transformation initiatives

A whopping 87% of the respondents agreed that culture created bigger barriers to digital transformation than technology. Most C-Suite interviewees shared that the outcomes and ROI on digital transformation were currently quite unclear, and this often posed a serious challenge in their ability to articulate the value proposition to their Boards and garner additional investment in resources. It would be important to develop a more agile and risk-taking approach by promoting a culture of 'rapid experimentation, testing, learning, developing a "growth mind-set" and courageous risk-taking' - a culture that permits and embraces failures as an important source of learning and resilience building for better future outcomes. Technological gaps were perceived to be easier to address than cultural barriers since technology could be easily upgraded or externally sourced with the right level of Board's support for appropriate investments. Conventional structures, business models and processes often impede digital transformation, and would need to be disbanded and rebuilt. The risk associated with digitalisation is that it is the perfect recipe for the cultural fabric to get weaker if not executed and adopted properly.

2. Humans and machines will co-create 'multiplicity' to rule technology

92% of the respondents believed that human intervention would continue to be important in the digital age although less than 10% stated that analogue methods were superior to digital. Leaders in the digital world would need to quickly develop the idea of "multiplicity" or the unique capability of humans to interface seamlessly with machines and co-create innovative solutions collaboratively. It is important to ensure that employees across the organisation do not become complacent and educate them about the changing nature of human intervention that will transcend conventional mastery of devices and platforms. In the digital age, humans will need to master technology and leverage its potential to the fullest, in order to enhance value to their consumers as well as to improve the efficiency and effectiveness of their internal processes and systems. Humans cannot be entirely replaced by

machines - human intervention would be required to master and leverage technology to its fullest potential by using strategic and critical thinking.

3. The CEO matters the most

C-Suite leaders and executives equivocally asserted that the role of the individual CEO as extremely critical to the success of the digital transformation initiative. He/she must be deeply engaged in crafting a bespoke strategy to fit the unique context of the organisation, set the goals, define the desired pace of implementation, launch the initiatives and nurture the process until a stable state is reached and others are ready to take over the baton. He/she may not be a digital native but must demonstrate a deep appreciation for technology and strong conviction about its ability to deliver value to external and internal stakeholders. The CEO must also act decisively to identify critical pivot points at which the strategic plan will need to be swiftly adjusted and direction altered. The CEO must assume the role of the chief evangelist of digital transformation - persuasively, persistently and convincingly articulating and communicating the "why" behind the initiative and convincing sceptics and fence-sitters that the change and/or investment is essential, and that it will create positive business impact.

In conclusion, C-Suite leaders must "be the change" that they seek in others. They must "walk the talk" by modelling the very behaviours such as risk-taking, tolerance for failure, collaboration and agility that they expect from other leaders in their organisations. With uncertainty and constant change as the hallmark of the digital era, major cultural and mind-set shifts are expected from leaders to drive digital transformation. Success will come to those leaders and organisations who take adequate steps to enable people to embrace the discomfort associated with these changes and empower them to manage their expectations.

ABOUT THE AUTHOR

Dr Flocy Joseph
Head, Strategic Partnerships & Programme Director, Singapore Management University Executive Development (SMU ExD)

For enquires about SMU Executive Development, please email to exd@smu.edu.sg

NURTURING INDUSTRY-READY AND INNOVATIVE TALENTS THROUGH AN APPLIED LEARNING MODEL

Applied Learning Competency-Driven Model

Singapore Institute of Technology (SIT), Singapore's university of applied learning, was created with a vision to shape the educational landscape by integrating learning, industry and community.

SIT's programmes are targeted at growth industries and are well structured to manage the disruptions and harness the opportunities that technology brings. This is achieved through close partnerships with industry in order to understand what's in demand, and where manpower is needed. Given the fast evolving tertiary education system in Singapore, SIT focuses on an applied learning competency-driven model where curriculum creation is demand-driven.

SIT takes on the practical approach in pioneering the applied learning model that ultimately increases student engagement in learning via real-world application. One key pillar of SIT's learning model is the integrated Work Study Programme (IWSP), which provides the opportunity for students to learn and contribute in a real work environment for up to eight to 12 months. This serves as a great platform for the industry to develop future engineering talents in accordance to the skills and demands of their businesses.

Singapore's economy is being subject to disruptive technological changes with the government rolling out several initiatives to restructure industries to meet future needs. The electronics and semiconductor industry is no different and is also going through a major transformation with emphasis on advanced manufacturing, market diversity and talent development. It is then essential for tertiary education to adapt to this transformation. To allow its graduates hit the ground running when in employment, SIT is pioneering the applied learning approach with its unique IWSP programme to meet this need.

Win-win Partnership & An Investment For Companies

The IWSP shifts the mindset of undergraduates towards a work-study continuum as they work on real-life projects. IWSP forges a win-win partnership and is an investment for companies that are already focusing on developing their future talent pipelines. The programme is designed to be more in-depth and structured than a traditional industrial attachment. Not only are the internships for a longer period, SIT impresses on its students to treat it as real work. Students apply for positions with companies onboard the programme as they would for any job. SIT then together with its partner companies monitor the students' progress week-on-week. By the end of the programme, which is undertaken in the second or third year, students are encouraged to identify a problem in the companies that they can use as a case study for their final-year project. They will have to come up with solutions to the problem. In Academic Year 2018, 'close to 1200 SIT students from 16 degree programmes went out for their IWSP with over 500 companies.

Reinventing worker's skills set and inspiring innovation are key to building a productive business environment and to uphold Singapore's reputation as a home for new businesses. The evolution of the education system should thus bridge the gap between knowledge, workers and the industries of the future. SIT is leading the path in this direction, and looks forward to collaborate with industry partners to be future ready.

SIT CAREER COACHES

- Ms Lim Chin Yen
  (SIT-NU Chemical Engineering)
  6592 3489
  ChinYen.Lim@SingaporeTech.edu.sg
- Ms Bernise Goh
  (SIT-NU Electrical Power Engineering)
  6592 8528
  Bernise.Goh@SingaporeTech.edu.sg
- Mr Lim Kim Peng
  (SIT-NU Mechanical Design & Manufacturing Engineering)
  6592 1516
  KimPeng.Lim@singaporetech.edu.sg

Student Profiles

Shukla Rati
Singapore Institute of Technology
Systems Engineering
(ElectroMechanical Systems)
2018 (Class of 2015)

My IWSP in STATS ChipPAC was an incredible experience. I was with the test department as a test engineer. My main job scope involved the design and implementation of a recovery system that enables recovery of corrupted data from test machines. While I was tasked with a specific role, that did not stop me from learning and experiencing the entire spectrum of operations at ChipPAC.

I was given the exposure of the clean room and attached to different teams within the test department. This allowed me to better understand the company's day-to-day operations and grasp various pertinent work flows. This attachment not only gave me the opportunity to work independently but also collaboratively with highly experienced engineers. Learning from the seniors and having them guide me through challenges taught me to communicate effectively and ultimately enabled me to do my job well with confidence.

There were ample opportunities for training too during my IWSP stint. The training sessions were very important as they empowered me to connect the dots between theory and practise and to better relate and appreciate the Industry. This 8-month-long training period was crucial to me feeling like an integral member of the team and a valued employee. I've grown individually and as team player as well. I'm extremely pleased and grateful for this experience which I'm confident will put me in good stead to hit the ground running when I eventually start work.

Tay Chor Sheng
Singapore Institute of Technology
Systems Engineering
(ElectroMechanical Systems)
2018 (Class of 2015)

In my time at STATS ChipPAC, I started off as a product engineer and underwent trainings and tutorials. In the production room where I was attached to, there were various types of testers and platform, I was mainly focusing on the HP93000 testers and MT9510 handler. With guidance from the senior engineers, I quickly learnt how the handler and testers work and how each device is tested.

Every device or semiconductor chip has a unique program and has to be run through the SmarTest programme to validate its quality. I learnt how to run program checkouts and ensure all engineering correlation units are passed in the good bin. In cases of any failure, I also learnt how to debug the problems with the test program such as using tools such as the shmoo plot and timing diagram.

Away from the production room, I learnt software analysis. I used systems such the DbVisualizer which operates in MySQL to obtain all the live data which was previously presented in a excel spreadsheet. With the acquired data, I created various scripts to extract accurate and pivotal information such as the MTFs, yield, number of continuities and the number of retests. I also got acquainted to methods of quality management by learning the concepts of 3-sigma, 6-sigma and the Tukey's method.

While this was an attachment, it never really felt like it. I was treated, and felt very much like a full time employee. This experience gave me so much insights on how the industry works over and on top of what we learn in our classrooms and labs. It really has prepared me well for my career.

Shukla Rati (Left) and Tay Chor Sheng (Right)

Quote from Industry Partner

Linus Ngu

Test/Product Engineering, STATS ChipPAC

"Both Rati and Chor Seng had demonstrated the can do attitude that we value from an important team player in our organisation. Both students showed hunger and initiative to do their own research and brainstorm for alternative solutions on their assigned projects.

Being junior engineers in the team didn't deter their enthusiasm. They were independent, were not shy from interacting with other colleagues and contributed good ideas. We received great feedback about Rati and Chor Seng's attachment from several supervisors and colleagues in the Test Department.

We would like to thank SIT for making this 8-months IWSP possible. The 8 months was a very good time frame for us to work with the students. It allowed for continuity and seeing through of important projects. It also enabled us to schedule on job and in-house technical training programs for the students and get them ready for their assigned scope of work. This means they had ample time to demonstrate their newly acquired skills and capability in the workplace and most importantly add value to our processes.

We look forward to collaborating with SIT on the upcoming internship programs".

To know more about IWSP visit:
https://www.singaporetech.edu.sg/industry-global-exposure/integrated-work-study-programme

DEVELOP THE TALENT PIPELINE

The SkillsFuture Earn and Learn Programme Leading to Part-time Diploma in Engineering (Electrical and Electronics)

Electronics is the major industry underpinning Singapore's economic growth. In 2016, EDB attracted S$9.4 billion in Fixed Asset Investments (FAI). Electronics accounted for 23.8% or S$2.2 billion of the Fixed Asset Investments. In year 2017, the figure was comparable. The strong pipeline of investment commitments was fueled by increased demand in smartphones, tablets and computing segments, as electronics become more pervasive worldwide.

Singapore's Electronics industry is a world-class, innovation-driven hub that provides technology, manufacturing, and business solutions to enable the development of new growth areas. Today, there are 15 silicon IC wafer fabs, 4 compound semiconductor wafer fabs and 3 Micro-Electro-Mechanical Systems ("MEMS") wafer fabs in Singapore.

In addition, manufacturing of finished electronics products created many spin-offs to other segments of the economy, such as precision component manufacturers, chemicals and materials suppliers, electronic manufacturing systems companies, and logistics service providers.

The electronics industry is currently undergoing transformation to manufacture higher value-added products. This, in turn, will fuel the demand for more trained personnel to support the industry. Some of the world's biggest semiconductor companies have manufacturing facilities here, as do many other top outsourced semiconductor assembly and test companies. Looking ahead, the Electronics Industry Transformation Map (ITM) aims to grow the sector by transforming the current installed base of companies through productivity, automation, and upgrading the manufacturing product mix. It also aims to grow the electronics sector to $22.2 billion and introduce over 2,000 new Professionals, Managers, Executives and Technicians (PMET) jobs by 2020.

However, one of the challenges the sector faces is the shortage of talent that can facilitate companies' transformation. Surveys with the industry have also indicated strong demand of talents from the semiconductor and electronics companies.

To address the issue, the government has been proactive in implementing schemes to address the talent shortage in the electronics industry. One of these initiatives is the SkillsFuture Earn and Learn Programme (ELP). It is a work-learn programme that gives fresh graduates from polytechnics and the Institute of Technical Education (ITE) a head start in careers related to their discipline of study. Participants will spend time working in the company and spend time studying.

Eligible individuals can receive a sign-on incentive of $5,000. Companies can get a grant of up to $15,000 for each participant to defray the costs of developing and providing structured on-the-job training.

This year, Republic Polytechnic has launched the Earn and Learn Programme for Electronics leading to Part-Time Diploma in Engineering (Electrical and Electronics), which aims to equip ITE graduates with the necessary skills and knowledge to support the electronics industry. This 12 months programme will be commencing in October 2019. Participants will enhance their knowledge in the microelectronics, electronics, networking and communications as well as upgrade and deepen their skills so that they are well placed to take on new or larger job scopes and progress in their careers.

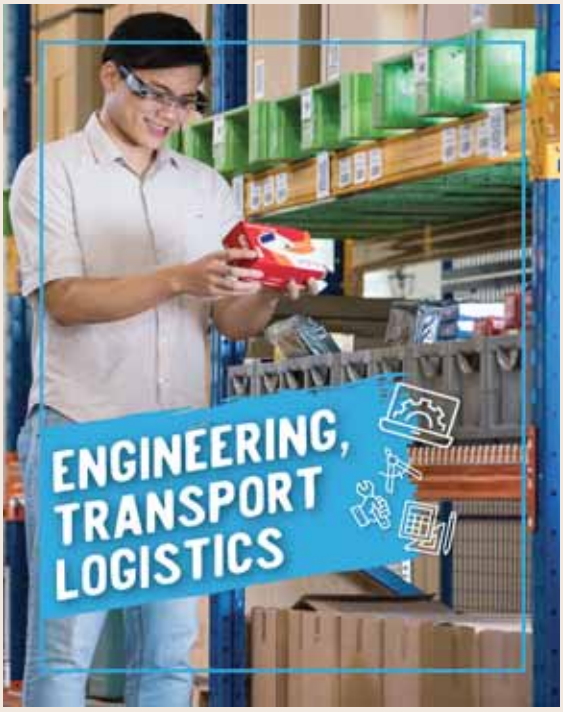
Upon completing the ELP programme, graduates will be able to continue to take on the Part-Time Diploma in Engineering (Electrical and Electronics).

ABOUT THE AUTHOR

Marcus Ng YS,
Assistant Manager, School of Engineering, Republic Polytechnic

Many companies and individuals have benefited through the ELP programme. We would like to share one of our ELP participants' success story. He is Mr. Feroz Khan Bin Ahmad Khan, 26, a Senior Operations Executive at Pan Asia Logistics Singapore Pte Ltd.

Here is his story:



How did you first hear about the ELP?

"I wasn't certain about which industry I wanted to join when I graduated. I had the option of returning to the food and beverage industry but towards the end of my diploma course, I decided to get some perspective from my lecturers about how to enter the supply chain industry. My lecturers were enthusiastic about enrolling me into the ELP, so here I am today."

How has the ELP helped you so far?

"The ELP has provided more than just a stepping stone into the supply chain industry! It has provided me with better qualifications and given me an edge over my peers, as I started work at Pan Asia Logistics just one week after my graduation.

During the one-year programme, I gained a lot of valuable industry experience. I was exposed to everything in the industry from dangerous goods handling to fronting customers, freighting and even performance measurements. These experiences helped me understand the relevance of what I learned in both my diploma course and the Specialist Diploma in Supply Chain Management. I probably would not have gotten these opportunities if I had chosen to return to the food and beverage industry.

Furthermore, my two years in Pan Asia Logistics has groomed me to be an effective and resourceful professional, leading a team of 25 people. This responsibility for their well-being and growth gives my job meaning, as I try my best to help them maximise their potential. My management gave me a promotion for my performance and we are in discussion of enrolling me for a degree in SUSS for BSc Logistics and Supply Chain Management with module exemptions under the ELP collaboration after I have settled down next year."

To learn more about our ELP programmes, please contact us at 6369 8906 or help-SEG@rp.edu.sg

BEYOND SMARTS, HARD WORK AND GREAT IDEAS:

Taking Advantage of the 5% Situations to Standout in Your Organizations

Critical 5% Situations

Asian executives are increasingly in demand thanks to a shifting global business and market opportunities. However, many are missing out from being considered for even higher leadership positions because they lack vital global communication and executive presence skills in the critical 5% situations that come up.

The 5% situations are events you have with your leaders at least 2 levels above you and when you are being assessed whether you know it or not. There are five primary situations; a) the one on one, b) key team meetings, c) conference calls, d) business presentations or lastly, e) company socials. These are some of the situations where these leaders see or hear you and make their determination if you are "ready" for the next level.

"I can't understand it," said Pete Bassi, a retired senior executive with PepsiCo and Yum! Brands, who worked many years in international operations. "Asians have most of the attributes I was looking for. They are respectful, hardworking and very smart. They just don't have the confidence to stand out from the crowd and be visible enough."

We all know what the issue is: we need to think carefully before speaking up and to only speak when spoken to. Only participate when you have something worthwhile to say, if not, be quiet. Asking a difficult question or challenging the norm is viewed as disrespectful or "not giving face" to the senior leader.

Asians who are competent but perhaps not promoted quickly enough may ask, "Shouldn't my work ethic, experience and results speak for itself?" The answer is: no. John Staines, a senior global HR executive with several MNC's (Multi-National Corporations) who has worked in Asian for many years, said: "Many Asian leaders need to learn to feel more comfortable outside of their home environments, and those that do, get to move ahead in large global corporations." The ones who can talk little league baseball or soccer, the Super Bowl in the U.S. or about fine wines or even performing arts in Europe.

So what do you need to do specifically?

So what do MNC executives look for beyond technical competence and hard work? MNC executives look for managers who can be sociable, communicate effortlessly, take ownership of challenges, and carry the organizational culture in those 5% situations.

As you know there are many Asians who have dispelled these traditional myths around self-effacing behaviour and are successful in their corporations. However, a much larger cadre of confident and outgoing Asian leaders are needed to make an impact across cultures and in the boardrooms of major U.S. or European corporations. Those who do will have an immediate advantage. If an Asian manager communicates as confidently as other global executives, the effect is often more pronounced because it is unexpected. He or she will likely be immediately noticed as a leader.

From our research from more than 100 Western corporate leaders, leaders want Asian managers and leaders who can:

- Instinctively lead and take ownership of projects and teams, instead of waiting for instructions.
- Take a position and articulate decisions effectively, not be a yes-man or yes-woman. Many cultures will respect a point of view held firmly even if they disagree with it.
- Build trust and influence at all levels. Be genuine and reach out to all types of employees, even those on the shop floor — word will get around.
- Have something meaningful to say and say it with poise. Communicate clearly, concisely and confidently.
- Deliver direct feedback and disagree with appropriate assertiveness. However never be negative always use neutral or more positive tones.
- Learn to Connect personally at all levels. Know how to develop relationships at formal and informal meetings; don't just mix with fellow Asians.
- Willingly develop teams, share knowledge, and recognize and reward individual efforts openly.
- Be genuine in helping to groom junior staff and give them due credit.
- Learn to be comfortable mingling with the bosses when they fly in from headquarters and leaving a lasting positive impression.

You need to work on these skills and not be scared over losing your identity; you are developing dormant or underdeveloped facets of your personality and skill sets. Sometimes you may need to be more outspoken with your Western colleagues to overcome preconceived ideas and perceptions. It sounds simple but many come to learn in our GEM (Global Executive Mindset) Program – simple is not easy.

You need to be ready to respond "spontaneously" to questions posed by your senior leaders because many will typically say at the end of meetings "Any questions or comments? ", and, the typical response from the group is "Silence".

So if you are already hardworking, knowledgeable and produce results; why not learn what many Western leaders are expecting from you in terms of your leadership, communication, and behavioural skills and join (or better yet) surpass your global counterparts!

ABOUT THE AUTHOR

Stephen Krempl
President and CEO of Krempl Communications International, Speaker of Singapore Semiconductor Leadership Accelerator Program

5 TRAPS TO AVOID WHEN PLANNING YOUR NEXT TEAM BUILDING EVENT

You've volunteered, assigned or "kenna" arrowed to plan a team building event. What's next? In this article, we've prepared a list of traps you can get into when planning your next team building event in a way that achieves your company's objectives, but also lets your colleagues have a blast.

Across the spectrum of planning and facilitating over 1,000 events in Singapore and SEA in the last 10 years, I've played multiple roles: from being a participant in team building activity, to becoming a team building activity planner for my company, to facilitating workshops. I've made and observed a fair share of mistakes and I am happy to share my lessons here.

Trap 1: Planning team building events sucks

It does. And it does not. It all depends on your perspective. It sucks because:

- You have to do this project in addition to your main work duties
- It is a whole lot of draggy meetings with undecisive committee
- It is about being *partly* responsible for the success of the event and *fully* responsible for things that go wrong

But don't fall into trap of negative thinking. Look for a brighter side:

- When planning team building, you get direct access to VIPs and VVIPs in your company, when these people give overall event objectives, and approve the budget, as well as on the actual day of the event. This means you get a very exclusive chance to showcase your strong leadership and project management skills. Since your higher-ups are actually a part of the event, it probably means they'll remember it. It's a chance to show that you take every project and opportunity seriously, which goes a long way in any career.

Trap 2: Team building is not an objective of team building

It is common to hear that the goal of our event is "team building". And It's a trap. "Team building" is too ambiguous. Be specific on what outcome you want to get and it will serve you well when planning every aspect of the team building event.

For your reference, we've outlined some of the typical objectives of team building events:

- To Reinforce Corporate Values: translating slogans on your office wall into specific everyday actions
- To Learn Specific Skills, e.g. essential soft skills of a modern workplace like creative problem solving, group decision making, conflict resolution, etc
- To Change Mindset. Examples include: Being open to change, accountability, cross-departmental collaboration
- To Build Internal Networks. Let your colleagues connect and know each other on a personal level. Get them to know the person behind that email signature.
- To Set Team Norms. Get the team to agree on what is acceptable and non-acceptable behavior in their team
- To Celebrate. Rewarding a team with a fun day off

Trap 3: Attracted by the look

When selecting activities (or shortlisting choices for a poll) don't just look at the name of the game and write-up on the website. Get more details about activities from your potential team building vendor:

- Make sure that experience is novel to your team (similar games can be "packaged" under different names),
- Check how many runs that activity was conducted and ask for references (you don't want your team ends up as a guinea pig for that game).
- Seek to understand game mechanics and how it achieves your event objectives

Trap 4: Forced fun

Whatever objectives you set for the event, they won't be achieved if participants are not engaged during the activity. Don't fall into trap of forcing participants to have fun if they don't. Want to guarantee engagement? Invite participants to co-create the experience by voting for their favourite game. Pre-select 3-5 activities that meet your objectives and get your team to poll.

Here are the types of activities offered in Singapore. Have a fair range of them when doing a poll:

- Outdoor Races like Running Man or Heritage Trails
- Sports-related, e.g. high elements or indoor Olympics
- Food-related activities, for example, cooking or food hunts
- Art and crafts, like art jams or terrarium making
- Mind-boggling, e.g. business simulations or escape games
- Creative, for example, music or film making

If you don't want your team to decide about the activity, you can invite them to have a say about other aspects of

the event, e.g. date, time, food, venue, door gifts, or just giving a generic choice: indoor or outdoor.

Trap 5: Team building event never ends

Don't assume your event ends once participants shake hands and leave the function room. You organise the event to impact your teams' life in the office. Here is what you can do get the effect of the event to last:

- Make "catch phrases" from team building event part of your office lingo. "It works!" "Don't assume!" or "I am not a Mole" – these words will not make sense to you. But they trigger vivid memories of participants from our activities "The Domino Effect" and "SpaceX"
- Display hilarious pictures from your event on the notice board (or internal online platform) and keep refreshing them once a month.
- Create reminders about the team's commitments made during the event. For example, you can spot these words framed and hanging on our office wall: "No Back Biting Takes Place Here: I choose not to talk negatively about the person who is not present" with everyone's' signatures below.

Conclusions

Planning a team building event is not hard. What it needs, however, is a bit of dedication, a bit of knowledge about the subject and a bit of luck! If you have started to read this article, it shows you have a dedication to make this project a success. If you've finished reading it, you've gathered essential knowledge about it. The only thing left is for us to wish you good luck. May your next team building event be a successful one!

> "'Team building' is too ambiguous. Be specific on what outcome you want to get and it will serve you well when planning every aspect of the team building event."

ABOUT THE AUTHOR

Gregory K
Director, Trainer, Facilitator
GRINESS PTE. LTD.
www.griness.com

SINGAPORE SEMICONDUCTOR VOICE

REACH OUT WITH US

REACHING TO THE FULL VALUE CHAIN ECOSYSTEM OF THE INDUSTRY

Be part of our community

If you are keen to participate and play an active role in this vibrant commuity with your marketing or advertising campaign, please write to secretariat@ssia.org.sg . Alternatively you can call us at +65-31091953.

SSIA
Singapore Semiconductor Industry Association

What are the Benefits of SSIA membership?

- Knowledge sharing platform with government agencies
- Business networking opportunities
- Extensive market outreach and branding opportunities
- Leadership and master class trainings
- Priority in customised talent outreach programmes
- Priority access to industry benchmark data and directories

To connect with us
visit https://ssia.org.sg

For more information about membership
visit https://ssia.org.sg/join-us/

SSIA
Singapore Semiconductor Industry Association

Follow us:

60 PAYA LEBAR ROAD, #10-28
PAYA LEBAR SQUARE, SINGAPORE 409051
T: (65) 3109 1953 **www.ssia.org.sg**

Singapore Semiconductor Voice Magazine: www.ssia.org.sg/singapore-semiconductor-voice/

WWW.SSIA.ORG.SG

PRICE: $6.00