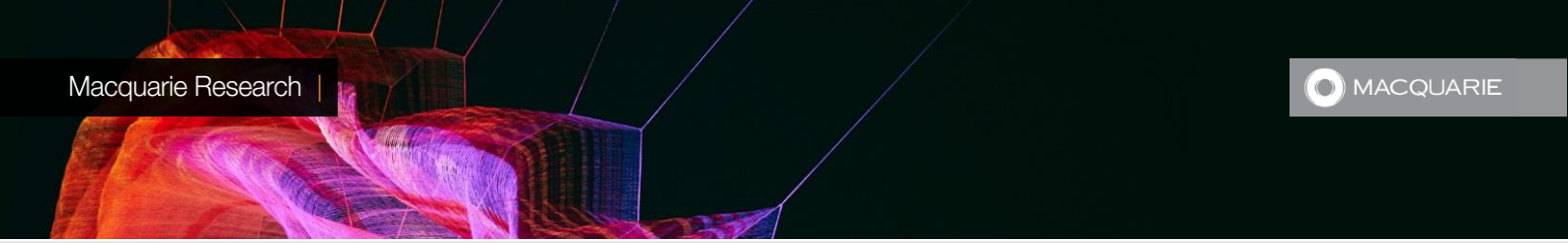

10 October 2018

Greater China

EQUITIES

DisruptiveEdge

Inside

Concierge economy
Opportunities in Tech, AI, IoT, AR

Key points

- We see new technologies driving the emergence of the concierge economy, including AI, IoT, IoV, autonomous driving, AR/VR, new retail, etc.
- We are positive on the concierge economy and see AI assistants in smartphones, smart homes, smart cars, etc as the earliest beneficiaries.
- We expect 5G to further drive new technologies (AR, IoV, autonomous driving, especially), fuelling the concierge economy.

In this report, we review developments in the 'concierge economy' and identify opportunities across technology sectors.

New technology drives the concierge economy

The concierge economy allows the needs and expectations of customers to be recognized and anticipated, anytime and anywhere, without lag. For example, smart home devices could remember user preferences and assist users like a concierge—eg, remind the 'master' to rest at the usual sleeping time. We are positive on the concierge economy and see new technologies, such as AI, IoT, IoV, autonomous driving, AR/VR, new retail, etc, driving the economy, fulfilling customers' growing demand for concierge-like services.

AI, concierge in hand, concierge in house

AI in smartphones – Recognizing users' needs is key in concierge-like services. AI in the smartphone acts as a virtual assistant that learns from users' habits via machine-learning (link, Jan 23), automatically set up schedules, reminders or provide suggestions. For example, making movie recommendations once it detects 'movie' in a text message. **AI in smart homes –** smart speaker/ TV could learn from users' habits with voice command. For example, detecting the weather and 'speaking' to remind the user to carry an umbrella on rainy days.

AI, ADAS, autonomous driving, concierge to ease driving burden

AI in automotives, before autonomous driving gets ready in the 5G era, such as assessing a driver's health and fitness to drive and thus enhance safety, facial recognition to unlock the door, and automated adjustments based on a driver's habits. **ADAS/autonomous driving** could ease driving by automating routine tasks. Cameras, LiDARs, or radars enable cars to 'see/sense' surroundings, while algorithms enable cars to 'understand' what it sees and to make decisions—such as choosing the best routes, speed up/slow down to maintain a safe distance, stop when it detects dangerous conditions, etc.

5G to accelerate the concierge economy

We expect AI assistants in smartphones/smart homes as the earliest beneficiaries of the concierge economy and 5G to further drive the economy with AR/VR, autonomous driving, IoV, etc. 5G brings high speed and low latency to enable massive data transmission and calculation without lags.

BUY: VR/AR: TSMC, Hon Hai, Sunny Optical, Lenovo; **AI/ML:** TSMC, Hikvision, Sunny Optical, Nanya Tech, Win Semi, Lenovo,SMIC, Hua Hong, Xiaomi, **Drones:** Sunny Optical, Hikvision, **Autonomous driving**: Sunny Optical, TSMC, Hua Hong, SMIC, Hikvision, CUB, Deren.

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Introducing Macquarie's DisruptiveEdge

At Macquarie, we strive to uncover opportunities others miss – disrupting our own thinking and challenging our clients to look at the world through a different lens. Our equity research model focuses on discovering the "unknown, unknowns" – and it is those insights that lead us to breakthrough investment ideas for our clients.

Our Analysts are empowered to think differently, search the industry and leverage our real asset experience to provide real market insights into the issues and trends that drive companies, industries and markets.

We are pleased to introduce our DisruptiveEdge – and our report on The Concierge Economy.

The Concierge Economy: Go Digital, Jeeves!

Our European Disruptive Tech & Consumer team explore the changing ecommerce landscape with **The Concierge Economy: Go Digital, Jeeves!** and view the internet buying experience as ripe for change. We see ecommerce evolving toward a "concierge service," where services are personalised, decision making is simplified, execution is automated and delivery worry-free.

In a related report, **3D Model: Digital, Data & Delivery**, we provide insights from a proprietary six-country consumer survey that points to still-significant latent demand for online and supports a desire for a more predictive and seamless experience, importantly by younger demographics. Across marketplaces and grocery, we initiate on three disruptive ideas in these reports.

Our European Telecom team in its report, **Concierge Economy in Telecoms: Service and Enablement**, highlights the dual role of operators in the Concierge Economy, looking at the shift from providing a commoditising product to a full-all-round service as well as the impact of network investment in enabling more advanced services, such as the Internet of Vehicles. From Asia, we provide a technology roadmap in **Opportunities in Tech (AI, IoT and AR)** and see AI assistants in smartphones, smart homes and smart cars as the earliest beneficiaries of the Concierge Economy.

The Road Ahead: Navigating Innovation & Disruption in Autos

Earlier this week, our US Automotive & Disruptive Tech team launched coverage on the sector, diving into an unprecedented era of tech disruption in the automotive industry. The team sees the industry entering a multi-decade transformation driven by disruptive innovation and technology – the same forces that have transformed many other technology industries (including IoT, smartphones, pc/tablets, TV and watches). Drawing from global technology, internet, battery, semiconductors and materials analysts, we highlight more than 50 relevant stocks across ten key related and investable themes.

We initiated on six US automotive technology and related stocks, and our team is excited to further explore these and other themes for our clients.

Macquarie's Heads of Equity Research

Christine Farkas, CFA	Jake Lynch	Paul Checchin	Greg MacDonald	Rowan Goeller
(US & Europe)	*(Asia)*	*(Australia & NZ)*	*(Canada)*	*(South Africa)*

Stock picks under concierge economy

Fig 1 Concierge economy-related stocks

Company	Ticker	Mkt cap (US$m)	3M ADTO (US$m)	Price (lcy)	Stock performance 1M	1Y	TP (lcy)	Upside	Rec	PE 18E	PE 19E	PB 19E	ROE 19E	EPS Growth Cagr (18-20E)	Div yield 19E	Analyst
VR/AR																
TSMC	2330 TT	209,963	264	250.00	-5%	11%	315.00	26%	O	17.7	14.9	3.4	24%	16%	4%	Patrick Liao
Hon Hai	2317 TT	42,431	88	75.60	-6%	-29%	150.00	98%	O	10.2	7.4	1.0	14%	30%	5%	Allen Chang
Sunny Optical	2382 HK	11,466	124	81.90	-13%	-36%	220.00	169%	O	20.2	12.2	5.1	50%	53%	2%	Allen Chang
Lenovo	992 HK	7,759	37	5.06	-5%	18%	6.30	25%	O	na	20.5	1.8	20%	na	5%	Verena Jeng
AI/ML																
TSMC	2330 TT	209,963	264	250.00	-5%	11%	315.00	26%	O	17.7	14.9	3.4	24%	16%	4%	Patrick Liao
Hikvision	002415 CH	38,607	162	28.74	-11%	-10%	57.00	98%	O	20.7	13.8	5.0	46%	50%	4%	Allen Chang
Sunny Optical	2382 HK	11,466	124	81.90	-13%	-36%	220.00	169%	O	20.2	12.2	5.1	50%	53%	2%	Allen Chang
Nanya Tech	2408 TT	5,244	36	52.20	-22%	-40%	138.00	164%	O	3.6	3.4	0.8	26%	8%	15%	Jeffrey Ohlweiler
WinSemi	3105 TT	1,629	52	119.00	-36%	-43%	200.00	68%	O	14.7	10.6	1.8	17%	33%	7%	Lynn Luo
Lenovo	992 HK	7,759	37	5.06	-5%	18%	6.30	25%	O	na	20.5	1.8	20%	na	5%	Verena Jeng
SMIC	981 HK	5,115	27	7.93	-11%	-10%	20.00	152%	O	61.7	23.4	0.9	4%	98%	0%	Allen Chang
Hua Hong	1347 HK	2,100	23	15.80	-19%	53%	33.00	109%	O	13.8	13.0	1.1	9%	11%	2%	Allen Chang
Xiaomi	1810 HK	41,150	174	14.28	-14%	N/A	30.00	110%	O	26.0	18.8	na	-17%	44%	0%	Allen Chang
Drone																
Sunny Optical	2382 HK	11,466	124	81.90	-13%	-36%	220.00	169%	O	20.2	12.2	5.1	50%	53%	2%	Allen Chang
Hikvision	002415 CH	38,607	162	28.74	-11%	-10%	57.00	98%	O	20.7	13.8	5.0	46%	50%	4%	Allen Chang
Autonomous driving																
Sunny Optical	2382 HK	11,466	124	81.90	-13%	-36%	220.00	169%	O	20.2	12.2	5.1	50%	53%	2%	Allen Chang
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Hikvision	002415 CH	38,607	162	28.74	-11%	-10%	57.00	98%	O	20.7	13.8	5.0	46%	50%	4%	Allen Chang
CUB	2231 TT	848	7	208.00	-16%	-24%	376.00	66%	O	20.2	15.6	5.9	41%	23%	5%	Kaylin Tsai
Deren	002055 CH	795	6	11.14	-8%	-55%	17.00	50%	O	29.0	25.4	2.4	10%	35%	1%	Jin Guo

Source: Bloomberg, Macquarie Research, October 2018. Prices as of Oct 5, 2018.

Facial/voice recognition facilitated by AI

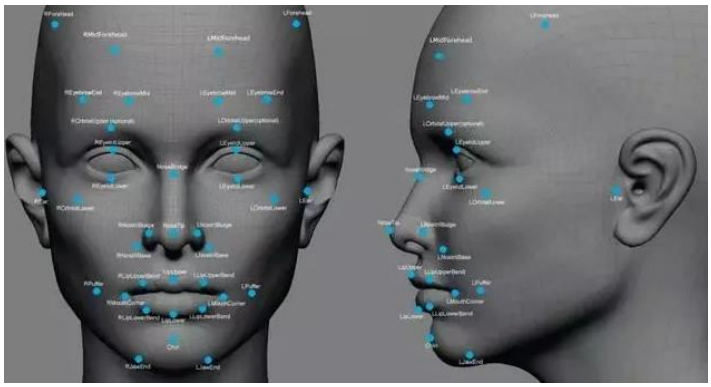
The key to concierge-like services is to address the needs of customers and **need recognition** is an inevitable stage. Facial/Voice recognition facilitated by Artificial Intelligence (AI) and Machine Learning (ML) in smartphones, surveillance, smart speakers, drones, robots and automotives can help to understand user habits, needs and conditions.

Data and algorithms are the two parts of AI, which enables machines to "see" clearer than humans, to "understand" what they "see", and to respond. As we highlighted in our *Machine Learning* report (Jan 2018), data (imaging, inter alia), as an input to the machine, plays a vital role in AI. Its size and quality – how clear the image is or how it is structured/labelled or noise-free – decides the complexity of an AI algorithm (image processing) and the final performance of AI. We gather that apart from providers of AI algorithms, imaging-chip start-ups are also growing in China, giving machines keener 'eyes' in the real world than humans.

AI in Smartphones

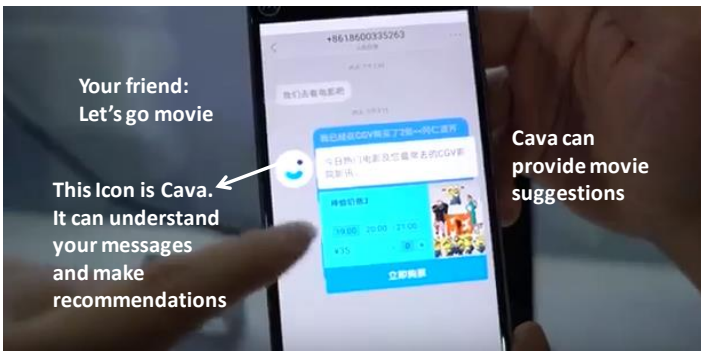
Facial/voice recognition using AI technology in smartphones give users a brand new experience – faster unlocking, adjusting portrait lighting mode etc. AI technology embedded in a smartphone nowadays could act as a virtual assistant which manages to learn from user habits via ML, automatically set up schedules, reminders or provides suggestions. For example, the assistant that acts as a concierge would make movie recommendations once it detected 'movie' in a text message, set up an alarm at the user's regular wake-up time, read a newspaper or magazine aloud for the user.

Fig 2 Facial recognition in smartphones



Source: Company data, Macquarie Research, October 2018

Fig 3 AI virtual assistant in smartphones



Source: Company data, Macquarie Research, October 2018

AI in Smart homes

Two major devices using AI technology in smart homes – the smart TV and smart speaker. A smart TV could connect with other electric appliances such as an air purifier, robot vacuum and air-conditioner and create an ecosystem within the home to **understand users' habits and lifestyle**. For example, a smart TV will remember the movie or TV program that the users like and broadcast it every time the TV is turned on and turn on the air-conditioner when the users "tell" the TV they feel hot. A smart speaker would be able to remind users to bring an umbrella during rainy days and adjust the lights during night time.

Development of Artificial Intelligence (AI)

AI is the core of recognizing customer needs, as it is the intelligence exhibited by machines or software and has become an essential part of the technology industry for the most challenging problems in computer science.

The tech giants such as Amazon, Google, Baidu, Alibaba, Tencent and Microsoft are betting big on AI technology to improve hardware, cognitive algorithms, big-data computing, datacenter infrastructure given the pursuit of higher response speed and accuracy. Aggressive M&A activities in acquiring promising start-ups have also been commonly seen in recent years in the hope of accelerating development. We expect the winners in the global race will have an advantage in setting unified standards, which could push the proliferation of AI technology.

Fig 4 Artificial Intelligence 101

Technology	Description	
Artificial Intelligence	Often abbreviated as AI, the term refers to the system development exhibiting "intelligence" in the field of computer science.	
	Machine learning	Without being explicitly programmed, the machines or robots are able to learn from algorithms and make predictions of data. Such algorithms overcome the limitation of following strictly static instructions for decision-making ability.
	Deep learning	A class of machine learning algorithm which is used for the composition of a layer of non-linear processing units to solve problems.
	Supervised learning	A supervised learning algorithm analyses the training data and produces an inferred function (pairing set of sample input with desired output).
	Reinforcement learning	Reinforcement learning differs from standard supervised learning in that correct input/output pairs are never presented. The method focuses on the balance between exploration (of unknown knowledge) and exploitation (of current knowledge).
	Transfer learning	The notion focuses on storing knowledge gained while solving one problem and applying it to a different and related problem.
	Cognitive computing	The term describes the technology platforms that encompass machine learning, reasoning, language processing, human-computer interaction, and vision. Cognitive computing aims to emulate the human brain's abilities for perception, action and cognition. The neurosynaptic chip, designed to emulate the neurons and synapses in the human brain, breaks path with traditional architectures used for the last 70 years.

Source: Macquarie Research, October 2018

Fig 5 "China AI Action Plan" 2018-20 Summary – related to concierge economy

AI Categories	Action Focus	2020 Targets
AI Products		
Intelligent Connected Vehicles	• Develop and improve automobile semiconductors, operating systems, and algorithms	• Establish reliable, secure, low-latency intelligent automobile platforms to support high-level autonomous driving
AI Service Robots	• Robots applications expansion • Robotic technologies in 3D imaging, precision control, operating systems	• Service Robots are capable of "environment sensing", "human-machine interaction", "self-learning" • Home Service Robots and Public Service Robots enter mass production and application • Support 20+ pilot robotic companies
Intelligent Drones	• Focus on collision avoidance, auto-cruising, auto-flight in complex environment • Develop drone communication and navigation system	• Consumer drones with 3-axis gimbal to achieved precision level of ±0.005 degree • Drones are capable of 360 degree obstacle sensing, collision and restricted zone avoidance
Video/image recognition	• Develop biometric recognition and enhance recognition accuracy • Expand applications in identity authentication, AI + surveillance, financial services	• Effective recognition ratio >97% • Recognition accuracy ratio >90%
Voice recognition/interaction	• Expand applications in smart manufacturing, smart appliances • Enhance effectiveness in conversation recognition	• Chinese language voice recognition accuracy >96%; accuracy >92% at 5-meter radius; User intention recognition accuracy >90%
Intelligent translation	• Utilize machine learning to improve translation accuracy and utility • Enhance multi-lingual translation and real-time translation	• Chinese to English translation accuracy >85%, vice versa
AI Semi		
Smart Sensors	• Support sensor design, manufacturing, R&D, embedded algorithms, etc. • Develop new types of bio / air / pressure/ fluid / inertia / image / acoustic sensors • Leverage MEMS and CMOS technology in smart sensors	• Mass production of acoustic sensors with signal-noise ratio >70dB and max input sound pressure >135 dB • Commercialization of pressure sensors with absolute accuracy <100Pa and noise level <0.6Pa
AI neural chips	• Develop AI chips with high-performance and low power consumption, desirable for machine learning	• Launch 128TFlops (16 floating points) AI chips with energy efficiency >1TFlops/w that can support multiple mainstream neural network algorithms such as convolutional, recurrent, and memory neural network • Commercialize AI neural chips for auto-driving, surveillance and smart appliances by 2020
AI infrastructure		
5G and Internet of Vehicles	• Deployment of 5G network, Internet of Vehicle network, industrial internet network, high-precision positioning system	• 90% of China's internet network have the access speed and latency to support AI applications • Support 10+ enterprises to build industrial internet network that covers their entire production process

Source: MIIT, Macquarie Research, October 2018

Data mining migration to accelerate ML and facilitate AI

ML relies on algorithms to build an artificial neural network for a program to learn from input data, requiring massive computing to train the neural network so as to recognise and infer when it faces new situations. This massive computing extends processors from CPU to GPU, FPGA (Field-programmable Gate Array), and ASIC (Application Specific Integrated Circuit), which are able to process parallel computing. FPGA is programmable and ASIC could be optimized for targeted applications. These multiple solutions increase the number of participants in AI chips, including giants in cloud/servers, internet, EVs and robots, accelerating AI market growth. The training requires high-performance systems running DNNs on data in large memory stores. Inference units running on smaller-scale hardware also have opportunities.

Algorithms power machine learning with multiple chips architecture

An AI algorithm in image processing is what enables a machine to 'understand' what it 'sees' and build an artificial neural network for a program to learn from input data, requiring massive computing to train the neural network so as to recognise and infer when it faces new situations. This massive computing extends processors from CPU to GPU, FPGA (Field-programmable Gate Array), and ASIC (Application Specific Integrated Circuit), which are able to process parallel computing. FPGA is programmable and ASIC could be optimized for targeted applications. These multiple solutions increase the number of participants in AI chips, including giants in cloud/servers, internet, EVs and robots, accelerating AI market growth. The training requires high-performance systems running DNNs (Deep Neural Networks) on data in large memory stores. Inference units running on smaller-scale hardware also have opportunities.

Machine learning to drive IC demand

Deep learning, which is an advanced form of machine learning used for training, is highly computer-intensive and is already driving significant innovation in the semiconductor market. Graphics processing units (GPUs) with their massively parallel computing capability currently dominate deep learning training. We expect GPUs to maintain their lead in training AI models while FPGAs, custom ASICs and CPUs appear better suited for on-the-field inferencing tasks.

Analog, sensing and connectivity ICs should benefit

The AI/ML semiconductor market is still relatively small today but NVIDIA's early success in GPUs shows that IC companies with the right exposure could see significant benefit. We expect GPUs to dominate the training side of machine learning in the near term. Once the models are trained, the computer intensity needed to "infer" from data goes down significantly. We believe FPGAs, CPUs, and custom ASICs are better suited for inferencing tasks as a result under the emergence of facial/voice recognition.

Fig 6 Machine learning processors comparison

	What is it	Advantages	Disadvantages	Examples
CPU	A central processing unit (CPU) is the electronic circuitry within a computer that carries out the instructions of a computer program by performing the basic arithmetic, logical, control and input/output (I/O) operations specified by the instructions.	• High market share in cloud servers	• Slower parallel computing vs GPU	• Intel Xeon SP processor
GPU	A graphics processing unit (GPU) is a specialized electronic circuit designed to rapidly manipulate and alter memory to accelerate the creation of images in a frame buffer intended for output to a display device.	• Faster parallel computing	• High power consumption • High cost	• NVIDIA Titan Xp, QuadroR GP100, DGXTM Systems, TeslaR Solutions
FPGA	A field-programmable gate array (FPGA) is an integrated circuit designed to be configured by a customer or a designer after manufacturing – hence "field-programmable".	• Reconfigurable • Higher performance/watt than GPU • Lower latency than CPU/GPU	• Hard to program • Slower parallel computing vs GPU	• Microsoft uses Intel's FPGA for deep learning cloud platform, Project Brainwave, targeting real-time AI with ultra-low latency.
ASIC	An application-specific integrated circuit (ASIC), is an integrated circuit (IC) customized for a particular use, rather than intended for general-purpose use. For example, a chip designed to run in a digital voice recorder or a high-efficiency Bitcoin miner is an ASIC.	• Optimized for targeted applications	• Higher development cost • Longer development time	• Google's TPU (tensor processing unit), specifically designed for Google's TensorFlow framework; for high volume of low precision computation with better performance/watt vs GPU. • Intel acquired Nervana (DL start-up) and developed NNP (Nervana Neural Processor) • Tesla is developing its own ASIC for its autonomous driving cars

Source: Company data, Macquarie Research, October 2018

Fig 7 Machine learning processor nodes

Function	ICs	Players	Process nodes
Computing	CPU	Intel	10/14nm
	GPU	Nvidia, AMD	12/16nm
	FPGA	Xilinx, Intel (Altera)	10/16nm
	ASIC	Google, Intel (Nervana)	14/16/28nm
	AP	Apple, Qualcomm, HiSilicon	10nm
Sensing	Image sensor	Sony, Samsung, Himax	40-180nm
Connection	Connectivity IC	Broadcom, Qualcomm, MediaTek, Realtek	28/40/55nm
Power management	PMIC	TI, Maxim, NXP, Silergy	110nm and above

Source: Company data, Macquarie Research, October 2018

AI in Automotives

Having a private driver is an ideal in the concierge economy; it could potentially happen when 5G is ready. Prior to that, using AI in automotives could help enhance a **driver's experience** and ensure safety driving. Just as a hotel's concierge would open the car door for the 'master', with facial recognition embedded in car, the vehicle could recognise its owner and automatically unlock the car. ML also enables the vehicles to adjust the seat, the mirror and the music to play based on the drivers' habits. Keeping the "master" safe is also the job of the concierge. AI in automotives could detect a driver's status using gaze estimation and emotion recognition and monitor the driver's state in real time with timely alerts so as to enhance safety if fatigue driving or sudden illnesses happens.

Fig 8 Autos: face unlock and start

Source: Company data, Macquarie Research, October 2018

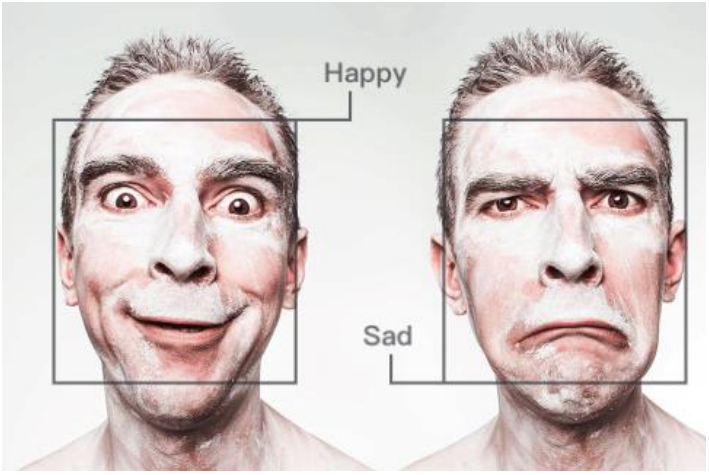
Fig 9 Automatically adjust settings to suit the driver

Source: Company data, Macquarie Research, October 2018

Fig 10 Auto: driver's status detection

Source: Company data, Macquarie Research, October 2018

Fig 11 Auto: emotion recognition technology

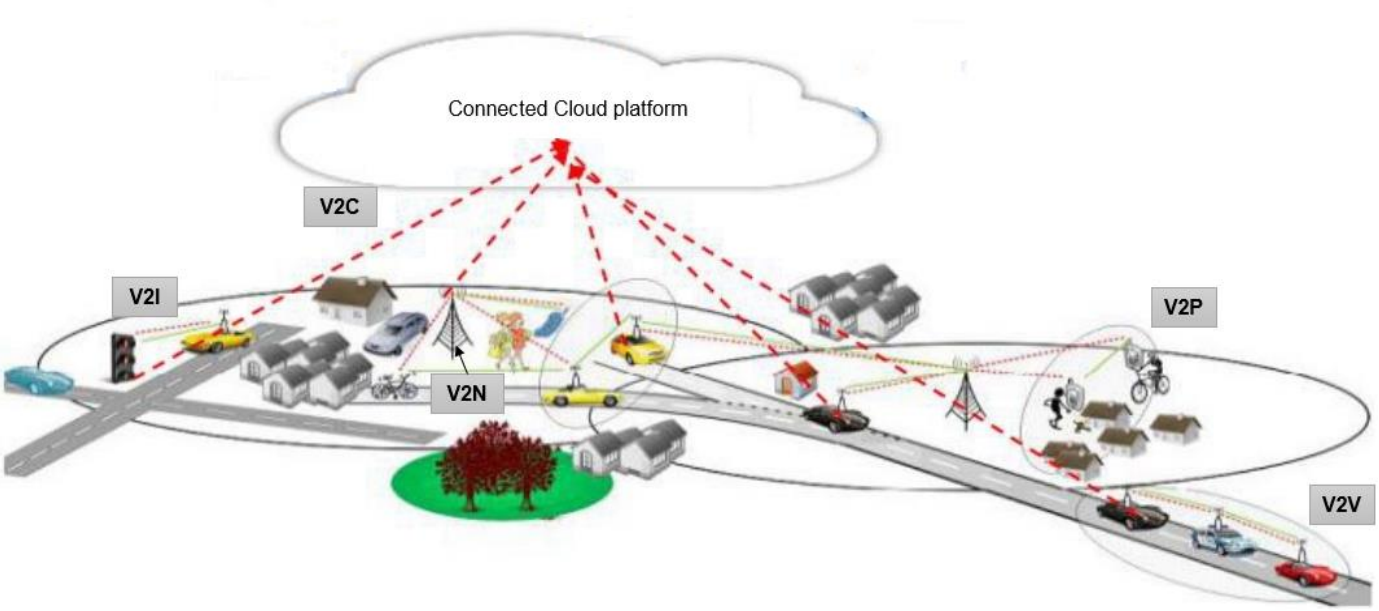


Source: Company data, Macquarie Research, October 2018

Autonomous Driving – Private drivers for everyone

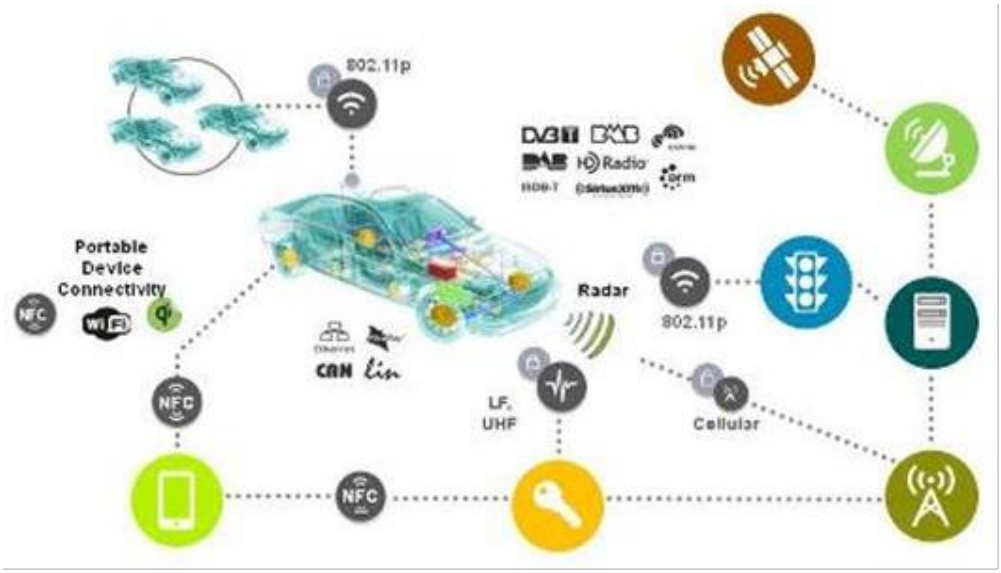
Autonomous driving, which could be ready in the 5G era, would be the perfect service in the concierge economy and is connected by IoV (Internet of Vehicles), which is an integration of five types of connections – vehicle to vehicle (V2V), vehicle to infrastructure (V2I), vehicle to network (V2N), vehicle to pedestrians (V2P), and vehicle to cloud (V2C). We expect rapid IoV expansion in the coming years driven by supportive government policies and the compelling economic benefits of IoV.

Fig 12 Internet of Vehicles system overview



Source: Company data , Macquarie Research, October 2018

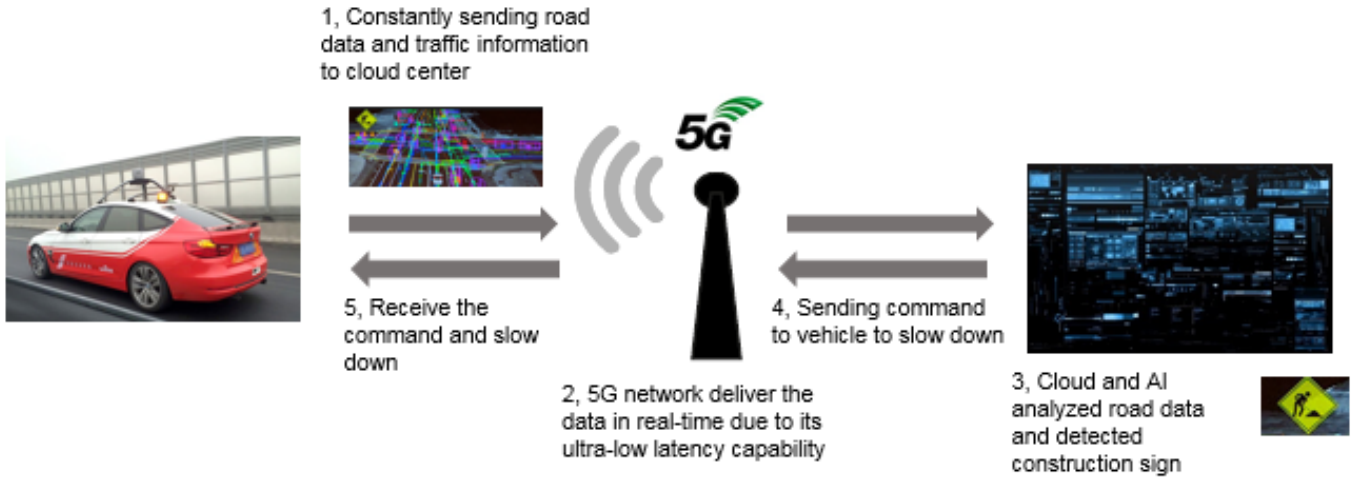
Fig 13 Potential connectivity applications in a car



Source: NXPI, Macquarie Research, October 2018

While advancements in radar, LiDAR, camera systems, LTE-V2X, and DSRC (dedicated short-range communications) have brought autonomous driving and V2X a step closer to reality, these sensors are limited by their line of sight and LTE or DSRC can't deliver the ultra-low latency that autonomous driving demands. As such, 5G is a key technology for enabling fully autonomous transportation.

Fig 14 5G enables real-time data communication in autonomous driving



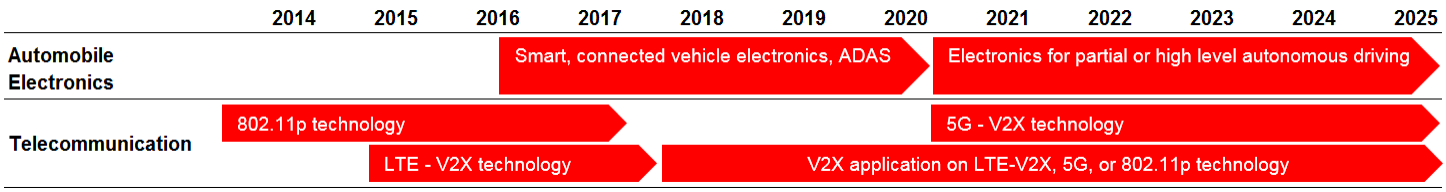
Source: Company data, Macquarie Research, October 2018

IoV: technology roadmap and network overview

We expect three major technologies to underpin the advancement of IoV. They are: 1) network connectivity (LTE-V2X, 5G, etc.), 2) automobile electronics (ADAS, semiconductors, etc.), and 3) the ultimate full autonomous vehicles.

For network transmission, the key players are telecom operators and telecom equipment vendors such as Huawei, ZTE, etc. and IoV can work on three technology options, DSRC (dedicated short-range communications), LTE-V2X, and 5G-V2X. IoV automobile electronics include ADAS, advanced sensors, and semiconductors, etc. Network connectivity and advanced automobile electronics are of great significance to the realization of autonomous driving.

Fig 15 IoV development roadmap



Source: CAICT, Macquarie Research, October 2018

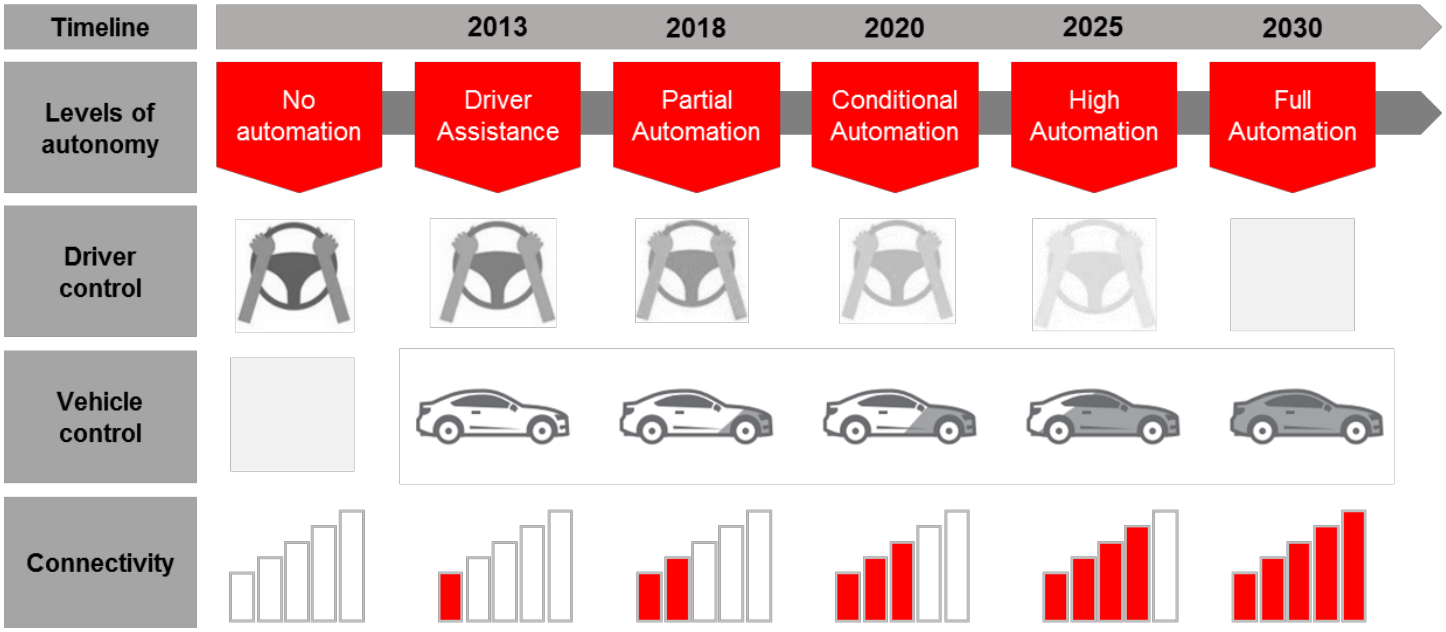
The U.S. National Highway Traffic Safety Administration (NHTSA) has categorized autonomous driving into several levels: no automation, driver assistance (DA), partial automation (PA), conditional automation (CA), high automation (HA), and full automation (FA). Each level of automation requires different levels of telecom connectivity and automation (see chart below).

Fig 16 Autonomous driving levels

Category	Name	Description
Level 1	No automation	Zero autonomy; the driver performs all driving tasks.
Level 2	Driver Assistance (DA)	Vehicle is controlled by the driver, but some driving assist features may be included in the vehicle design.
Level 3	Partial Automation (PA)	Vehicle has combined automated functions, like acceleration and steering, but the driver must remain engaged with the driving task and monitor the environment at all times
Level 4	Conditional Automation (CA)	Driver is a necessity, but is not required to monitor the environment. The driver must be ready to take control of the vehicle at all times with notice.
Level 5	High Automation (HA)	The vehicle is capable of performing all driving functions under certain conditions. The driver may have the option to control the vehicle.
Level 6	Full Automation (FA)	The vehicle is capable of performing all driving functions under all conditions. The driver may have the option to control the vehicle.

Source: NHTSA, Macquarie Research, October 2018

Fig 17 Driver and connectivity requirement at different levels of autonomous driving



Source: Company data, Macquarie Research, October 2018

In terms of IoV connectivity, IoV network currently has two technology routes: **1) DSRC** (dedicated short range communication) and **2) LTE-V2X** based on LTE networks. DSRC has existed since 1990s and is well-developed, with products readily available in the market, while LTE-V2X is still in the trial phase and the global standard is expected to finalize in 3Q18. We expect LTE-V2X to have larger potential in the long term as it is based on the cellular network therefore can leverage the existing ecosystem and future 5G technology, which we expect to be a critical enabler of autonomous driving.

DSRC is the more developed and matured communication technology for V2X. It started in the 1990s and various governments and institutions have invested in DSRC technology and applications. However, there has been no unified DSRC standard across the globe. The US, EU and Japan have been developing separated standards of DSRC.

LTE-V2X is based on current LTE networks and a relatively new technology with first discussion initiated in 2015, but the technology is developing fast and has received support from cellular players such as China Mobile, China Unicom, Vodafone, and Deutsche Telekom, etc. and telecom vendors such as Huawei, ZTE, and Qualcomm, etc. LTE-V2X can also be upgrade with 5G technology to achieve even better performance in the 5G era.

Fig 18 DSRC, LTE, LTE-V2X and 5G for IoV: comparison overview

	DSRC	3GPP LTE	3GPP LTE-V2X (R14)	5G
Accessibility	Unlimited	Require network coverage	Unlimited	Require network coverage
Coverage	Small (<1km)	Large (up to 30km)	Depends on RSU (roadside units) and OBU (On-board units) power and frequency	Large on low frequency spectrum
Throughput	Small (up to 27Mbps)	Large (up to 1Gbps)	Large (up to 1Gbps)	Very large (10Gbps)
Latency	<50ms	Single-cast: <100ms; Multi-cast: >100ms	<50ms; Can be low as 20ms	<1ms
Connection density	<100	100k per cell	<100	millions/cell
Reliability	Interference at times	High	Mode3: same as LTE; Mode4: same as DSRC	Very high
Applications	• Safety and security; • Transportation efficiency;	• Infotainment; • Transportation efficiency;	• Safety and security; • Transportation efficiency;	• Safety and security; • Transportation efficiency; • Infotainment;
Standard setting	Standard established	Standard established	V2X first version released in Mar 2017	Expected in 1H18
Industry maturity	• Commercialized with still low penetration; • DSRC required for new cars by US government	• Commercialized with large scale deployment	• In trial phase; • Expected commercialization in 2019	• In development and trial phase; • Commercialization expected in 2020E

Source: Company data, CAICT, Macquarie Research, October 2018

Fig 19 Pros and Cons: DSRC vs. LTE-V2X

	DSRC	LTE-V2X
Supporters	Mainly automobile electronic/component companies such as **NXP**	Cellular operators, telecom equipment vendor and semiconductor vendors; For example **China Mobile, Vodafone, Deutsche Telekom, Huawei, ZTE, and Qualcomm**
Advantages	• Technology is well developed and matured and products are readily available in the market; • Safety and security level is high as products have already been heavily tested; • DSRC has received US government support in IoV; • DSRC is not limited by network coverage.	• Benefit from introduction of 5G technologies in coming years and established mobile LTE ecosystem; • Better V2I and V2N communications; • Broader coverage than DSRC; • LTE-V2X's data transmission rate reliability is much higher (70%) than DSRC according to Huawei; • LTE-V2X can be rapidly and inexpensively deployed by reusing the existing cellular infrastructure and spectrum.
Disadvantages	• Not as efficient in V2I and V2N; • Require infrastructure build along the road.	• Still in trial phase and commercialization expected in 2019E; • Safety and security features are not yet as complete and thorough as DSRC, which are a matured technology with many years of development.

Source: Company data, CAICT, Macquarie Research, October 2018

Smart retail – smart stores & smart delivery supported by IoT, robots and drones

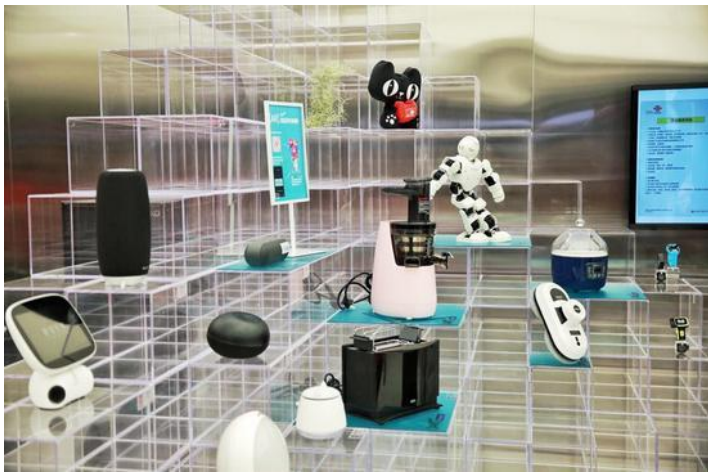
Receiving services/information and purchasing items without lag is also one of the key elements in the concierge economy and it is empowered by smart stores and smart logistics. Smart stores use AR technology to enhance customers' experiences while smart delivery is supported by IoT, robots and drones.

Smart stores – tech-powered to cater to customers' needs

The new type of store integrated products have a QR code attached for shoppers to scan and purchase on line, connecting online-offline visitor flow. **Augmented Reality (AR)** is also equipped in the store, allowing customers to scan key features of products when shopping in the store. AR function in smartphone adds virtual information to the real world, enriching the user's experience in online shopping.

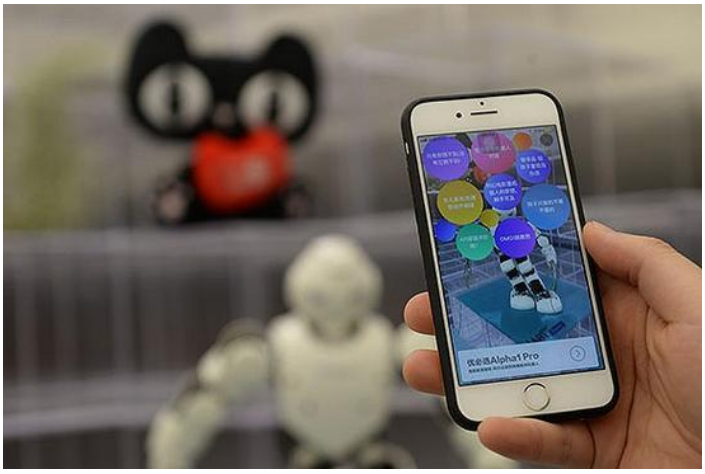
Augmented Reality, is capable of providing an augmented view of real-world through superimposing visualised data, sound and other sensory stimulations on user's field of view. The user is able to see through a translucent display with vivid and intelligently notified information which is processed on the AR computer.

Fig 20 Product display in the Smart Store



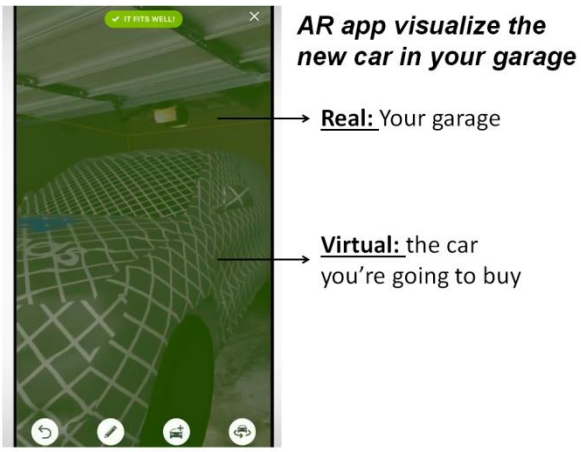
Source: Macquarie Research, October 2018

Fig 21 AR application in the Smart Store



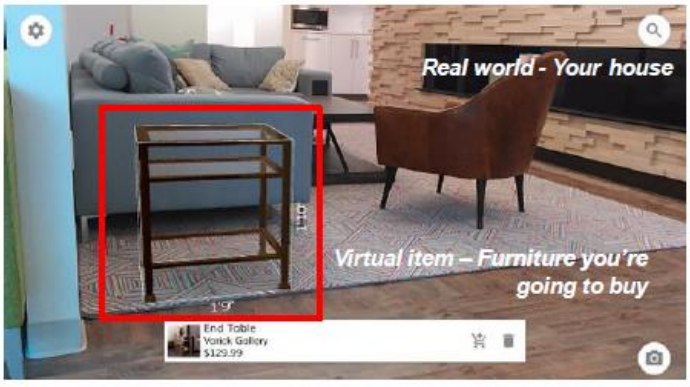
Source: Macquarie Research, October 2018

Fig 22 AR in smartphone: enhances shopping



Source: Edmunds, Macquarie Research, October 2018

Fig 23 AR in smartphone: online shopping



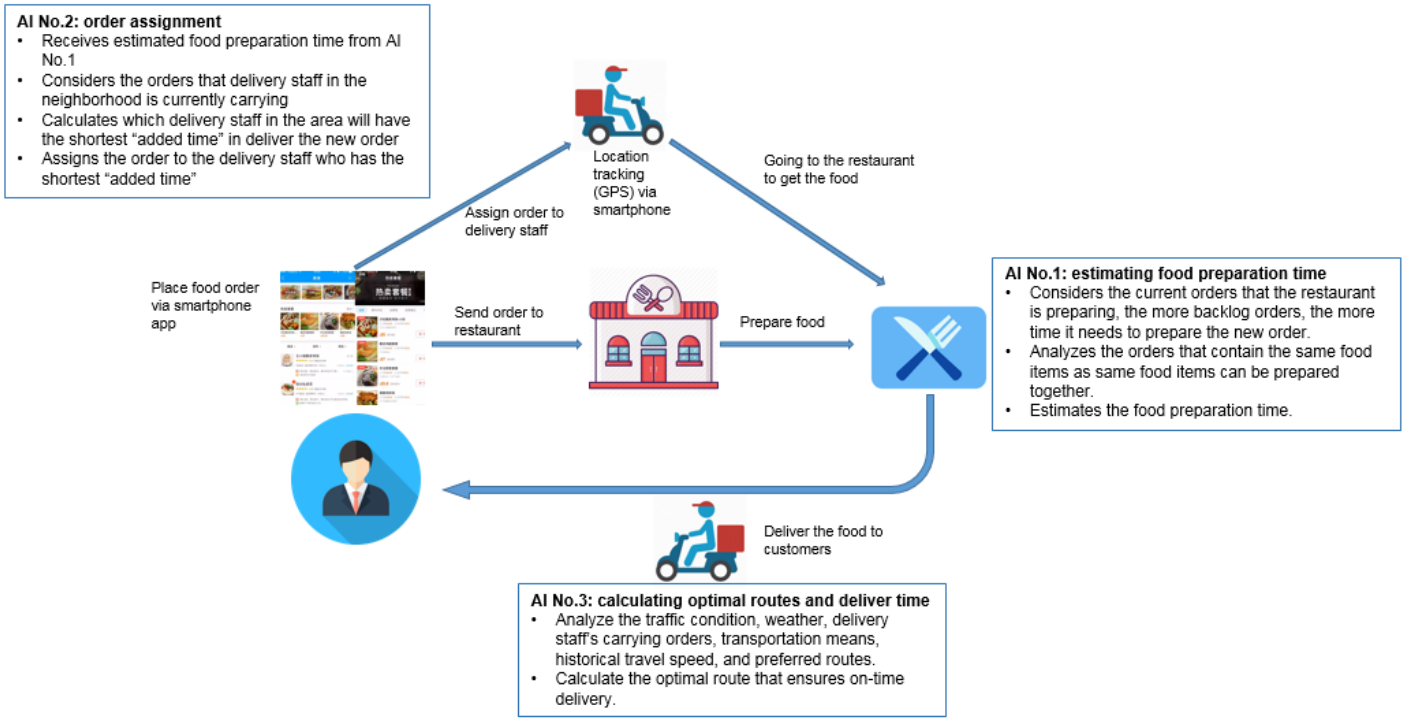
Source: Lenovo, Macquarie Research, October 2018

Smart logistics: smart food delivery

Logistics companies are utilizing IoT technologies to drive delivery efficiency. For example, Ele.me (饿了么) is the second-largest food ordering and delivery service platform in China with daily orders of ~10m units. The company has been utilizing IoT, AI, and Big Data to optimize its delivery operation to reduce delivery time. Ele.me is also developing drone and robot delivery technology and plans to deploy them in 3-5 years to achieve an "intelligent delivery" system.

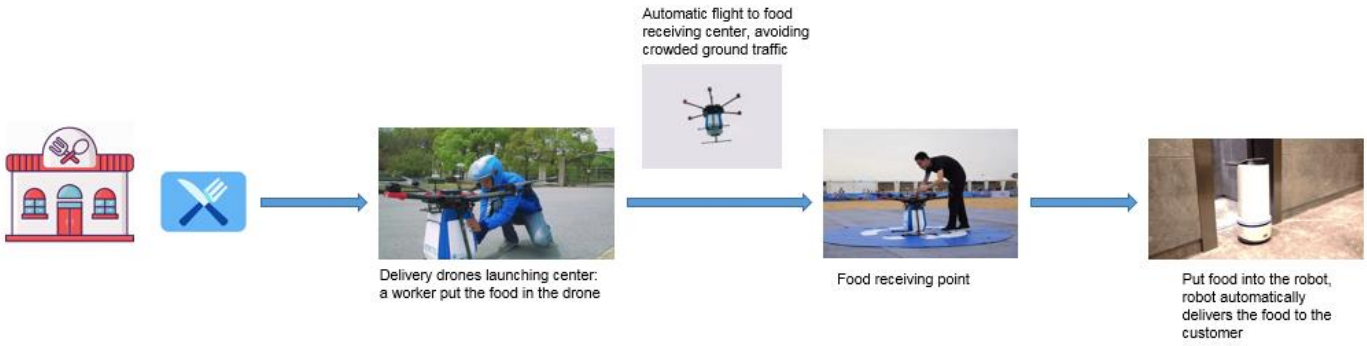
AI and IoT play a critical role in Ele.me's food delivery, for estimating food preparation time, calculating delivery travel time, and assigning orders to delivery staff.

Fig 24 AI + IoT + Big Data: supporting Ele.me to deliver food within ~30minutes



Source: Company data, Macquarie Research, October 2018

Fig 25 Ele.me to deploy drones and robots to create a connected "intelligent delivery" service

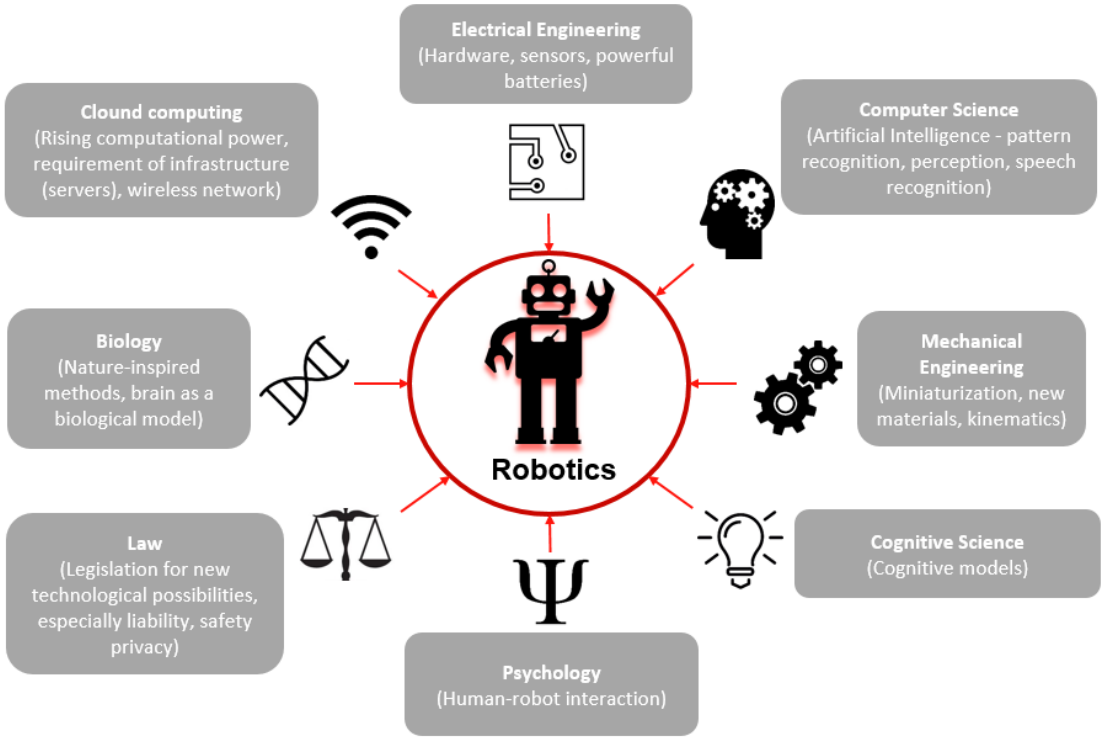


Source: Company data, Macquarie Research, October 2018

Smart food delivery - Service robots

Service Robots come with greater mobility which allows them to operate co-presence with users. Compared to Industrial Robots, Service Robots are often embodied AI (Artificial Intelligence) to enable reactions according to the environment or user behaviour. Service Robots are also required to understand users' preferences and expectations, accumulating a database to facilitate their capabilities through time (aka, machine learning).

Fig 26 The ingredients to form intellectual robots



Source: Macquarie Research, October 2018

We expect food delivery to drive logistics robot development, with the so-called "last mile" delivery to be fulfilled by robots. Food-delivery robots not only create an economical and efficient system, but also can potentially bring a delightful experience to customers, which we think will lead to more business opportunities for food-delivery services. While in the early days of development, delivery robots are already commercially deployed, they appear technically capable and practical and they are expected to be lower cost and more efficient that human delivery. Regulatory and technical uncertainties remain but we believe they will be overcome.

Currently there are some trial operations being carried out in major cities like Washington D.C., San Francisco, and London to experiment with the possibilities. The travel range and autonomous level are still limited in most cases in this preliminary phase, while we expect a breakthrough in industry development and regulation could push the sector to be one of the key applications of Service Robots. In the future, we think delivery goods could extend to groceries and medicines, rather than just meals.

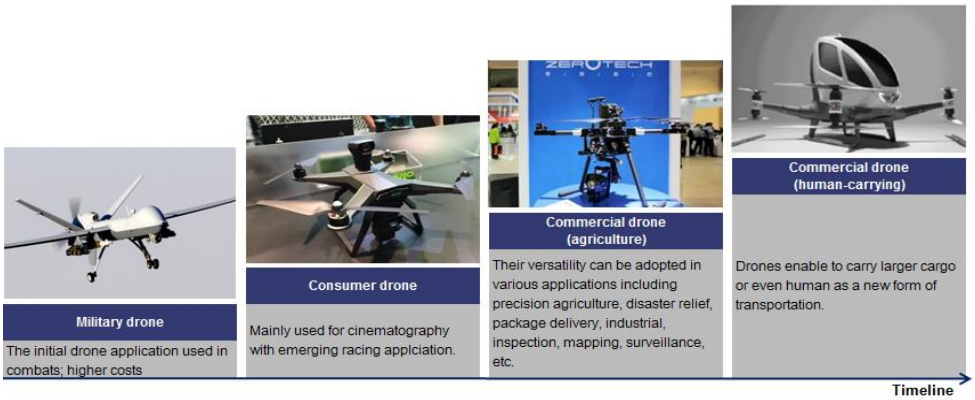
Smart package delivery – commercial drones

Speed is the key in the delivery process in the concierge economy as a "master" will not accept any delay from his or her concierge, especially for urgent requests such as medical supplies. We believe that drones can be used wisely in concierge economy- when a "master" forgets to bring any document to work, drones can help deliver within a minute.

Drones migration – from military to consumer and commercial – Initially focused on military use, drones, also known as Unmanned Aerial Vehicles (UAVs), have recently begun to penetrate the consumer and commercial markets. We believe demand for military drones will remain high, while consumer and commercial drones are still in an early upcycle.

We believe consumer drones will take off first, while commercial ones will enjoy widespread applications in the long term. We are confident drones will penetrate various industries, given the potential benefits they bring: decreasing costs, replacing humans for dangerous tasks, increasing productivity, increasing data accuracy and, eventually, improving competitiveness. **Kuang-Chi (439 HK, NR)** is a leading innovator in the unmanned aerial vehicle industry with five product lines currently in IoT, transportation, surveillance, logistics and communication/ Space travel. More innovation in drone technology should enable the rapid delivery service that is demanded in the concierge economy.

Fig 27 The development of drones



Source: Rapoo, Ehang, Macquarie Research, October 2018

Commercial drones can be used for package delivery

⇒ **Express for small parcels:** Current commercial drones can carry lightweight packages such as medical supplies, books and food straight to waiting hands, reducing costs, increasing convenience, and saving time, given more flexibility in travel path and zero traffic jams. The goods are usually boxed and securely attached via straps under the drone's rotors. **Remark:** Amazon (Prime Air), and Google (Project Wing), XAircraft

Fig 28 XAircraft X Mission: package delivery

Source: Company data, Macquarie Research, October 2018

Fig 29 SMD delivery drone

Source: Company data, Macquarie Research, October 2018

Low-altitude traffic control in progress

- Google has promoted an idea to create an air-traffic control system to prevent collisions in the skies. At this point, dozens of companies including Google, Amazon have come to an agreement with NASA to develop the first air-traffic control system to coordinate small, low-altitude drones. Such a system will work more functionally with the coordination of manned aircraft to ensure flight safety.
- We expect the system to be integrated with governments' regulation for enhanced flight safety. We think the system is necessary for drones to fly long distance, especially for commercial applications. Some commercial applications such as package delivery will definitely require a system to ensure safety for people on the ground when drones are flying intensively all over the sky to deliver goods.

Fig 30 UTM system (Unmanned aircraft Traffic Management)

Source: NASA, Macquarie Research, October 2018

5G to accelerate concierge economy

AI and IoT are key in the concierge economy and **5G should further drive the economy** with AR/VR, autonomous driving, IoV, etc. 5G brings high speed and low latency to enable massive data transmission and calculation without lag, which is vital to AR/VR, AI, IoT, IoV, autonomous driving, etc.

We expect 5G to enable an even broader range of IoT applications such as AR (augmented reality) 3D video call, autonomous driving, and real-time drone operation, etc. Current 4G network can't effectively and efficiently support these applications as they require data and information transmission in "real-time". 5G, with low latency, high throughput, and massive connection capability, will greatly accelerate the advancement of the aforementioned applications.

According to ITU (international telecommunication union), 5G network will bring:

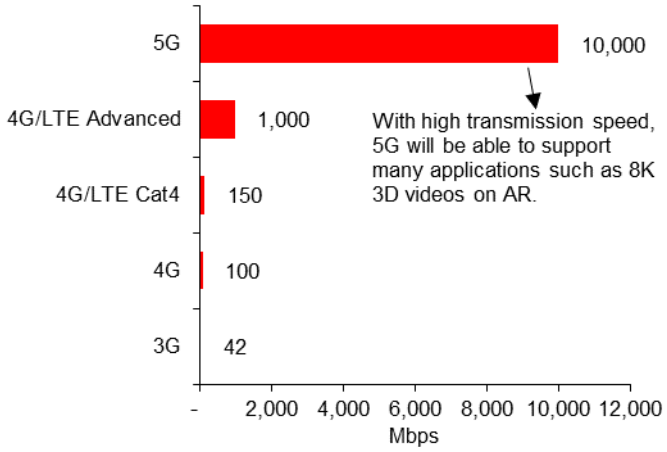
- <1ms latency (vs. 50ms in 4G)
- 10Gbps throughput (vs. 1Gbps in 4G)
- Millions of connections per km^2 (vs thousands in 4G)
- 3x spectrum efficiency as 4G

Also, ITU has identified three major groups of 5G applications:

- Enhanced mobile broadband, e.g., 3D videos, Ultra HD (8K) videos, etc.
- Massive machine type communications, e.g., IoT in smart cities, etc.
- Ultra-reliable and low latency communications, e.g., self-driving cars, etc.

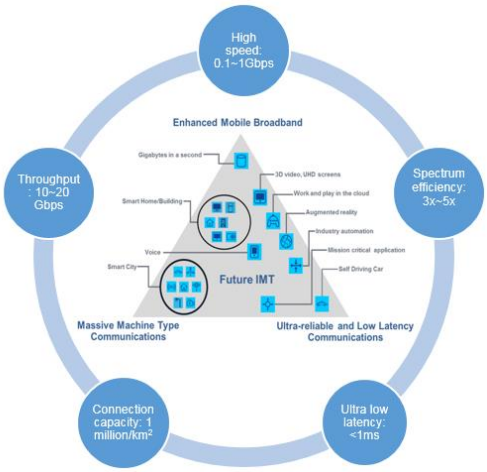
The Phase II 5G trials in China conducted by telecom operators and equipment vendors prove 5G's low latency and high throughput are already achieved and we view 5G is essential to enable a broad range of advanced applications.

Fig 31 5G offers the highest transmission speed



Source: ITU, Macquarie Research, October 2018

Fig 32 5G applications



Source: CAICT, Macquarie Research, October 2018

5G progress overview

Leading telecom equipment makers have completed 5G Phase II trial in China with convincing proof that 5G's low latency (<1ms) and high throughput (10Gbps) are highly achievable. **We have also seen that China's equipment makers Huawei (NR) and ZTE leading the trial phase with successful completion of all the test items.**

Fig 33 Huawei and ZTE leading the 5G Phase II trials in China

Equipment vendors	Continuous wide area coverage	Low latency	Large connection capacity	Hotspot on low frequencies	Hotspot on high frequencies	Mixed frequencies	Other cases	5G base stations	5G core network
Huawei	✓	✓	✓	✓	✓	✓	✓	✓	✓
ZTE	✓	✓	✓	✓	✓	✓	✓	✓	
Ericsson	✓	✓		✓	✓	✓			
Nokia	●	✓		●	●				
Datang	✓	✓	✓	✓	●		●		

Huawei and ZTE leading the 5G phase II trial in China

Note: ✓ : completed; ●: partially completed; empty cell: not tested; Source: IMT-2020, Macquarie Research, October 2018

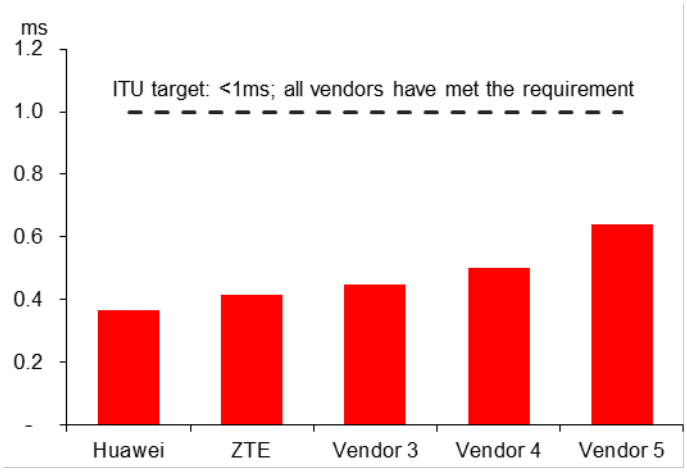
Equipment vendors have also achieved better test outcomes than ITU defined targets. For example, three equipment vendors have achieved higher throughput rate than ITU defined 10Gbps target during the trial and the highest test result was 28Gbps.

Fig 34 All ITU targets have been achieved during 5G Phase II trial in China

Test scenarios	ITU targets	Test results	Target achieved?
Continuous wide area coverage throughput	>10Gbps	3 vendors exceeded the ITU target with one achieving 28Gbps	✓
Low latency with high reliability	<1ms with reliability >99.999%	All 5 vendors achieved latency <0.64ms with >99.999% reliability	✓
High capacity hotspot on low frequencies	Data traffic density: >10Mbps/m^2	4 vendors exceeded 36Mbps/m^2. The highest was 107Mbps/m^2	✓
High capacity hotspot on high frequencies	Throughput: 10~20Gbps	3 vendors achieved >20Gbps, the highest was 62.25Gbps	✓

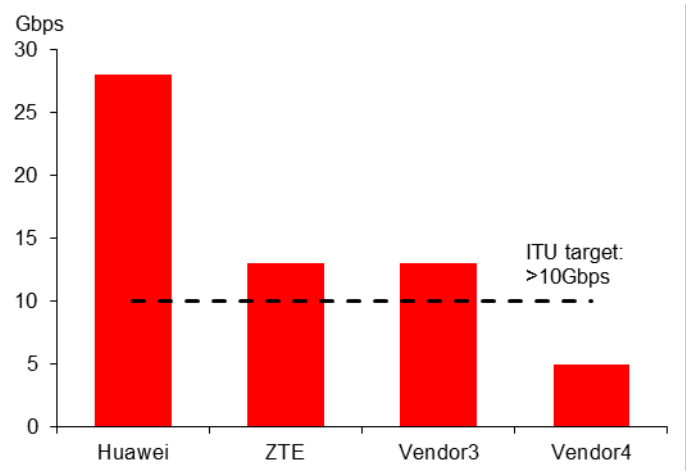
Source: IMT-2020, Macquarie Research, October 2018

Fig 35 Ultra low latency trial: target achieved



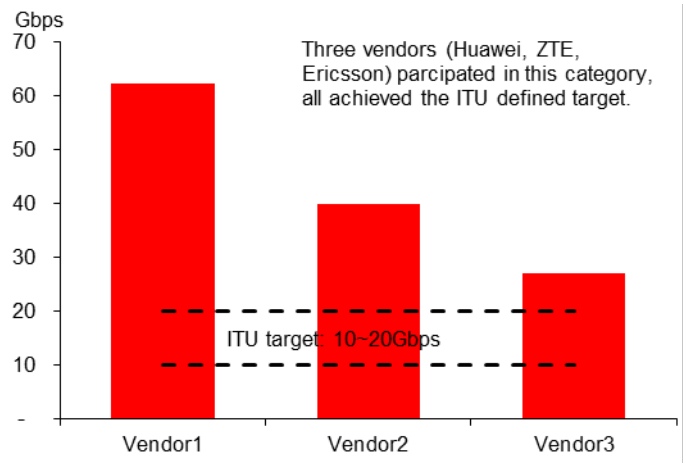
Source: ITU, Macquarie Research, October 2018

Fig 36 Continuous wide area coverage throughput



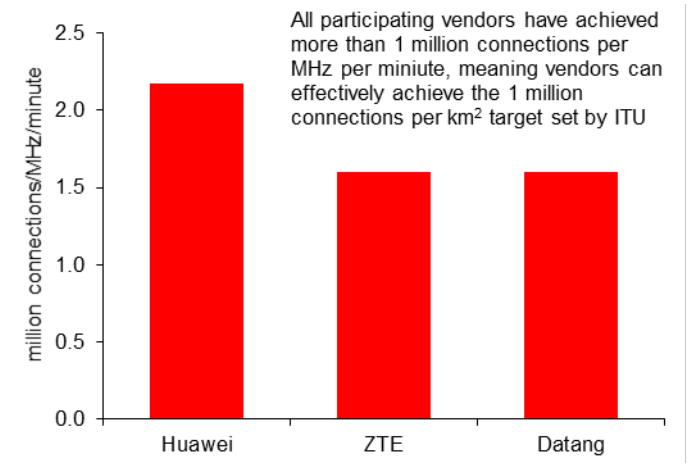
Source: ITU, Macquarie Research, October 2018

Fig 37 High data capacity on high frequency



Source: ITU, Macquarie Research, October 2018

Fig 38 Low-power large connections: target achieved



Source: ITU, Macquarie Research, October 2018

New technology trends in 5G

New technologies are expanding mobile network capabilities by 1) **network densification** (i.e. Small Cell, distributed antenna system), 2) **improving spectrum efficiency** (i.e. NOMA, MIMO, beamforming), and 3) **extending spectrum** (i.e. carrier aggregation).

⇒ **Small Cell:** Smaller volume, transmitting power and coverage vs. micro base station, with greater deployment flexibility to complement existing network architecture.

⇒ **DAS (Distributed Antenna System):** DAS are antenna nodes that can be split separately to improve network coverage as well as reduce power consumption. This is similar to the concept of Small Cell, featuring the flexibility in various scenarios (urban areas in particular).

⇒ **NOMA (Non-Orthogonal Multiple Access):** Compared to previous technology which separates spectrum by time and frequency, NOMA creates a new method to allow users to use the same spectrum with radio signals to vary power levels.

⇒ **MINO (Multiple Input, Multiple Output):** MIMO increases spectrum efficiency to improve the network capacity with existing sites and spectrum by more than double (2x2 MIMO) or quadruple (4x4 MIMO).

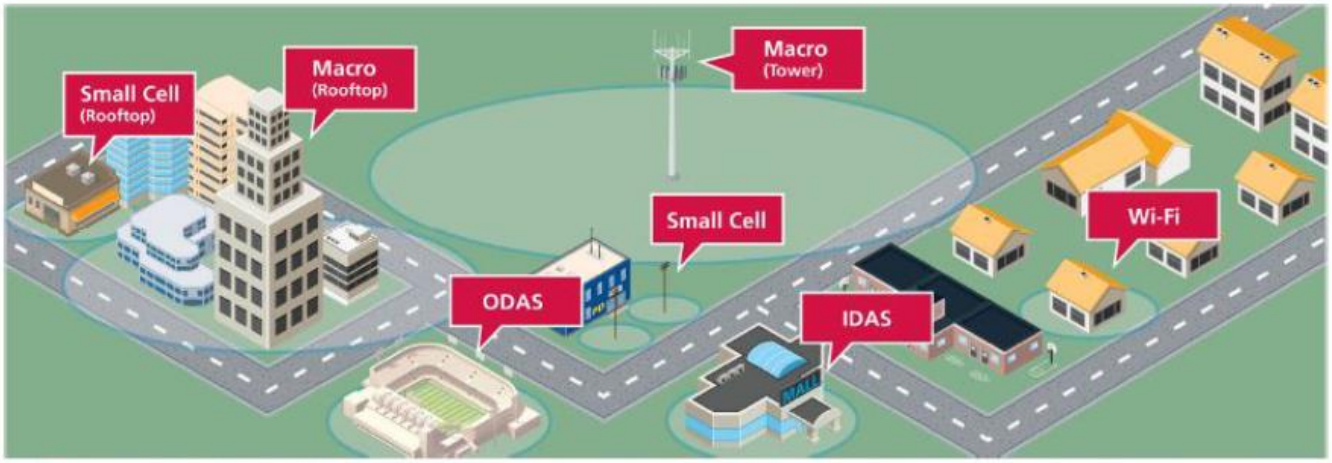
⇒ **Beamforming:** Beamforming is a signal processing technique used in sensor arrays for directional signal transmission or reception.

⇒ **CA (Carrier Aggregation):** CA is the key technology in LTE Advanced commercialization, offering increased data rates. The technology basically combines different spectrums for better network efficiency.

Small Cell

Compared with the traditional macro station, the Small Cell base station features much smaller volume, transmitting power and coverage. The statistics show that the vast majority of data services occur in indoor or hot spots. Small Cell base stations effectively enhance the deep coverage, increase network capacity, and improve the user experience, attracting more and more attention from the industry nowadays.

Fig 39 Network design of the future – handling greater capacity in urban environments



- Macro sites will continue to provide wide area coverage for high mobility users and are the core of wireless networks
- Multiple solutions including DAS, Rooftops, Wi-Fi and Small Cell networks will complement the coverage provided by towers

Source: American Tower, Macquarie Research, October 2018

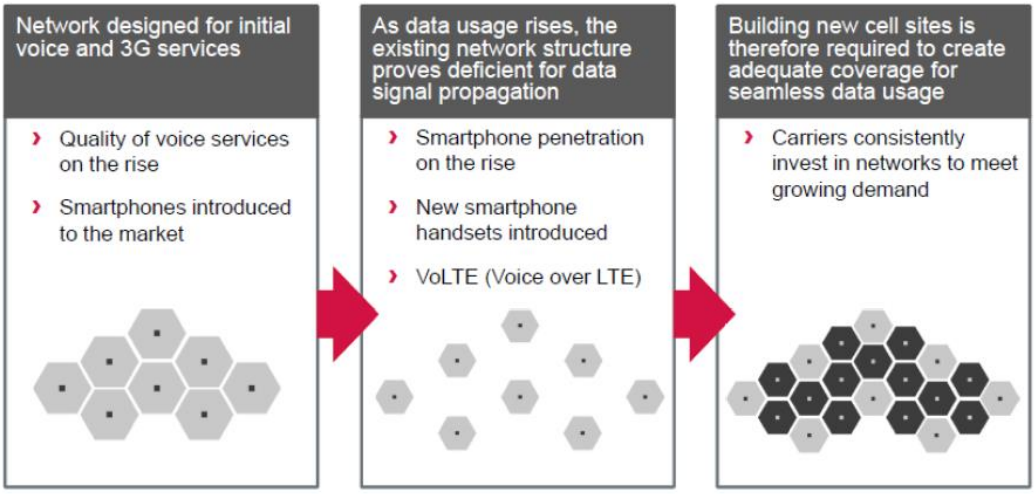
Future network architecture = macro cells + Small Cells + DAS + WiFi

In our view, Small Cells will become a core part of telecom operators' urban networks while macro cells will not disappear as Small Cell deployment grows. On the other hand, we still need macro cells to provide blanket cell-to-cell coverage, while Small Cells will complement existing infrastructure in urban areas in particular. The emergence of Small Cells presently represent one of the more important shifts in mobile network architecture and likely enable a range of technologies by handling greater levels of network consumption in 5G.

Small Cell delivery getting quicker and easier

- Small Cell economics have improved making associated capex and opex less onerous. (~50% cost savings for operators according to Comba).
- Backhaul is key issue for Small Cells. Fibre is best – particularly as we move to 5G – but microwave can also be feasible.
- Small Cells are getting smaller (increased form factor) and can be slotted into street furniture, making planning permission easier to obtain.
- When traffic grows, spectrum propagation is reduced. This effectively reduces the size of a cell site.
- In urban areas it is difficult to find any more suitable sites for macro towers. Therefore, small cells represent the way to address network white spots.

Fig 40 Growing 4G penetration created greater strain on networks; network densification via small cells is one remedy – or an increase in macro cell tower density is another option (we expect the trend to continue in 5G)



Source: American Tower, Macquarie Research, October 2018

10 October 2018

Hong Kong

EQUITIES

992 HK
Price (at CLOSE#, 5 Oct 2018)

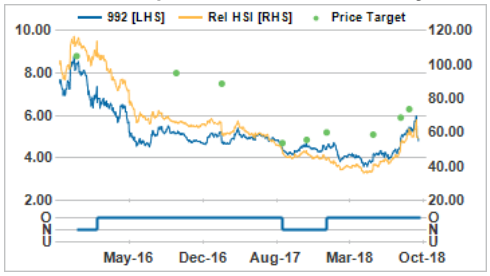
Outperform
HK$5.03

Valuation - Price to Book	HK$	6.30
12-month target	HK$	6.30
Upside/Downside	%	+25.2
12-month TSR	%	+30.5
Volatility Index		Low
GICS sector Technology Hardware & Equipment		
Market cap	HK$m	60,435
Market cap	US$m	7,361
Free float	%	57
30-day avg turnover	US$m	49.7
Number shares on issue	m	12,015

Investment fundamentals

Year end 31 Mar		2018A	2019E	2020E	2021E
Revenue	m	45,350	50,059	53,933	56,795
EBITDA	m	1,123	1,108	1,331	1,499
EBITDA growth	%	-21.8	-1.3	20.2	12.6
EBIT	m	384	834	1,069	1,246
EBIT growth	%	-44.6	117.1	28.2	16.5
Reported profit	m	-189	374	546	680
EPS rep	¢	-1.6	3.2	4.6	5.7
EPS rep growth	%	nmf	nmf	46.0	24.5
PER rep	x	nmf	20.4	13.9	11.2
Total DPS	¢	3.4	3.4	3.4	3.4
Total div yield	%	5.3	5.3	5.3	5.3
ROA	%	1.4	2.9	3.6	4.1
ROE	%	7.1	8.7	12.5	14.9
EV/EBITDA	x	8.5	8.6	7.1	6.3
Net debt/equity	%	43.3	8.3	4.5	1.5
P/BV	x	1.8	1.8	1.7	1.6

992 HK rel HSI performance, & rec history



Note: Recommendation timeline - if not a continuous line, then there was no Macquarie coverage at the time or there was an embargo period.
Source: FactSet, Macquarie Research, October 2018
(all figures in USD unless noted, TP in HKD)

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Lenovo (992 HK)
Concierge economy: AI, AR, smart speaker

Key points

- We see Lenovo as one of the early beneficiaries in the growing concierge economy, given its AI / AR in smartphones and smart speakers, etc.
- In this report, we discuss Lenovo's AI / AR in smartphones and smart speakers, showing how these products provide concierge-like services.
- We are positive on Lenovo, given fundamental improvements post business transition, 5% dividend yields, and attractive valuation.

Conclusion

- **We see Lenovo as one of the early beneficiaries** in the growing concierge economy, given its AI / AR in smartphones and smart speakers, etc. In this report, we discuss Lenovo's AI / AR in smartphones and smart speakers, showing how these products provide concierge-like services. As we highlighted in January (*Driving profitability*), we are positive on Lenovo given fundamental improvements post business transition (NDR in Feb, NDR in May, NDR in Aug), 5% dividend yields, and attractive valuation.

Impact

- **AI in smartphones, concierge-like services in hand:** As we highlighted in July 2017, Lenovo's virtual assistant in smartphone, Cava, provides facial recognition, voice interaction and can automatically set up schedules and reminders based on users' habits. For example, it can pop out a movie schedule automatically when the user inputs text "movies".
- **AR in smartphones, concierge-like services in hand:** As we highlighted in July 2016, Lenovo's AR system in smartphones does more than presenting 3D images—it overlays virtual objects or info / data on to the real world. For example, before purchasing appliances or furniture, end-users could use the smartphone to see whether it would fit or how it would look in their house. Another example: when visiting a museum, end-users could use the smartphone to see details on certain objects.
- **Smart speakers, concierge-like services at home:** Lenovo's smart speaker, Smart Cast+, not only interacts by voice but visually with its built-in projector. The device could recognise objects and realise the AR experience, enriching the interaction with end-users. 'Education' and 'on-line shopping' are the two initial markets Lenovo is targeting with this new product.

Earnings and target price revision

- No change to EPS rep.

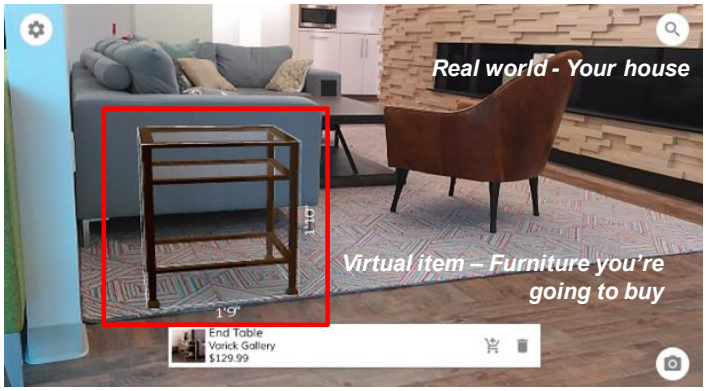
Price catalyst

- 12-month price target: HK$6.30 based on a Price to Book methodology.
- Catalyst: FY2Q19 results

Action and recommendation

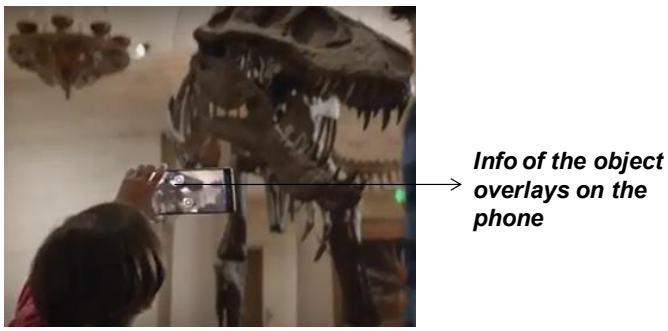
- Maintain Outperform.

Fig 1 Shop with AR smartphone – Lowe's Home app



Source: Lenovo, September 2018

Fig 2 Visit museum with AR smartphone

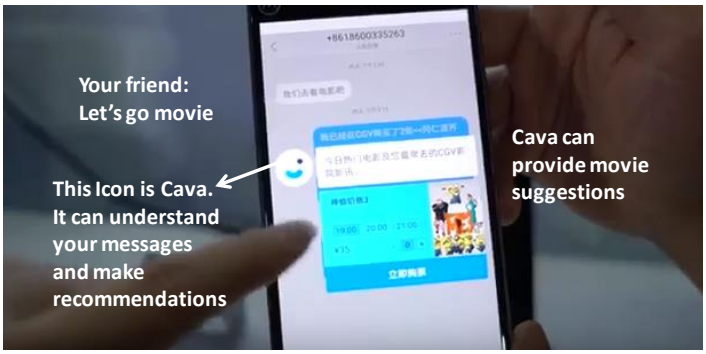


Source: Lenovo, September 2018

Fig 3 Lenovo Cava – smartphone facial recognition

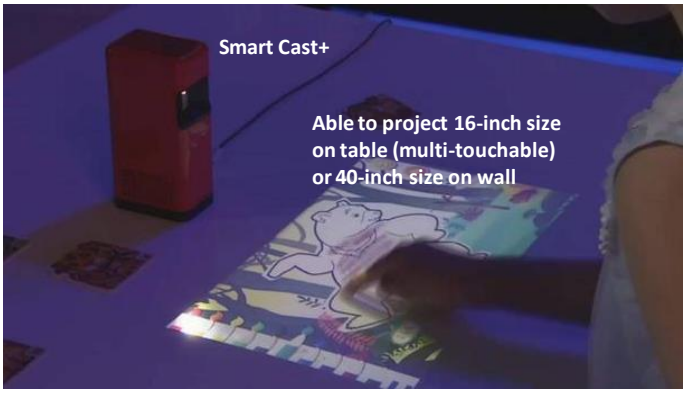
Source: Bloomberg, Macquarie Research, September 2018

Fig 4 Lenovo Cava – AI virtual assistant



Source: Company data, Macquarie Research, September 2018

Fig 5 Lenovo Smart Cast+ in education



Source: Bloomberg, Macquarie Research, September 2018

Fig 6 Lenovo Smart Cast+ in on-line shopping

Source: Company data, Macquarie Research, September 2018

Fig 7 Lenovo – P&L

(US$ m)	1Q18	2Q18	3Q18	4Q18	1Q19	2Q19E	3Q19E	4Q19E	2016	2017	2018	2019E	2020E	2021E
Revenue	10,012	11,761	12,939	10,638	11,913	12,843	14,016	11,287	44,912	43,035	45,350	50,059	53,933	56,795
Gross profit	1,365	1,613	1,751	1,544	1,632	1,766	1,943	1,551	6,624	6,106	6,272	6,891	7,541	8,061
Operating profit	-6	72	204	101	180	212	247	196	-64	661	371	835	1,069	1,246
Pretax income	-69	35	150	37	113	153	189	138	-277	490	153	593	840	1,018
Net income	-72	139	-289	33	77	94	121	82	-128	535	-189	374	546	680
EPS (US cents)	-0.61	1.17	-2.44	0.28	0.65	0.79	1.02	0.69	-1.08	4.51	-1.60	3.15	4.60	5.73
Margin														
Gross margin	13.6%	13.7%	13.5%	14.5%	13.7%	13.7%	13.9%	13.7%	14.7%	14.2%	13.8%	13.8%	14.0%	14.2%
Opex ratio	13.7%	13.1%	12.0%	13.6%	12.2%	12.1%	12.1%	12.0%	14.9%	12.7%	13.0%	12.1%	12.0%	12.0%
OP margin	-0.1%	0.6%	1.6%	0.9%	1.5%	1.6%	1.8%	1.7%	-0.1%	1.5%	0.8%	1.7%	2.0%	2.2%
Net margin	-0.7%	1.2%	-2.2%	0.3%	0.6%	0.7%	0.9%	0.7%	-0.3%	1.2%	-0.4%	0.7%	1.0%	1.2%
QoQ														
Revenue	5%	17%	10%	-18%	12%	8%	9%	-19%						
Gross profit	0%	18%	9%	-12%	6%	8%	10%	-20%						
Operating profit	na	na	183%	-51%	79%	17%	17%	-21%						
Net income	na	na	na	na	136%	22%	28%	-32%						
EPS (US cents)	na	na	na	na	136%	22%	28%	-32%						
YoY														
Revenue	0%	5%	6%	11%	19%	9%	8%	6%	-3%	-4%	5%	10%	8%	5%
Gross profit	-11%	0%	10%	13%	20%	9%	11%	0%	-1%	-8%	3%	10%	9%	7%
Operating profit	na	-65%	47%	37%	na	193%	21%	95%	na	na	-44%	125%	28%	17%
Net income	na	-11%	na	-69%	na	-32%	na	152%	na	na	na	na	46%	25%
EPS (US cents)	na	-11%	na	-69%	na	-32%	na	152%	na	na	na	na	46%	25%

Source: Company data, Macquarie Research, September 2018

Fig 8 Lenovo key financial ratios

US$ m	2014	2015	2016	2017	2018	2019E	2020E	2021E
Revenue	38,707	46,296	44,912	43,035	45,350	50,059	53,933	56,795
Gross profit	5,064	6,682	6,624	6,106	6,272	6,891	7,541	8,061
EBIT	1,061	1,126	-73	694	384	834	1,069	1,246
EBITDA	1,397	1,634	668	1,436	1,123	1,108	1,331	1,499
Pretax profit	1,014	971	-277	490	153	593	840	1,018
Net profit	817	829	-128	535	-189	374	546	680
YoY (%)								
Revenue		20%	-3%	-4%	5%	10%	8%	5%
Gross profit		32%	-1%	-8%	3%	10%	9%	7%
Net profit		1%	na	na	-135%	-297%	46%	25%
Per share data (US cents)								
Sales per share	326.51	390.53	378.85	363.02	382.55	422.27	454.95	479.09
EPS	6.89	6.99	-1.08	4.51	-1.60	3.15	4.60	5.73
BVPS	25.51	34.64	25.53	34.55	38.35	38.14	39.39	41.77
DPS	3.09	3.42	3.42	3.41	3.39	3.39	3.40	3.40
FCF PS	8.55	-8.39	12.68	10.26	-10.48	14.15	6.91	6.65
Net cash PS	29.50	-0.23	-9.88	-2.53	-11.12	-2.47	-1.07	0.08
Net debt/Equity	-116%	1%	39%	7%	29%	6%	3%	0%
Margin (%)								
Gross margin	13.1%	14.4%	14.7%	14.2%	13.8%	13.8%	14.0%	14.2%
EBIT margin	2.7%	2.4%	-0.2%	1.6%	0.8%	1.7%	2.0%	2.2%
EBITDA margin	3.6%	3.5%	1.5%	3.3%	2.5%	2.2%	2.5%	2.6%
Pretax margin	2.6%	2.1%	-0.6%	1.1%	0.3%	1.2%	1.6%	1.8%
Net margin	2.1%	1.8%	-0.3%	1.2%	-0.4%	0.7%	1.0%	1.2%
Valuation multiples (x)								
P/E	10.7	10.6	na	16.3	na	23.2	15.9	12.8
P/B	2.9	2.1	2.9	2.1	1.9	1.9	1.9	1.8
FCF yield	11.6%	-11.4%	17.2%	13.9%	-14.3%	19.3%	9.4%	9.1%
ROE (%)	27.0%	23.2%	-3.6%	15.0%	-4.4%	8.2%	11.9%	14.1%
Dividend yield	4.2%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%
Payout ratio	45%	49%	na	76%	-212%	108%	74%	59%

Source: Company data, Macquarie Research, September 2018

Macquarie Quant View

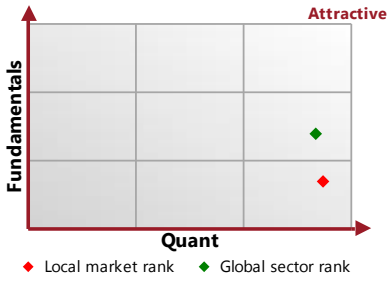
The Quant View page below has been derived from models that are developed and maintained by Sales and Trading personnel at Macquarie. The models are not a product of the Macquarie Research Department.

The quant model currently holds a strong positive view on Lenovo Group. The strongest style exposure is Price Momentum, indicating this stock has had strong medium to long term returns which often persist into the future. The weakest style exposure is Profitability, indicating this stock is not efficiently converting investments to earnings; proxied by ratios like ROE or ROA.

105/946

Global rank in
Technology Hardware & Equipment

% of BUY recommendations	38% (8/21)
Number of Price Target downgrades	0
Number of Price Target upgrades	4

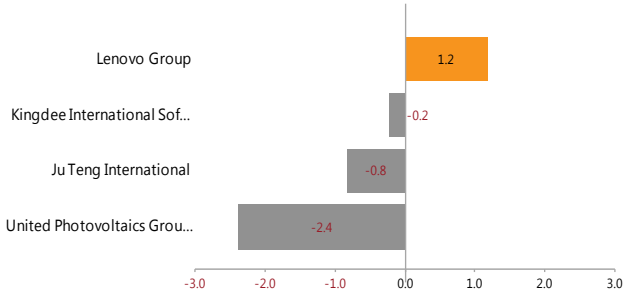


Displays where the company's ranked based on the fundamental consensus Price Target and Macquarie's Quantitative Alpha model.

Two rankings: Local market (Hong Kong) and Global sector (Technology Hardware & Equipment)

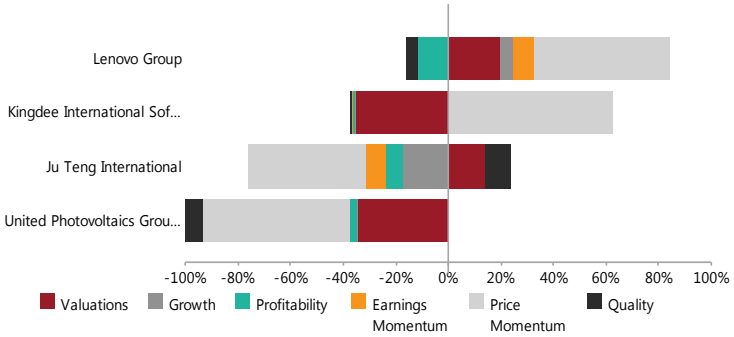
Macquarie Alpha Model ranking

A list of comparable companies and their Macquarie Alpha model score (higher is better).



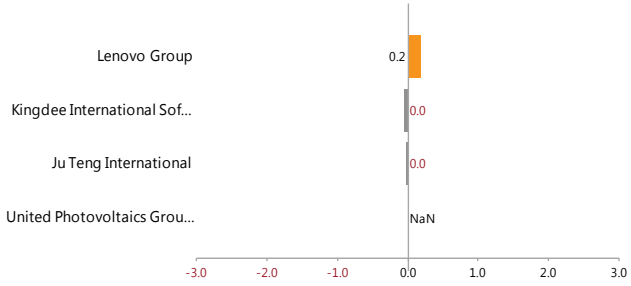
Factors driving the Alpha Model

For the comparable firms this chart shows the key underlying styles and their contribution to the current overall Alpha score.



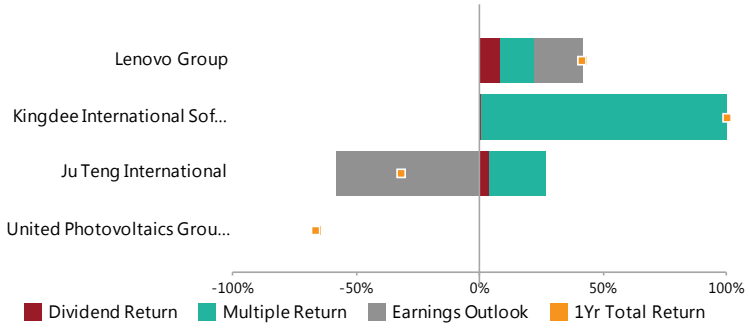
Macquarie Earnings Sentiment Indicator

The Macquarie Sentiment Indicator is an enhanced earnings revisions signal that favours analysts who have more timely and higher conviction revisions. Current score shown below.



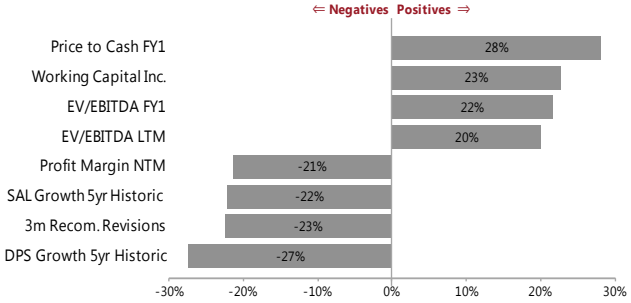
Drivers of Stock Return

Breakdown of 1 year total return (local currency) into returns from dividends, changes in forward earnings estimates and the resulting change in earnings multiple.



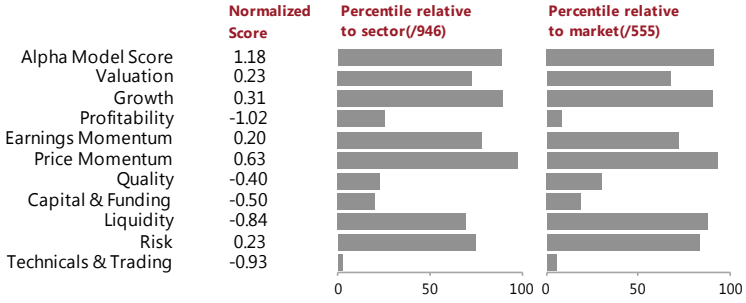
What drove this Company in the last 5 years

Which factor score has had the greatest correlation with the company's returns over the last 5 years.



How it looks on the Alpha model

A more granular view of the underlying style scores that drive the alpha (higher is better) and the percentile rank relative to the sector and market.



Source (all charts): FactSet, Thomson Reuters, and Macquarie Quant. For more details on the Macquarie Alpha model or for more customised analysis and screens, please contact the Macquarie Global Quantitative/Custom Products Group (cpg@macquarie.com)

Lenovo Group (992 HK, Outperform, Target Price: HK$6.30)

Quarterly Results		1Q/19A	2Q/19E	3Q/19E	4Q/19E
Revenue	**m**	**11,913**	**12,843**	**14,016**	**11,287**
Gross Profit	**m**	**1,632**	**1,766**	**1,943**	**1,551**
Cost of Goods Sold	m	10,281	11,078	12,073	9,737
EBITDA	**m**	**248**	**280**	**316**	**264**
Depreciation	m	68	68	68	68
Amortisation of Goodwill	m	0	0	0	0
Other Amortisation	m	0	0	0	0
EBIT	**m**	**179**	**212**	**247**	**196**
Net Interest Income	m	-67	-58	-58	-58
Associates	m	-1	0	0	0
Exceptionals	m	0	0	0	0
Forex Gains / Losses	m	0	0	0	0
Other Pre-Tax Income	m	1	-0	-0	0
Pre-Tax Profit	**m**	**113**	**153**	**189**	**138**
Tax Expense	m	-27	-38	-47	-34
Net Profit	**m**	**85**	**115**	**142**	**103**
Minority Interests	m	-8	-21	-21	-21
Reported Earnings	**m**	**77**	**94**	**121**	**82**
Adjusted Earnings	**m**	**77**	**94**	**121**	**82**
EPS (rep)	¢	0.6	0.8	1.0	0.7
EPS (adj)	¢	0.6	0.8	1.0	0.7
EPS Growth yoy (adj)	%	62.0	-63.7	nmf	-46.0
EBITDA Margin	%	2.1	2.2	2.3	2.3
EBIT Margin	%	1.5	1.6	1.8	1.7
Earnings Split	%	20.6	25.1	32.3	22.0
Revenue Growth	%	19.0	9.2	8.3	6.1
EBIT Growth	%	nmf	144.8	21.7	94.0

Profit & Loss		2018A	2019E	2020E	2021E
Revenue	**m**	**45,350**	**50,059**	**53,933**	**56,795**
Gross Profit	**m**	**6,272**	**6,891**	**7,541**	**8,061**
Cost of Goods Sold	m	39,078	43,168	46,392	48,734
EBITDA	**m**	**1,123**	**1,108**	**1,331**	**1,499**
Depreciation	m	259	273	262	253
Amortisation of Goodwill	m	479	0	0	0
Other Amortisation	m	0	0	0	0
EBIT	**m**	**384**	**834**	**1,069**	**1,246**
Net Interest Income	m	-231	-242	-230	-228
Associates	m	-3	-1	0	0
Exceptionals	m	0	0	0	0
Forex Gains / Losses	m	0	0	0	0
Other Pre-Tax Income	m	3	1	-0	-0
Pre-Tax Profit	**m**	**153**	**593**	**840**	**1,018**
Tax Expense	m	-280	-147	-210	-255
Net Profit	**m**	**-127**	**445**	**630**	**764**
Minority Interests	m	-63	-71	-84	-84
Reported Earnings	**m**	**-189**	**374**	**546**	**680**
Adjusted Earnings	**m**	**290**	**374**	**546**	**680**
EPS (rep)	¢	-1.6	3.2	4.6	5.7
EPS (adj)	¢	2.4	3.2	4.6	5.7
EPS Growth (adj)	%	-71.2	28.9	46.0	24.5
PE (rep)	x	nmf	23.2	15.9	12.8
PE (adj)	x	29.9	23.2	15.9	12.8
Total DPS	¢	3.4	3.4	3.4	3.4
Total Div Yield	%	4.7	4.6	4.6	4.6
Basic Shares Outstanding	m	11,855	11,855	11,855	11,855
Diluted Shares Outstanding	m	11,855	11,855	11,855	11,855

Profit and Loss Ratios		2018A	2019E	2020E	2021E
Revenue Growth	%	5.4	10.4	7.7	5.3
EBITDA Growth	%	-21.8	-1.3	20.2	12.6
EBIT Growth	%	-44.6	117.1	28.2	16.5
Gross Profit Margin	%	13.8	13.8	14.0	14.2
EBITDA Margin	%	2.5	2.2	2.5	2.6
EBIT Margin	%	0.8	1.7	2.0	2.2
Net Profit Margin	%	0.6	0.7	1.0	1.2
Payout Ratio	%	139.6	107.4	73.7	59.3
EV/EBITDA	x	9.4	9.5	7.9	7.0
EV/EBIT	x	27.6	12.6	9.9	8.5
Balance Sheet Ratios					
ROE	%	7.1	8.7	12.5	14.9
ROA	%	1.4	2.9	3.6	4.1
ROIC	%	-7.3	9.6	16.4	19.1
Net Debt/Equity	%	43.3	8.3	4.5	1.5
Interest Cover	x	1.7	3.5	4.7	5.5
Price/Book	x	2.0	2.0	2.0	1.8
Book Value per Share		0.4	0.4	0.4	0.4

Cashflow Analysis		2018A	2019E	2020E	2021E
EBITDA	**m**	**1,123**	**1,108**	**1,331**	**1,499**
Tax Paid	m	-280	-147	-210	-255
Chgs in Working Cap	m	2,212	2,912	865	790
Net Interest Paid	m	-231	-242	-230	-228
Other	m	-3,580	-1,987	-975	-1,054
Operating Cashflow	**m**	**-756**	**1,643**	**781**	**751**
Acquisitions	m	120	-374	0	0
Capex	m	-218	-218	-274	-274
Asset Sales	m	0	0	0	0
Other	m	-1,016	374	56	56
Investing Cashflow	**m**	**-1,113**	**-218**	**-218**	**-218**
Dividend (Ordinary)	m	-405	-803	-402	-403
Equity Raised	m	295	-186	148	282
Debt Movements	m	779	665	0	0
Other	m	205	-76	-144	-277
Financing Cashflow	**m**	**874**	**-399**	**-398**	**-397**
Net Chg in Cash/Debt	**m**	**-907**	**1,026**	**165**	**136**
Free Cashflow	**m**	**-974**	**1,426**	**508**	**478**

Balance Sheet		2018A	2019E	2020E	2021E
Cash	m	1,848	2,874	3,040	3,176
Receivables	m	4,984	5,006	5,393	5,679
Inventories	m	3,792	3,885	3,943	4,142
Investments	m	373	0	0	0
Fixed Assets	m	1,305	1,249	1,205	1,170
Intangibles	m	8,515	8,515	8,515	8,515
Other Assets	m	7,678	8,051	8,051	8,051
Total Assets	**m**	**28,494**	**29,580**	**30,147**	**30,734**
Payables	m	7,253	5,612	6,031	6,335
Short Term Debt	m	1,167	746	746	746
Long Term Debt	m	2,649	2,505	2,505	2,505
Provisions	m	0	0	0	0
Other Liabilities	m	12,880	16,196	16,196	16,196
Total Liabilities	**m**	**23,948**	**25,059**	**25,478**	**25,782**
Shareholders' Funds	m	3,519	2,976	3,124	3,406
Minority Interests	m	247	239	239	239
Other	m	781	1,307	1,307	1,307
Total S/H Equity	**m**	**4,546**	**4,522**	**4,669**	**4,952**
Total Liab & S/H Funds	**m**	**28,494**	**29,580**	**30,147**	**30,734**

All figures in USD unless noted.
Source: Company data, Macquarie Research, October 2018

EQUITIES

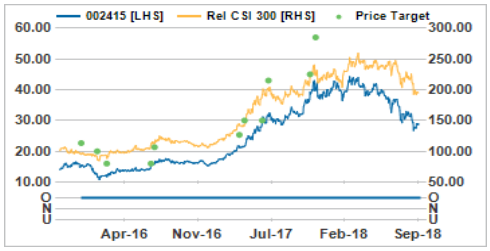
AShare Research

002415 CH		Outperform
Price (at CLOSE#, 5 Oct 2018)		Rmb28.74
Valuation - PER	Rmb	57.00
12-month target	Rmb	57.00
Upside/Downside	%	+98.3
12-month TSR	%	+101.6
Volatility Index		Medium
GICS sector		
Technology Hardware & Equipment		
Market cap	Rmbm	265,184
Market cap	US$m	38,588
Free float	%	38
30-day avg turnover	US$m	152.9
Number shares on issue	m	9,227

Investment fundamentals

Year end 31 Dec		2017A	2018E	2019E	2020E
Revenue	bn	41.9	56.3	76.2	103.3
EBITDA	bn	10.5	14.4	21.7	32.7
EBITDA growth	%	25.3	36.7	50.9	50.3
EBIT	bn	10.4	14.2	21.4	32.2
EBIT growth	%	25.3	37.5	50.6	50.3
Reported profit	bn	9.4	12.8	19.3	28.9
EPS rep	Rmb	1.02	1.39	2.09	3.13
EPS rep growth	%	26.8	36.2	50.2	50.0
PER rep	x	28.2	20.7	13.8	9.2
Total DPS	Rmb	0.46	0.68	1.02	1.53
Total div yield	%	1.6	2.4	3.6	5.3
ROA	%	22.3	25.2	31.2	37.4
ROE	%	34.4	38.1	46.1	53.4
EV/EBITDA	x	24.2	17.7	11.7	7.8
Net debt/equity	%	-51.9	-42.8	-36.6	-33.7
P/BV	x	7.9	6.3	5.0	3.7

002415 CH rel CSI 300 performance, & rec history



Note: Recommendation timeline - if not a continuous line, then there was no Macquarie coverage at the time or there was an embargo period.
Source: FactSet, Macquarie Research, September 2018
(all figures in Rmb unless noted, TP in CNY)

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Hikvision (A-Share) (002415 CH)
Concierge economy: AI in surveillance

Key points

- We expect Hikvision to be one of the earliest beneficiaries in a growing concierge economy given its market leadership position in AI-surveillance.
- In this report, we discuss Hikvision's AI-surveillance in retail store and automotive, showing how it provides concierge-like services to customers.
- As we highlighted in Nov 2017, we see AI lifting surveillance to an active predictor from a passive observer, enlarging the applications.

Conclusion

- **We expect Hikvision to be one of the earliest beneficiaries** in a growing concierge economy given its market leadership position in AI-featured surveillance. As we highlighted in Nov 2017 (link, *Beyond surveillance*), we see AI lifting surveillance to an active predictor from a passive observer, enlarging the applications and allowing surveillance to be part of business development.
- **Concierge economy** allows needs and expectations of customers to be recognized and anticipated anytime and anywhere without lag. In this report, we discuss Hikvision's AI products in retail store and automotive, showing how it provides concierge-like services to end customers.

Impact

- **AI in retail store allows entrepreneurs to better know their customers and to develop a more targeted / concierge-like services:** The AI-featured surveillance shows the traits of customers (gender, age, dress type, etc.), counts footfalls, analyse customers flow during a day, track customers shopping routes / behaviour in the store, track staff's interactions with customers, etc. This info helps entrepreneurs better know their customers and shows the best spot in a store, the highest visitor flow in a day, optimised staff numbers during different times in a day, etc. supporting entrepreneurs to develop a more targeted / concierge-like services to their customers and improve operating efficiency.
- **AI in automotive, concierge-like services for the driver:** Hikvision's AI-featured surveillance in automotive include front end (camera), back end (DVR / on-board diagnostics), central management system (real-time data analysis), dashboard camera, etc. The dashboard camera could automatically alert drivers of traffic light changes, front car movements, speed limit, etc. The on-board surveillance system could do people counting, lane change detection, driver behaviour detection and send alerts automatically, such as making phone calls, smoking, sleepiness, etc., enhancing driving safety.

Earnings and target price revision

- No change

Price catalyst

- 12-month price target: Rmb57.00 based on a PER method (27.5x 2019E PE).
- Catalyst: 3Q18 results

Action and recommendation

- Maintain Outperform.

Fig 1 Hikvision dual-lens people counting camera

Source: company data, Macquarie Research, September 2018

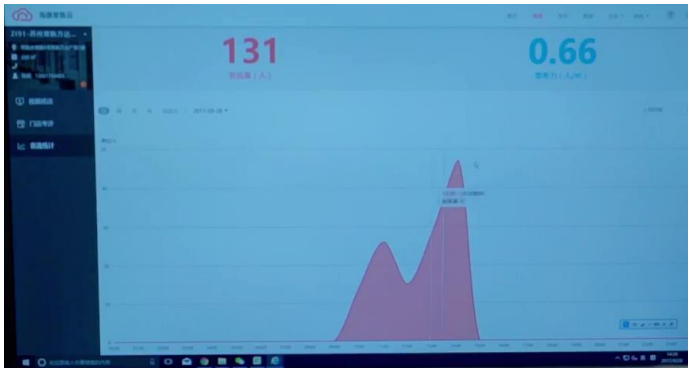
Fig 2 Hikvision cameras: track targets automatically

Source: Company data, Macquarie Research, September 2018

Fig 3 Hikvision recorders

Source: Company data, Macquarie Research, September 2018

Fig 4 Hikvision visitor flow analysis

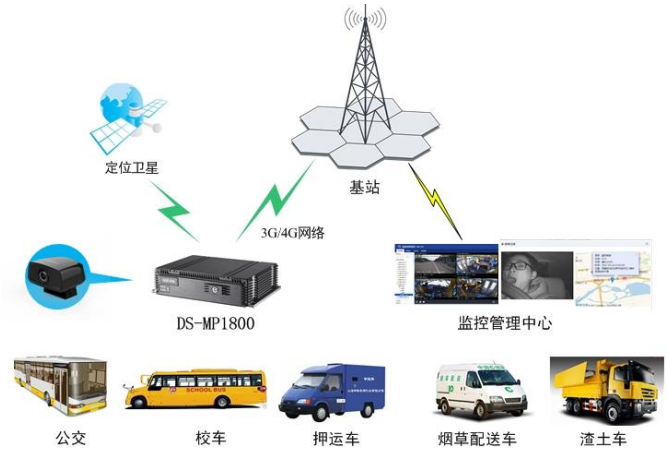


Source: Company data, Macquarie Research, September 2018

Fig 5 Hikvision AI dashboard camera

Source: Company data, Macquarie Research, September 2018

Fig 6 Hikvision on board surveillance system



Source: Company data, Macquarie Research, September 2018

Fig 7 Hikvision P&L

(Rmb m)	1Q17	2Q17	3Q17	4Q17	1Q18	2Q18	3Q18E	4Q18E	2016	2017	2018E	2019E	2020E
Revenue	7,044	9,404	11,282	14,176	9,365	11,511	15,038	20,393	31,924	41,905	56,306	76,171	103,253
Gross profit	3,013	4,014	5,225	6,186	4,220	5,069	6,971	9,357	13,274	18,438	25,617	35,403	50,186
Operating profit	1,498	1,866	2,789	3,279	2,070	1,889	3,919	5,686	6,921	9,432	13,563	21,448	32,245
Pretax income	1,799	2,046	2,939	3,703	2,156	2,617	3,927	5,694	8,310	10,487	14,394	21,600	32,422
Net income	1,481	1,811	2,861	3,258	1,816	2,331	3,540	5,131	7,422	9,411	12,819	19,252	28,885
EPS (RMB$)	0.16	0.20	0.31	0.35	0.20	0.25	0.38	0.56	0.80	1.02	1.39	2.09	3.13
Margin													
Gross margin	42.8%	42.7%	46.3%	43.6%	45.1%	44.0%	46.4%	45.9%	41.6%	44.0%	45.5%	46.5%	48.6%
Opex ratio	21.5%	22.8%	21.6%	20.5%	23.0%	27.6%	20.3%	18.0%	19.9%	21.5%	21.4%	18.3%	17.4%
OP margin	21.3%	19.8%	24.7%	23.1%	22.1%	16.4%	26.1%	27.9%	21.7%	22.5%	24.1%	28.2%	31.2%
Net margin	21.0%	19.3%	25.4%	23.0%	19.4%	20.3%	23.5%	25.2%	23.2%	22.5%	22.8%	25.3%	28.0%
QoQ													
Revenue	-35%	34%	20%	26%	-34%	23%	31%	36%					
Gross profit	-33%	33%	30%	18%	-32%	20%	38%	34%					
Operating profit	-38%	24%	49%	18%	-37%	-9%	107%	45%					
Net income	-42%	22%	58%	14%	-44%	28%	52%	45%					
EPS	-42%	22%	58%	14%	-44%	28%	52%	45%					
YoY													
Revenue	35%	28%	31%	31%	33%	22%	33%	44%	26%	31%	34%	35%	36%
Gross profit	38%	41%	39%	38%	40%	26%	33%	51%	31%	39%	39%	38%	42%
Operating profit	38%	37%	37%	35%	38%	1%	41%	73%	25%	36%	44%	58%	50%
Net income	29%	24%	28%	27%	23%	29%	24%	57%	26%	27%	36%	50%	50%
EPS	29%	24%	28%	27%	23%	29%	24%	57%	26%	27%	36%	50%	50%

Source: Company data, Macquarie Research, September 2018

Fig 8 Hikvision key financial ratios

(Rmb m)	2014	2015	2016	2017	2018E	2019E	2020E
Revenue	17,233	25,271	31,924	41,905	56,306	76,171	103,253
Gross profit	7,655	10,135	13,274	18,438	25,617	35,403	50,186
EBIT	5,078	6,635	8,269	10,361	14,242	21,448	32,245
EBITDA	5,188	6,790	8,411	10,537	14,404	21,740	32,665
Pretax profit	5,206	6,750	8,310	10,487	14,394	21,600	32,422
Net profit	4,665	5,869	7,422	9,411	12,819	19,252	28,885
YoY (%)							
Revenue	60%	47%	26%	31%	34%	35%	36%
Gross profit	50%	32%	31%	39%	39%	38%	42%
Net profit	52%	26%	26%	27%	36%	50%	50%
Per share data (RMB$)							
Sales per share	1.87	2.74	3.46	4.54	6.10	8.25	11.19
EPS	0.51	0.64	0.80	1.02	1.39	2.09	3.13
BVPS	1.61	2.09	2.65	3.32	4.02	5.09	6.68
DPS	0.18	0.31	0.40	0.50	0.68	1.02	1.53
FCF PS	0.29	0.17	0.49	0.58	0.62	1.14	1.91
Net cash PS	0.71	0.99	1.29	1.89	1.89	2.03	2.42
Net debt/Equity	-44%	-47%	-49%	-57%	-47%	-40%	-36%
Margin (%)							
Gross margin	44.4%	40.1%	41.6%	44.0%	45.5%	46.5%	48.6%
EBIT margin	29.5%	26.3%	25.9%	24.7%	25.3%	28.2%	31.2%
EBITDA margin	30.1%	26.9%	26.3%	25.1%	25.6%	28.5%	31.6%
Pretax margin	30.2%	26.7%	26.0%	25.0%	25.6%	28.4%	31.4%
Net margin	27.1%	23.2%	23.2%	22.5%	22.8%	25.3%	28.0%
Valuation multiples (x)							
P/E	56.8	45.2	35.7	28.2	20.7	13.8	9.2
P/B	17.8	13.7	10.8	8.7	7.1	5.6	4.3
FCF yield	1.0%	1%	2%	2%	2%	4%	7%
ROE (%)	35.8%	34%	34%	34%	38%	46%	53%
Dividend yield	0.6%	1%	1%	2%	2%	4%	5%
Payout ratio	35%	49%	50%	49%	49%	49%	49%

Source: Company data, Macquarie Research, September 2018

Macquarie Quant View

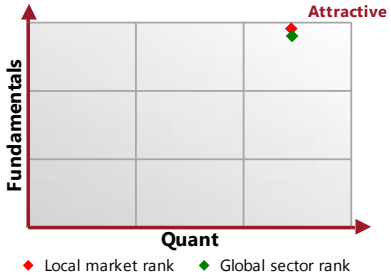
The Quant View page below has been derived from models that are developed and maintained by Sales and Trading personnel at Macquarie. The models are not a product of the Macquarie Research Department.

The quant model currently holds a reasonably positive view on Hikvision (A-Share). The strongest style exposure is Profitability, indicating this stock is efficiently converting investments to earnings; proxied by ratios like ROE or ROA. The weakest style exposure is Valuations, indicating this stock is over-priced in the market relative to its peers.

172/933

Global rank in
Technology Hardware & Equipment

% of BUY recommendations	87% (20/23)
Number of Price Target downgrades	2
Number of Price Target upgrades	0

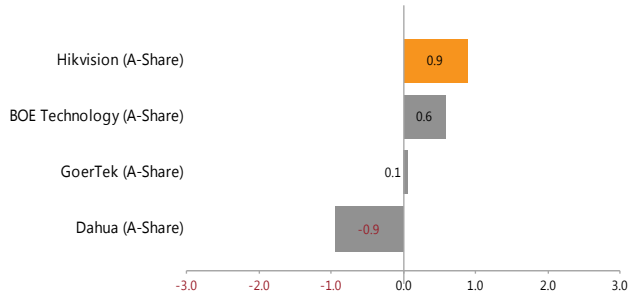


Displays where the company's ranked based on the fundamental consensus Price Target and Macquarie's Quantitative Alpha model.

Two rankings: Local market (China A) and Global sector (Technology Hardware & Equipment)

Macquarie Alpha Model ranking

A list of comparable companies and their Macquarie Alpha model score (higher is better).

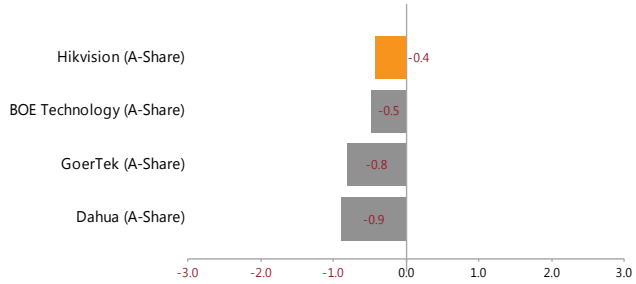


Factors driving the Alpha Model

For the comparable firms this chart shows the key underlying styles and their contribution to the current overall Alpha score.

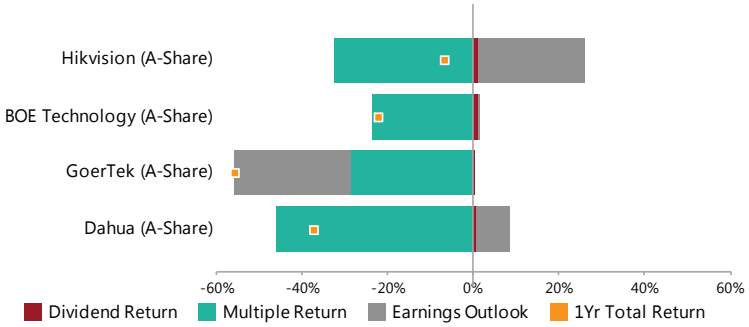
Macquarie Earnings Sentiment Indicator

The Macquarie Sentiment Indicator is an enhanced earnings revisions signal that favours analysts who have more timely and higher conviction revisions. Current score shown below.



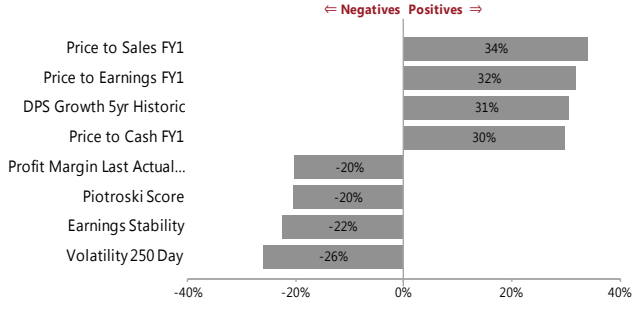
Drivers of Stock Return

Breakdown of 1 year total return (local currency) into returns from dividends, changes in forward earnings estimates and the resulting change in earnings multiple.



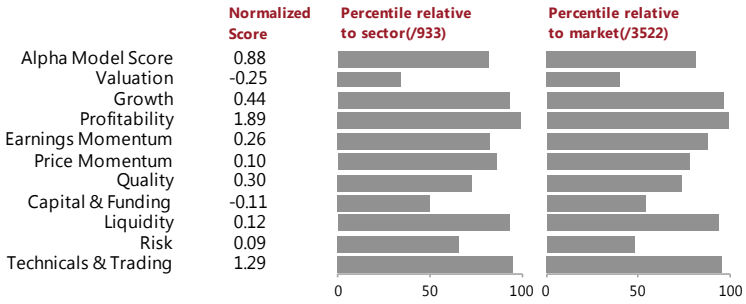
What drove this Company in the last 5 years

Which factor score has had the greatest correlation with the company's returns over the last 5 years.



How it looks on the Alpha model

A more granular view of the underlying style scores that drive the alpha (higher is better) and the percentile rank relative to the sector and market.



Source (all charts): FactSet, Thomson Reuters, and Macquarie Quant. For more details on the Macquarie Alpha model or for more customised analysis and screens, please contact the Macquarie Global Quantitative/Custom Products Group (cpg@macquarie.com)

Hikvision (A-Share) (002415 CH, Outperform, Target Price: Rmb57.00)

Quarterly Results		2Q/18A	3Q/18E	4Q/18E	1Q/19E
Revenue	**m**	**11,511**	**15,038**	**20,393**	**13,137**
Gross Profit	**m**	**5,069**	**6,971**	**9,357**	**6,236**
Cost of Goods Sold	m	6,441	8,067	11,036	6,901
EBITDA	**m**	**2,590**	**3,959**	**5,726**	**3,879**
Depreciation	m	40	40	40	73
Amortisation of Goodwill	m	0	0	0	0
Other Amortisation	m	0	0	0	0
EBIT	**m**	**2,550**	**3,919**	**5,686**	**3,806**
Net Interest Income	m	68	8	8	38
Associates	m	0	0	0	0
Exceptionals	m	0	0	0	0
Forex Gains / Losses	m	0	0	0	0
Other Pre-Tax Income	m	0	0	0	0
Pre-Tax Profit	**m**	**2,617**	**3,927**	**5,694**	**3,844**
Tax Expense	m	-292	-393	-569	-423
Net Profit	**m**	**2,325**	**3,534**	**5,125**	**3,421**
Minority Interests	m	6	6	6	6
Reported Earnings	**m**	**2,331**	**3,540**	**5,131**	**3,427**
Adjusted Earnings	**m**	**2,331**	**3,540**	**5,131**	**3,427**
EPS (rep)		0.25	0.38	0.56	0.37
EPS (adj)		0.25	0.38	0.56	0.37
EPS Growth yoy (adj)	%	28.8	23.7	57.5	88.7
EBITDA Margin	%	22.5	26.3	28.1	29.5
EBIT Margin	%	22.1	26.1	27.9	29.0
Earnings Split	%	18.2	27.6	40.0	17.8
Revenue Growth	%	22.4	33.3	43.9	40.3
EBIT Growth	%	27.0	34.4	54.5	82.2

Profit & Loss		2017A	2018E	2019E	2020E
Revenue	**m**	**41,905**	**56,306**	**76,171**	**103,253**
Gross Profit	**m**	**18,438**	**25,617**	**35,403**	**50,186**
Cost of Goods Sold	m	23,467	30,689	40,768	53,067
EBITDA	**m**	**10,537**	**14,404**	**21,740**	**32,665**
Depreciation	m	153	162	292	421
Amortisation of Goodwill	m	0	0	0	0
Other Amortisation	m	23	0	0	0
EBIT	**m**	**10,361**	**14,242**	**21,448**	**32,245**
Net Interest Income	m	126	152	152	177
Associates	m	0	0	0	0
Exceptionals	m	0	0	0	0
Forex Gains / Losses	m	0	0	0	0
Other Pre-Tax Income	m	0	0	0	0
Pre-Tax Profit	**m**	**10,487**	**14,394**	**21,600**	**32,422**
Tax Expense	m	-1,109	-1,628	-2,373	-3,562
Net Profit	**m**	**9,378**	**12,766**	**19,227**	**28,860**
Minority Interests	m	33	52	25	25
Reported Earnings	**m**	**9,411**	**12,819**	**19,252**	**28,885**
Adjusted Earnings	**m**	**9,411**	**12,819**	**19,252**	**28,885**
EPS (rep)		1.02	1.39	2.09	3.13
EPS (adj)		1.02	1.39	2.09	3.13
EPS Growth (adj)	%	26.8	36.2	50.2	50.0
PE (rep)	x	28.2	20.7	13.8	9.2
PE (adj)	x	28.2	20.7	13.8	9.2
Total DPS		0.46	0.68	1.02	1.53
Total Div Yield	%	1.6	2.4	3.6	5.3
Basic Shares Outstanding	m	9,227	9,227	9,227	9,227
Diluted Shares Outstanding	m	9,227	9,227	9,227	9,227

Profit and Loss Ratios		2017A	2018E	2019E	2020E
Revenue Growth	%	31.3	34.4	35.3	35.6
EBITDA Growth	%	25.3	36.7	50.9	50.3
EBIT Growth	%	25.3	37.5	50.6	50.3
Gross Profit Margin	%	44.0	45.5	46.5	48.6
EBITDA Margin	%	25.1	25.6	28.5	31.6
EBIT Margin	%	24.7	25.3	28.2	31.2
Net Profit Margin	%	22.5	22.8	25.3	28.0
Payout Ratio	%	44.9	49.0	49.0	49.0
EV/EBITDA	x	24.2	17.7	11.7	7.8
EV/EBIT	x	24.6	17.9	11.9	7.9
Balance Sheet Ratios					
ROE	%	34.4	38.1	46.1	53.4
ROA	%	22.3	25.2	31.2	37.4
ROIC	%	73.5	85.8	89.9	96.4
Net Debt/Equity	%	-51.9	-42.8	-36.6	-33.7
Interest Cover	x	nmf	nmf	nmf	nmf
Price/Book	x	7.9	6.3	5.0	3.7
Book Value per Share		3.6	4.6	5.8	7.8

Cashflow Analysis		2017A	2018E	2019E	2020E
EBITDA	**m**	**10,537**	**14,404**	**21,740**	**32,665**
Tax Paid	m	-1,109	-1,628	-2,373	-3,562
Chgs in Working Cap	m	-5,371	-7,824	-10,817	-14,443
Net Interest Paid	m	126	152	152	177
Other	m	3,191	3,375	4,700	5,729
Operating Cashflow	**m**	**7,373**	**8,480**	**13,403**	**20,568**
Acquisitions	m	0	0	0	0
Capex	m	-1,692	-2,600	-2,700	-2,800
Asset Sales	m	23	7	0	0
Other	m	460	-7	0	0
Investing Cashflow	**m**	**-1,209**	**-2,600**	**-2,700**	**-2,800**
Dividend (Ordinary)	m	-3,692	-4,153	-6,284	-9,438
Equity Raised	m	6,500	6,534	9,814	14,724
Debt Movements	m	-1,167	0	0	0
Other	m	-5,043	-8,242	-12,968	-19,447
Financing Cashflow	**m**	**-3,402**	**-5,860**	**-9,438**	**-14,161**
Net Chg in Cash/Debt	**m**	**2,833**	**20**	**1,264**	**3,607**
Free Cashflow	**m**	**5,681**	**5,880**	**10,703**	**17,768**

Balance Sheet		2017A	2018E	2019E	2020E
Cash	m	16,468	16,488	17,753	21,360
Receivables	m	18,342	24,646	33,340	45,194
Inventories	m	4,940	6,461	8,582	11,172
Investments	m	4	4	4	4
Fixed Assets	m	3,024	5,462	7,870	10,249
Intangibles	m	429	31	31	31
Other Assets	m	8,363	8,363	8,363	8,363
Total Assets	**m**	**51,571**	**61,455**	**75,944**	**96,373**
Payables	m	10,885	14,235	18,910	24,615
Short Term Debt	m	97	97	97	97
Long Term Debt	m	490	490	490	490
Provisions	m	0	0	0	0
Other Liabilities	m	9,494	9,494	9,494	9,494
Total Liabilities	**m**	**20,967**	**24,317**	**28,992**	**34,697**
Shareholders' Funds	m	31,130	37,665	47,478	62,202
Minority Interests	m	246	246	246	246
Other	m	-772	-772	-772	-772
Total S/H Equity	**m**	**30,604**	**37,138**	**46,952**	**61,676**
Total Liab & S/H Funds	**m**	**51,571**	**61,455**	**75,944**	**96,373**

All figures in Rmb unless noted.
Source: Company data, Macquarie Research, September 2018

Important disclosures:

Recommendation definitions

Macquarie - Australia/New Zealand
Outperform – return >3% in excess of benchmark return
Neutral – return within 3% of benchmark return
Underperform – return >3% below benchmark return

Benchmark return is determined by long term nominal GDP growth plus 12 month forward market dividend yield, which is currently around 9%.

Macquarie – Asia/Europe
Outperform – expected return >+10%
Neutral – expected return from -10% to +10%
Underperform – expected return <-10%

Mazi Macquarie – South Africa
Outperform – expected return >+10%
Neutral – expected return from -10% to +10%
Underperform – expected return <-10%

Macquarie - Canada
Outperform – return >5% in excess of benchmark return
Neutral – return within 5% of benchmark return
Underperform – return >5% below benchmark return

Macquarie - USA
Outperform (Buy) – return >5% in excess of Russell 3000 index return
Neutral (Hold) – return within 5% of Russell 3000 index return
Underperform (Sell)– return >5% below Russell 3000 index return

Volatility index definition*

This is calculated from the volatility of historical price movements.

Very high–highest risk – Stock should be expected to move up or down 60–100% in a year – investors should be aware this stock is highly speculative.

High – stock should be expected to move up or down at least 40–60% in a year – investors should be aware this stock could be speculative.

Medium – stock should be expected to move up or down at least 30–40% in a year.

Low–medium – stock should be expected to move up or down at least 25–30% in a year.

Low – stock should be expected to move up or down at least 15–25% in a year.
* Applicable to Asia/Australian/NZ/Canada stocks only

Recommendations – 12 months
Note: Quant recommendations may differ from Fundamental Analyst recommendations

Financial definitions

All "Adjusted" data items have had the following adjustments made:
Added back: goodwill amortisation, provision for catastrophe reserves, IFRS derivatives & hedging, IFRS impairments & IFRS interest expense
Excluded: non recurring items, asset revals, property revals, appraisal value uplift, preference dividends & minority interests

EPS = adjusted net profit / efpowa*
ROA = adjusted ebit / average total assets
ROA Banks/Insurance = adjusted net profit /average total assets
ROE = adjusted net profit / average shareholders funds
Gross cashflow = adjusted net profit + depreciation
*equivalent fully paid ordinary weighted average number of shares

All Reported numbers for Australian/NZ listed stocks are modelled under IFRS (International Financial Reporting Standards).

Recommendation proportions – For quarter ending 30 September 2018

	AU/NZ	Asia	RSA	USA	CA	EUR	
Outperform	51.56%	59.51%	45.05%	46.88%	67.86%	46.70%	(for global coverage by Macquarie, 3.70% of stocks followed are investment banking clients)
Neutral	33.20%	28.92%	37.36%	47.70%	25.00%	42.73%	(for global coverage by Macquarie, 2.04% of stocks followed are investment banking clients)
Underperform	15.23%	11.57%	17.58%	5.42%	7.14%	10.57%	(for global coverage by Macquarie, 0.47% of stocks followed are investment banking clients)

Company-specific disclosures:

Important disclosure information regarding the subject companies covered in this report is available at www.macquarie.com/research/disclosures.

Analyst certification:
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This publication was disseminated on 10 October 2018 at 16:07 UTC.