

## UBS Global I/O

# Tech Hardware/Displays/Semis 10 key findings from CES '20

### Moving towards AI personalisation and mobility

1/ CES 2020 was a transition event, with stable or slightly down attendance. AI/IoT is going through a transition in consumer electronics towards delivering more personalised experiences; Samsung (literally) rolled out its "new life companion" robot Ballie. 2/ Sony may have stolen the limelight with its Vision-S electric car concept (which will seek OEMs), showcasing the reach of its core sensors technology, whilst Toyota's Woven City experiment promises to test mobility ecosystems.

### 5G debate rages, Foldables unfold, TV & panels in transition til QD Display

3/ 5G remains at the forefront, with debates between elevated smartphone build forecasts and operators' deployment (UBSe 275mil 5G smartphones in '20E), all in the context of some procurement cuts at Huawei ([link](#)). 4/ Samsung preps the launch of the Bloom foldable clamshell smartphone alongside the Galaxy S20 & after Motorola RAZR 2019, and Lenovo is releasing the ThinkPad X1 Fold notebook; while more optimisation / costing down is needed, we remain believers in Foldables as a new products category. 5/ The TV market is in transition til Samsung moves to QD Displays (by 2021E), with some interesting OLED uses in the meantime (rolling down TVs, immersive bendable displays). 6/ Whist we continue to expect LCD capacity reductions in Korea to help panels supply/demand, January contracts for sub 55 inch TV sizes appear flat, and the LGD reduction in TV panel output is as we expected.

### CPU shortage & Ice Lake volume uncertainty vs improving DRAM pricing

7/ PC volumes are clearly negatively impacted by CPU shortages, unlikely to be resolved before mid-20, whilst the Windows 10 refresh cycle in Commercial (ahead of the end of Windows 7 extended support) is gradually slowing. 8/ The CPU situation is at the margin helping PC share gains for AMD mostly in SMB/consumer, whilst server share gains remains more tied up to Cloud/Hyperscale. 9/ Even if Ice Lake server CPUs are technically available late-2020, the bias remains more towards pushouts. 10/ This in turn makes us question the sustainability of the continuing improvement in server DRAM procurement, which is biasing up pricing expectations into 1H20.

### Tech has rallied – recommend selectivity

See Page 2 for a complete list of our Most and Least Preferred stocks.

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**Figure 1: Most and least preferred list**

Company	Ticker	Rating	Price	PT	'20E PE	'21E PE	'20E PB	'21E PB	'20E EV/Sales	'21E EV/Sales
<b>Most preferred</b>										
Catcher Technology	2474.TW	Buy	NT\$236	NT\$295	8.8	7.8	1.08	0.99	1.88	1.74
GUC	3443.TW	Buy	NT\$250.5	NT\$320	22.9	19.1	6.39	5.75	2.06	1.87
Infineon	IFXGn.DE	Buy	€21.42	€25	23.3	20.6	2.85	2.61	2.94	2.62
Lens Technology	300433.SZ	Buy	Rmb16.05	Rmb17	26.3	21.4	2.72	2.45	1.86	1.62
LG Innotek	011070.KS	Buy	Won148500	Won145000	12.0	10.3	1.35	1.20	0.47	0.44
Murata Mfg.	6981.T	Buy	¥6884	¥7700	19.4	17.1	2.34	2.13	2.58	2.32
Nokia	NOKIA.HE	Buy	€3.6535	€4.1	14.4	13.4	1.36	1.34	0.77	0.74
NVIDIA	NVDA.O	Buy	US\$244.32	US\$240	43.0	30.9	12.14	11.51	13.25	10.65
Samsung SDI	006400.KS	Buy	Won249000	Won280000	16.8	12.4	1.19	1.09	0.87	0.76
Sony	6758.T	Buy	HK\$7843	HK\$8400	15.4	13.9	1.96	1.73	-0.39	-0.44
Sunny Optical	2382.HK	Buy	Rmb142	Rmb145	23.7	18.2	8.15	5.98	2.76	2.35
TDK	6762.T	Buy	¥12550	¥14600	14.6	11.8	1.54	1.39	1.06	0.95
TSMC	2330.TW	Buy	NT\$339.5	NT\$335	20.8	18.1	4.83	4.37	6.76	5.97
<b>Least preferred</b>										
Applied Materials	AMAT.O	Sell (CBE)	US\$61.47	US\$48	18.0	15.8	6.89	7.22	4.27	3.95
Casetek	5264.TW	Sell	NT\$45.85	NT\$35	15.8	17.3	0.59	0.58	0.34	0.32
Chipbond	6147.TWO	Sell	NT\$64.9	NT\$51	11.6	12.3	1.34	1.27	1.80	1.62
GoerTeK	002241.SZ	Sell	Rmb21.28	Rmb12	39.3	33.0	3.89	3.53	1.25	0.98
GWC	6488.TWO	Neutral	NT\$379	NT\$345	12.4	12.5	3.31	3.07	2.45	2.24
Hirose Electric	6806.T	Sell	¥14200	¥11000	28.1	27.3	1.60	1.55	2.23	2.16
KLA Corporation	KLAC.O	Sell	US\$173.01	US\$140	16.9	16.9	10.35	9.07	4.74	5.09
LAM Research	LRCX.O	Sell	US\$294.34	US\$240	19.0	17.0	8.68	9.40	4.76	4.40
LG Display	034220.KS	Neutral	Won15900	Won14000	-14.1	16.5	0.47	0.46	0.65	0.68
Melexis	MILXS.BR	Sell	€67.25	€57	33.6	23.1	8.29	7.36	5.14	4.66
O-Film Tech	002456.SZ	Sell	Rmb16.01	Rmb11	29.8	23.7	4.13	3.58	1.08	0.99
Pegatron	4938.TW	Sell	HK\$67	HK\$50	16.0	15.3	1.09	1.04	0.14	0.12
Sharp	6753.T	Sell	HK\$1734	HK\$870	17.3	16.8	2.75	2.43	0.50	0.49
SMIC	0981.HK	Neutral (CBE)	HK\$12.96	HK\$10.5	-93.0	380.7	0.99	0.99	2.52	2.52
Texas Instruments	TXN.O	Sell	US\$130	US\$110	24.1	20.2	13.07	12.20	8.57	7.72
Wistron	3231.TW	Sell	NT\$28.75	NT\$17.5	16.5	16.7	0.91	0.87	0.11	0.10

Source: UBS estimates Note: Priced as of 10<sup>th</sup> Jan 2020.

# Key takeaways

## Smartphones

After the positive sentiment building in 4Q19, our meetings indicate some relative degree of caution, although we remain comfortable with our forecast for industry smartphones units to grow 1% YoY in 2020. First, 5G expectations remain under question (UBSe 275mil units in 2020 and 500mil in 2021) when comparing smartphone builds vs operators / services rollout. Qualcomm on their side, reiterated 200mil 5G smartphones industry forecast for 2020, and over 750mil by 2022 and acknowledged for this is well below most industry forecasts, did not specifically indicate it feels its number is conservative.

We recently found evidence of some adjustment down re Huawei smartphones procurement ([link](#)) both for 4G and 5G, although the magnitude varies. Regarding Samsung, we slightly lowered by 2mil our 2020 forecast Sell In units to 295.5mil (flat YoY). We note however that our current build forecast is closer to 270-275mil, with inventory adjustment one variable. Possible downside could come from both ODM volumes (60-70mil in 2020) and GS20 (the replacement of the GS10). We note however that the GS20 volumes have also to make room for the foldable units (UBSe 5mil).

We expect the replacement to the Samsung Fold to be close to 1.2mil in 2020, whilst the Bloom (clamshell foldable) should launch in February and hence come to the market close enough to the GS20. We expect the Bloom to be higher ASPs than the Note series, but lower than the Fold; it will also be 5G. Note that Motorola did a limited launch of the RAZR 2019 back in late December 2019, at a retail price of US\$1,499 (4G). Our hands-on use of the device revealed positives (design, dual screen) vs some limitations (screen resolution, battery capacity, mid-range SoC). Motorola will refresh the RAZR in late 2020. Overall though, the conclusion on foldable displays clamshells remains similar to the initial use of the Fold: the products are not fully mature yet, but the possible user cases are promising, and we think, compelling.

**Figure 2: Motorola RAZR 2019 (1)**



Source: UBS

**Figure 3: Motorola RAZR 2019 (2)**



Source: UBS

**Figure 4: Smartphones announced at CES 2020**

Company	Model	Launch Date	Display (inch)	Camera	DRAM	NAND	CPU	OS	Retail Price (US\$)
Alcatel	Alcatel 3L	1Q20	6.22" LCD	48MP wide + 5MP ultrawide + 2MP macro rear / 8MP front	4 GB	64 GB	Mediatek MT6762 Helio P22	Android 10.0	\$155
Alcatel	Alcatel 1S	1Q20	6.22" LCD	13MP wide + 5MP ultrawide + 2MP macro rear / 5MP front	3 GB	32 GB	Mediatek MT6762D Helio P22	Android 10.0	\$110
Alcatel	Alcatel 1V	1Q20	6.22" LCD	13MP wide + 5MP rear / 5MP front	2 GB	32 GB	Mediatek MT6762D Helio P22	Android 10.0	\$88
Alcatel	Alcatel 1B	1Q20	5.5" LCD	13MP wide rear / 5MP front	2 GB	16 GB	Qualcomm QM215	Android 10.0	\$66
Coolpad	Legacy 5G	2Q20	6.53" FHD Plus Display	48MP wide + 8MP ultrawide / 16MP front	4 GB	64 GB	Qualcomm Snapdragon 765	Android 10.0	\$359
Samsung	Galaxy S10 Lite	1Q20	6.7" Super AMOLED (20:9)	48MP wide + 12MP ultrawide + 5MP macro rear / 32MP front	6/8 GB	128 GB	Qualcomm Snapdragon 855	Android 10.0	TBA
Samsung	Galaxy Note10 Lite	1Q20	6.7" Super AMOLED (20:9)	12MP wide + 12MP ultrawide + 12MP telephoto rear / 32MP front	6/8 GB	128 GB	Exynos 9810	Android 10.0	TBA
TCL	TCL 10 5G	2Q20	6.39" LCD	64MP + 8MP + 5MP + 2MP rear / 32MP front	8 GB	128/256 GB	Qualcomm Snapdragon 765G	Android 10.0	TBA
TCL	TCL 10 Pro	2Q20	6.39" AMOLED	64MP + 8MP + 5MP + 2MP rear / 32MP front	8 GB	128/256 GB	Qualcomm Snapdragon 765	Android 10.0	TBA
TCL	TCL 10L	2Q20	6.39" LCD	48MP + 8MP + 5MP + 2MP rear / 16MP front	8 GB	128/256 GB	Qualcomm Snapdragon 765	Android 10.0	TBA
TCL	TCL Foldable	TBA	7.2" LCD	TBA	TBA	TBA	TBA	Android	TBA
Xiaomi	Black Shark 2 Pro	Aug 2019	6.39" AMOLED	48MP wide + 12MP telephoto rear / 20MP front	8/12 GB	128/256 GB	Qualcomm Snapdragon 855+	Android 9.0 Pie	\$599/\$699

Source: Company announcements

## PCs

### Volume risks entering 2020

Our meetings with PCs OEMs indicate that the CPU shortage situation is having a material impact on PC builds since November 2019 again. This could result in c. 5mil PC unit build adjustments on a quarterly run-rate basis. The situation is not expected to ease before mid-2020, though most OEMs believe that INTC will finally once and for all solve the PC-related supply issues in this time frame by adding a significant amount of dedicated supply. This is consistent with our recent industry forecast update ([link](#)) though the increase in supply does create the risk of CPU supply digestion for INTC as we move through mid-2020.

In addition, PC vendors acknowledge that the extended support for Windows 7 (January 14<sup>th</sup> 2020) boosted demand on the commercial side. The impact is estimated to have been maximum in 2Q19, and supported by c. 700mil PCs in the installed base being >4 years old. Although the magnitude of the replacement cycle was mitigated by the CPU shortage issue, and Microsoft will for some larger customers negotiate extended support, this remains a risk for demand for the balance of 2020.

### Notebooks focusing on new features and experimenting with Foldables

Amongst features which are being used to refresh product lines, the main stand-outs were minimal bezel notebook PCs and security (anti-reflection screen mode,

mechanical shutter of front camera). SSD adoption is expected to continue to accelerate. OLED adoption seems to modestly re-accelerate (beyond foldables) with HP Spectre, NEC LaVie Vega and Samsung Galaxy Chromebook. Other innovative use of displays include animated display on the lid (Asus Zephyrus 14) or monochromatic ink-jet display on the lid (Lenovo ThinkBook Plus).

**Figure 5: Dell XPS 13 (2020)**



Source: UBS

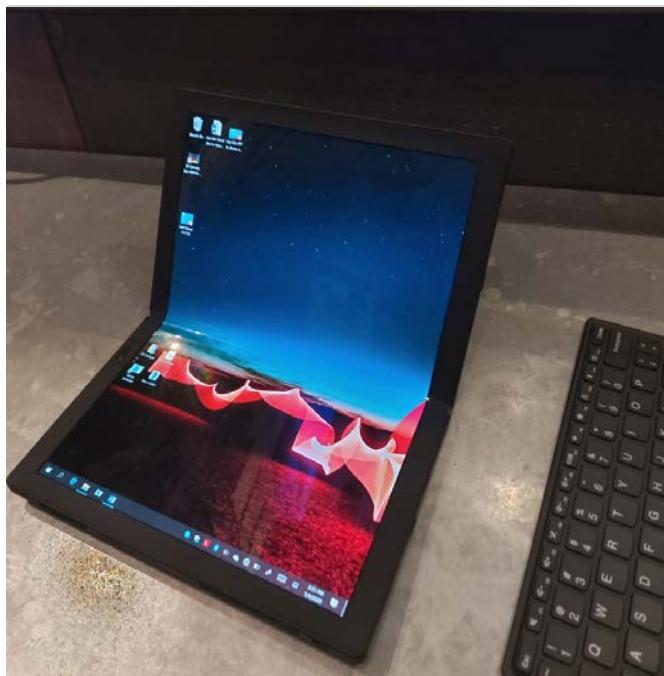
**Figure 6: HP Spectre 360 15 (OLED)**



Source: UBS

Foldable PCs also attracted a lot of attention with the Lenovo ThinkPad X1 Fold (previewed at Computex) and the concept Dell Ori (not confirmed to launch yet). We had an hands-on experience of the ThinkPad X1 Fold (13.3 inch plastic OLED from LGD) and found the touch keyboard responsive (option of mechanical keyboard magnetically attached on one side), could not see a cringe in the middle (after several days of CES use), and found the design robust and appealing (albeit on the thicker side). It will launch mid 2020 at U\$2,499. In addition to showing the Lenovo product in their press conference, INTC also showed a new demo concept called Horseshoe Bend – a 17" foldable PC with very strong battery life, per INTC. All in all, there is some way to go on pricing in particular, but we believe (more than we did pre CES) that this could be an emerging products category.

**Figure 7: Lenovo ThinkPad X1 Fold**



Source: UBS

**Figure 8: Dell Ori**



Source: UBS

New notebooks using Qualcomm came out from Asus and Lenovo as QCOM highlighted converging use cases between PC and smartphone in its press conference. 5G is starting to appear in PCs with Lenovo launching the Yoga 5G (to be released Spring 2020). Mediatek modems optimised for PCs should sample in 3Q20. Broader 5G adoption is expected in 2021/2022. This will be mmWave and sub-6 compatible with an eSIM solution.

**Figure 9: Laptops announced at CES 2020**

Company	Model	Launch date	Display (inch)	DRAM	NAND	CPU	OS	Retail Price (US\$)
Acer	Spin 5	Jun-20	13.5	Up to 16 GB	Up to 1 TB SSD	10th Gen, Intel Core i5 / i7	Windows 10	\$899
Acer	Spin 3	Apr-20	14	Up to 16 GB	Up to 1 TB SSD	10th Gen, Intel Core i3 / i5	Windows 10	\$699
Acer	Concept D 7 Ezel Pro	TBA	15.6	32 GB	2 TB SSD	Up to 10th Gen, Intel Core H-Series / Xeon	Windows 10	\$3,099
Acer	Concept D 7 Ezel	TBA	15.6	32 GB	2 TB SSD	Up to 10th Gen, Intel Core H	Windows 10	\$2,699
Acer	TravelMate P6	Feb-20	14	Up to 24 GB	Up to 1 TB SSD	Up to 10th Gen, Intel Core i7	Windows 10	\$1,150
Acer	Swift 3 SF314-42	May-20	14	Up to 16 GB	128/ 512 GB SSD	Ryzen 7 4700U	Windows 10	\$599
Acer	Swift 3 SF313-52/G	Mar-20	13.5	Up to 16 GB	Up to 1 TB SSD	Up to 10th Gen, Intel Core i7	Windows 10	\$699
Asus	Vivobook S13	1H20	13	Up to 16 GB	256/ 512 GB SSD	Up to 10th Gen, Intel Core i7	Windows 10	TBA
Asus	Vivobook S14	2Q20	14	Up to 16 GB	Up to 1 TB SSD	Up to 10th Gen, Intel Core i7	Windows 10	TBA
Asus	Vivobook S15	2Q20	15	Up to 16 GB	Up to 1 TB SSD	Up to 10th Gen, Intel Core i7	Windows 10	TBA
Asus	Chromebook Flip C436	Mar-20	TBA	Up to 16 GB	TBA	Up to 10th Gen, Intel Core i7	ChromeOS	TBA
Asus	Vivobook 14	TBA	14	Up to 16 GB	Up to 1 TB SSD	Up to 10th Gen, Intel Core i7	Windows 10	TBA
Asus	Vivobook 15	TBA	15	Up to 16 GB	Up to 16 GB	Up to 10th Gen, Intel Core i7	Windows 10	TBA
Asus	Zenbook Duo	1Q20	14 +12.6	16 GB	1 TB SSD	10th Gen, Intel Core i7	Windows 10	TBA
Asus	Zephyrus G14	TBA	14	Up to 32 GB	Up to 1 TB SSD	Ryzen 7 Processors	Windows 10	TBA
Dell	XPS 13 (9300)	Jan-20	13.4	4/8/16/32 GB	256G/512GB SDD 1TB HDD	Up to 10th Gen Intel Core i7-1065G7	Windows 10	\$1,000
Dell	XPS 13 Dev. Edition 2020	Feb-20	13.4	4/8/16/32 GB	256GB/512GB SSD 1TB HDD	Up to 10th Gen Intel Core i7-1065G7	Ubuntu 18.04 LTS	\$1,200
Dell	Latitude 9510	Mar-20	15	Up to 16 GB	Up to 1 TB SSD	10th Gen, Intel Quad-core	Windows 10	\$1,799
Dell	G5 15 Special Edition	Apr-20	15.6	TBA	Up to 1 TB SSD, 2TB HDD	3rd Gen, AMD Ryzen 4000 H-Series	Windows 10	\$799
HP	Elite Dragonfly G2	Feb-20	13.3	Up to 16 GB	1/ 2 TB	10th Gen, Intel Core i3 / i5 / i7	Windows 10	TBA
HP	Spectre x360	Mar-20	15.6	Up to 16 GB	1 TB SSD	Up to 10th Gen, Intel Core i7	Windows 10	\$1,599
Lenovo	Legion Y740s	May-20	15.6	Up to 32 GB	Up to 1 TB SSD	Up to 10th Gen, Intel Core H	Windows 10	\$1,099
Lenovo	ThinkPad X1 Carbon Gen8	TBA	14	8/16 GB	Up to 2 TB SSD	10th Gen, Intel Core i5 / i7	Windows 10	\$1,499
Lenovo	ThinkPad X1 Carbon Yoga	TBA	14	8/16 GB	Up to 2 TB SSD	10th Gen, Intel Core i5 / i7	Windows 10	\$1,599
Lenovo	Yoga Creator 7	TBA	15.6	Up to 16 GB	Up to 1 TB SSD	Up to 10th Gen, Intel Core i7	Windows 10	TBA
Lenovo	Yoga Creator 5	TBA	15.6	Up to 16 GB	Up to 1 TB SSD	Up to 10th Gen, Intel Core i7	Windows 10	TBA
Lenovo	Ducati 5	Apr-20	14	8 GB	1 TB SSD	10th Gen, Intel Core i5	Windows 10	\$999
Lenovo	Yoga 5G	1Q20	14	8 GB	256/ 512 GB	Snapdragon 8cx	Windows 10	\$1,499
Lenovo	Yoga Slim 7	Apr-20	14 / 15	Up to 16 GB	Up to 1 TB SSD	AMD Ryzen 4000 series / 10th Gen, Intel Core i7	Windows 10	\$850
Lenovo	ThinkBook Plus	Mar-20	13.3 +10.8	8/16 GB	256/ 512 GB	10th Gen, Intel Core i7	Windows 10	\$1,199
Lenovo	ThinkPad X1 Fold	Summer 20	13.3	8 GB	Up to 1 TB SSD	Intel Core processor+Hybrid	Windows 10	\$2,499
MSI	Creater 17	TBA	17.3	TBA	TBA	Up to 10th Gen, Intel Core i9	Windows 10	TBA
MSI	Prestige 14	TBA	14	Up to 32 GB	1 TB SSD	Up to 10th Gen, Intel Core i7	Windows 10	TBA
MSI	MSI GS66	TBA	15.6	Up to 32 GB	Up to 2 TB SSD	Up to 10th Gen, Intel Core i9	Windows 10	TBA
MSI	MSI GE66 Raider	1Q20	15.6	TBA	TBA	Up to 10th Gen, Intel Core i9	Windows 10	TBA
NEC	Lavie Vega	Mar-20	15.6	8 GB	512GB SSD	9th Gen, Intel Core i7	Windows 10	\$2,099
NEC	Lavie Pro Mobile	Mar-20	13.3	8 GB	512GB SSD	8th Gen, Intel Core i7	Windows 10	\$1,599
Samsung	Galaxy Chromebook	1Q20	13.3	Up to 16 GB	Up to 16 GB	10th Gen, Intel Core i5	ChromeOS	\$999
Samsung	Galaxy Book Flex α	1H20	13.3	8/12 GB	256/ 512GB SSD	10th Gen, Intel	Windows 10	\$830

Source: Company announcements

## Semiconductors

### Memory

Our meetings confirmed that server DRAM pricing remains biased up in 1Q20 QoQ, whilst mobile down QoQ; the magnitude of the server DRAM increase being the

key variable in overall blended ASP changes. The inflection is expected to gather pace in 2Q20. Whilst server DRAM procurement continues to improve, the CPU refresh cycle also bears watching as even if Ice Lake is technically available in late 2020, we expect very low volumes, the bias remains more to the pushout side. How much of current inventory rebuild at server customers is hence sustainable is open for question.

Current negotiations in NAND may also result in modest upward bias in 1Q although we continue to forecast a mild "double dip" as the industry goes back to full capacity and Samsung adds capacity & aggressively transiton to 128L.

In that context, and responding to current procurement trends. Samsung is likely to add capacity in Pyeongtaek P1 in 2020 – both NAND and DRAM.

## **Non-memory**

Most of our meetings validated the ~Oct/Nov cyclical trough that is now in place and most semiconductor companies are optimistic on 2020 demand as downstream inventories have largely cleared and upstream should be aligned in CQ1:20. While there was nothing definitive on trade, most companies view the trade picture through more of a positive incremental lens.

We continue to see a lot of moving parts still though over the coming months including: 1) tightening of loopholes allowing many companies to resume substantial (in some cases like MU) shipments to Huawei; 2) broadened CFIUS jurisdiction starting mid Feb as final draft regulations should be out imminently per our experts; 3) final lists of "emerging technology" that will be subject to export control under ECRA of 2018 (likely narrowly defined and thus not very impactful for semis in a dollar sense); and 4) initial movement on lists of "foundational technology" that will be ultimately subject to export control under ECRA (likely defined more broadly (including potentially semis mfg equipment) and thus more impactful to the broad semis industry today in dollar terms before the licensing mechanism is ultimately streamlined).

## **Processors**

We met with major OEMs like DELL, HP and HPE. Regarding AMD penetration, recent INTC shortages are, at the margin, helping AMD in terms of client share though still mostly in SMB and consumer. Enterprise/commercial still seems to be a tougher nut for AMD to crack given significant peripheral investment by these companies around INTC's ecosystem.

On the server side, our meetings re-affirmed the notion that these customers are focused nearly wholly on performance so given AMD's clear advantages (largely process and memory channel-related), there is a solid runway for share gain. Even so, even HPE – who is acquiring some sizable (\$600-700MM) government contracts that CRAY won with AMD – was not suggestive of a significant inflection in enterprise penetration as large enterprises are still focused on warranty and reliability so will wait a bit longer before becoming more confident of AMD's execution. We continue to see more interesting opportunities for AMD on the cloud and hyperscale side as these customers are more mercenary in nature and less tied into the INTC hegemony.

## **AMD's key products announcements**

In a keynote by CEO Lisa Su, AMD reinforced the theme that, in addition to server, it is aggressively pushing best-in-class computing performance to key consumer markets as it continues to leverage 7nm. The company introduced 3<sup>rd</sup> gen Ryzen 4000 (industry's first 7nm notebook CPU), Radeon 5600XT (1080p gaming), and is leveraging its unique portfolio of CPU+GPU+software for better NB gaming performance. Lastly, it introduced Threadripper 3990x – the first 64 core desktop processor. AMD highlighted a slight performance advantage for Ryzen 4000 for notebooks on single-threaded workloads and >90% advantage for multi-threaded (though we note this is not against INTC's new NB parts). For Desktops, AMD highlighted a very substantial performance advantage for its new 3990x 3<sup>rd</sup> gen Threadripper – and at a substantially lower price – for very high-end workstation applications (rendering, etc.). AMD's performance advantages are tangible and proliferating, though we feel a significant portion of this relates to process – a factor that INTC could theoretically (and likely) nullify in part by much more aggressive outsourcing to TSMC and a big move to chiplet (this is already happening).

AMD also highlighted its burgeoning tier-1 ecosystem highlighted by MSFT (XBox), AAPL (Mac Pro), Sony (PlayStation), Google (Stadia, GCP), AMZN (AWS), TWTR, and all major PC OEMs. The company also again highlighted its three-pronged competitive advantage: 1) Ryzen/ Epyc cores that are better optimized for IPC, 2) process (7nm), and 3) manufacturability (chiplet mix/match architecture + Infinity fabric).

## **Qualcomm's Snapdragon Ride and push into AI Edge**

Qualcomm at CES announced Snapdragon Ride – new platform enabling QCOM to expand beyond telematics/infotainment and push more aggressively into compute for ADAS with scalability all the way from L2+ to L4+. Lastly, it announced a new inference solution for edge computing. The company highlighted 100m vehicles on the road today using QCOM technology (infotainment/telematics) and updated its overall design win pipeline to ~\$7bn. Most importantly, it is now pushing aggressively beyond connectivity and infotainment by launching Snapdragon Ride – a full software/hardware platform for ADAS with compatibility all the way to L4+. SD Ride will be available for development in 1H:20 with vehicles on the road by 2023 (we note still far behind both NVDA and INTC). Lastly, it is launching a new secure/connected autos services business for full lifecycle management on telematics/ADAS.

In Wireless, the recently announced Snapdragon 865 has seen 2x increase in design wins vs prior gen 855, enabling Oppo/Xiaomi to gain more traction in Europe. The company also highlighted 5G momentum pushing down to lower price points with the 765/765G now seeing 2.5x more design traction than prior gen 7-series. The company highlighted a new Snapdragon-based 5G PC from Lenovo, which highlights converging use cases between PC/smartphone in a 5G world.

QCOM also highlighted how 5G is changing the cloud and pushing more compute to the edge. It again highlighted the Cloud AI 100 for inference applications with >350TOPS of peak performance and announced the first deployment of its new 5G edge box using AI 100, scheduled to be deployed by a major CSP in 2H:20.

## TVs and Displays

### Transition year for the TV market waiting for further OLED penetration

CES 2020 was a relatively quieter year in terms of new TV product innovations, with largely more iterations of last year's key concepts. We think this in part have led the focus to of new products to tilt towards unique designs such as rotating TVs or industrial designs. We are concerned that ahead of Samsung moving some its products portfolio to QD Display (OLED) that price competition in the mid/high end TV market will intensify between QD LCD and the OLED segments.

Following last year's first introduction of a rollable TV, LG demonstrated a new rollable TV concept where the screen rolls down. Another interesting demonstration was a bendable OLED TV screen, where the flat screen can bend to turn into a curved screen better suited for gaming and other immersive use. OLED 88 inch 8K TV with strongly enhanced Cinematic Sound (previously referred to as Crystal Sound, where the OLED panel also serves as speakers), with up to 11 vibrators in a film type on the back of the panel, for more immersive sound experience while keeping the thin form factor.

We also note incremental improvements being made from the LCD TV camp. Samsung showcased a bezel-less 8K QLED TV (Q950TS) which comes with almost no visible bezel. TCL and others rolled out more mini-LED backlit LCD TV line ups, with up to 4,000 local dimming zones to provide better black similar to that of OLED TVs.

On the commercial side, Samsung's The Wall Micro-LED display continued to stand out and attract a lot of attention. LG also showcased different ways to leverage OLED for commercial display, with the use of transparent OLED for retails standing out the most.

**Figure 10: LG Rollable Waterfall**



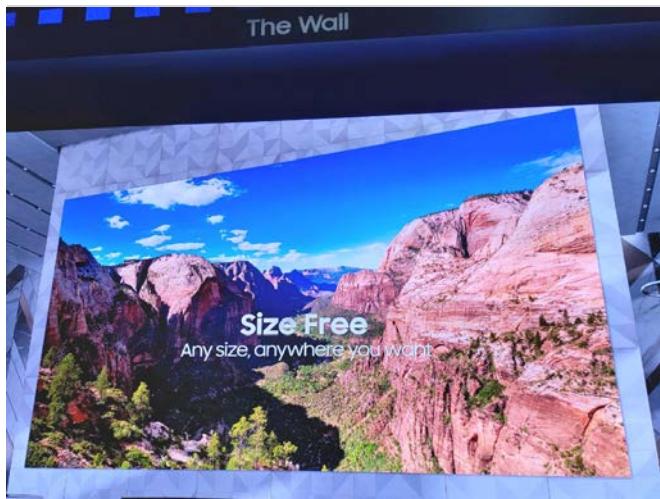
Source: UBS

**Figure 11: Samsung Sero rotating TV**



Source: UBS

**Figure 12: Samsung “The Wall”**



Source: UBS

**Figure 13: Skyworth transparent OLED**



Source: UBS

## Large panels OLED

Following the delay in its Guangzhou OLED fab ramp, we estimate LG Display's OLED TV panel unit output for 2020 has been lowered to 6.3-6.5mil from 7mil before, and for 2021 9mil from 10mil before. The fab will now ramp more gradually to reach 90k capacity by end-2020, for full production starting from 2021. The rollout of Multi Mode Glass (MMG) capability in China will also allow for 48 inch alongside 77 inch. LGD expects to maintain ASPs per panels around US\$700-720. However, considering pricing competition with QD LCD, we believe this is a potentially optimistic goal.

For Samsung's QD Display, recent equipment order filings from the supply chain suggest Samsung Display likely has fixed the final equipment process steps for the first 30k spm capacity mass production line. With the equipment installation largely scheduled from Aug 2020 and assuming no meaningful mis-execution, we think this sets Samsung up to come out with the initial TV product by 2021.

## Large panels LCD

LG Display's new CEO announced in a press conference during CES that the company intends to stop making LCD TV panel production from its remaining LCD capacity in Korea. The company aims to shift application from the capacity more towards IT/commercial which they assess are less commoditized. As for the LCD panel demand for key customers, LG Display will support this mainly from its China fab which is relatively better suited to compete with the Chinese panel makers' gen 10.5 fabs in terms of cost structure.

We think the magnitude or the pace of LCD capacity reduction is unchanged from what transpired back last September ([link](#)) (still aiming to reduce 50% of its gen 7 and gen 8.5 LCD capacity in P7 and P8 Korea fabs by end-2020), so we do not see this changing the overall large LCD industry supply/demand dynamics. With the intent to shift the remaining Korea capacity's allocation away from TV panels and towards IT/commercial, however, we believe this could be supportive for select LCD TV panel price dynamics for the nearer term.

## Automotive displays

We see automotive displays as a market that is still niche but with attractive and meaningful longer term opportunities. In that context, CES 2020 provided a more eye-catching display innovations visible in the automotive than for TVs, enabled mainly by flexible OLED. Across various automotive cockpit demonstrations and recent product launches, we could see the average screen sizes getting larger and more number of displays per vehicle being incorporated. We see new technologies potentially enabling display adoption in new real estates within a vehicle longer term – 1) display panel with multi-curvature that can allow more seamless design integration, and 2) transparent display that can potentially turn the windshield into a screen to display information, as showcased by Audi. While the latter is faced with heavier technological challenges such as further improving the transparency and overcoming the brightness etc, these altogether present new opportunities for the automotive display TAM to further expand.

**Figure 14: TVs announced at CES 2020**

Companies	Model	Availability	Size (inch)	Display	Starting Price
HiSense	R8F ULED	Jan-20	55 / 65	ULED	\$500
Konka	X11	Spring 20	55 / 65	OLED	TBA
Konka	Q7	Spring 20	50 / 55 / 65 / 75	Quantum Dots	\$700
Konka	U5	Spring 20	43 / 50 / 55 / 65 / 75	LCD	\$400
Konka	H3	Spring 20	32 / 40	LCD	\$200
Konka	H3	Spring 20	32 / 40	LCD	\$200
Konka	8K OLED	Prototype	88	OLED	Prototype
Konka	4K MicroLED	Prototype	118 / 236	MicroLED	Prototype
Konka	8K LED	Prototype	75	LED	Prototype
LG	GX Signature Series	TBA	55 / 65 / 77	OLED	TBA
LG	CX Series	TBA	48 / 55 / 65 / 77	OLED	TBA
LG	BX Series	TBA	55 / 65	OLED	TBA
LG	WX Signature Series	TBA	65	OLED	TBA
LG	ZX Signature Series	TBA	77 / 88	OLED	TBA
LG	RX Signature Series	Summer 20	65	OLED	\$60,000
Panasonic	HZ2000	Summer 20	55 / 65	OLED	TBA
Samsung	Q950	TBA	65 / 75 / 85	QLED	TBA
Samsung	The Wall	TBA	88 / 93 / 110 / 150	MicroLED	TBA
Samsung	The Frame	TBA	32 / 75	QLED	TBA
Samsung	Sero	TBA	43	QLED	TBA
Skyworth	W81	TBA	65 / 77	OLED	\$3,599
Skyworth	Q91	TBA	75	OLED	\$5,999
Sony	Z8H 8K	TBA	75 / 85	LED	TBA
Sony	MASTER A9S	TBA	48	OLED	TBA
Sony	A8H	TBA	55 / 65	OLED	TBA
Sony	X950H	TBA	49 / 55 / 65 / 75 / 85	LED	TBA
Sony	X900H	TBA	55 / 65 / 75 / 85	LED	TBA
TCL	8-Series 8K TV	Summer 20	65 / 75	LED	TBA
Vizio	P-Series Quantum X (PX)	TBA	65 / 75 / 85	Quantum Dots	TBA
Vizio	P-Series Quantum (P9)	TBA	65 / 75	Quantum Dots	TBA
Vizio	M-Series (M8 and M7)	TBA	50 / 55 / 65	Quantum Dots	TBA
Vizio	V-Series	TBA	40/43/50/55/58/60/65/70/75	LCD	TBA
Vizio	Vizio OLED	TBA	55 / 65	OLED	TBA

Source: Company announcements

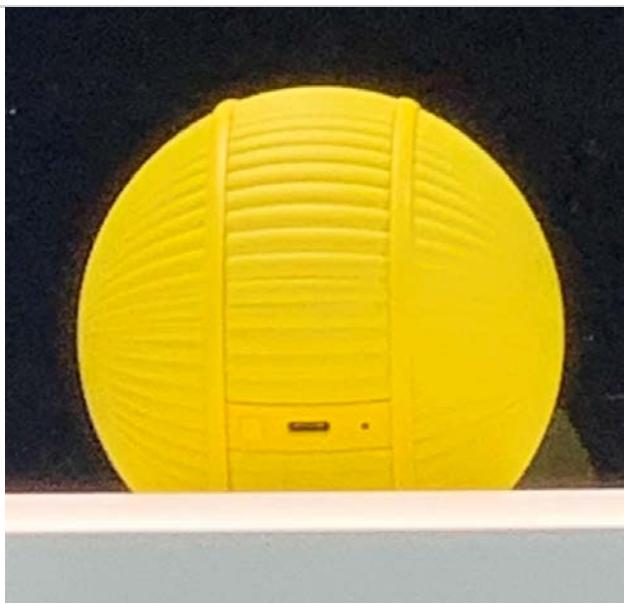
## AI/IoT/Smart Homes & Smart Cities

CES 2020 appeared to outline a digestion phase in how AI and IoT change users experiences. AI assistants have well proliferated in consumer electronics, smart speakers, appliances, cars and phones. Key ecosystems are established, but will remain fragmented, with still many legacy software environments to deal with. This continues to create hurdles in how to achieve the next stage of personalisation for how end users benefit from AI-enabled applications. But this also remains a key focus for major tech companies.

### Samsung:

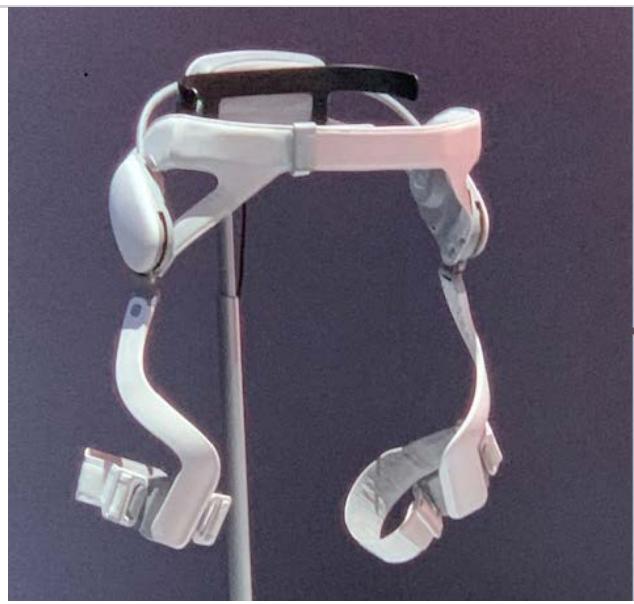
Samsung showcased a concept product named "Ballie", a round ball-shaped robot powered by artificial intelligence (AI) that can function as a personalized home assistant, control for other smart home devices, and more. The company also stressed on On-Device AI as a key enabler to providing truly personalized experience and demonstrated concepts of intelligent home (more personalized, blurring the boundaries between digital and physical, intelligent kitchen and living room) and smart city (smarter buildings, smarter commute enabled by 5G telematics, Edge Compute, and AI).

**Figure 15: Samsung Ballie**



Source: UBS

**Figure 16: Samsung GEMS**



Source: UBS

### LG Electronics:

LGE's AI strategy remains to bring its ThinQ platform across all of its products and services over time. It sees 4 stages: Efficiency improvement, personalization, reasoning and exploration. So far user cases (e.g. appliances learning from prior uses, users' preferences etc.) extend to the first three stages with exploration requiring new data sets beyond initial training sets. LGE intends to roll out AI-enabled proactive customer care across 1mil appliances by 2021 which optimise usage of appliances as well as maintenance. AI ThinQ washers and dryers will

detect load weights and volumes as well as fabrics to determine optimum cycles. ThinQ ovens will offer InstaView and Air Fry with no pre-heating required.

### **Toyota:**

Toyota announced "woven city" where Toyota will design and test completely connected and environmentally sustainable Ecosystem. The place is at the base of Mt Fuji in Japan and currently used as its vehicle assembly plants which will be closed at the end of 2020. The purpose of building a new city from scratch is to test key mobility eco system including autonomous driving, electrification, hydrogen system, robotic and AI. There are several places or cities under construction to test autonomous driving or connected city vehicle in the world, but Toyota's project will be in a private land lead by a private company.

It is too early to evaluate it as positive or negative on its earnings or share price. As many big companies at CES even ex-automobile companies discussed "Smart City" as one of the key ward, it will be a good opportunity to see ideal city(=smart city) and its role in the city as a mobility company.

## **AR/VR**

Overall we saw more pervasion of AR-related devices from the floor. Samsung's keynote gave a sneak peak of its prototype AR glasses when demonstrating a virtual personal training experience in use together with its GEMS exoskeleton wearable. Lenovo also showcased its ThinkReality A6 AR headsets running in Qualcomm Snapdragon 845 SoC and Android OS, for mainly custom B2B applications. One interesting product was Norm Glasses from Human Capable – AR smart glasses with simpler function but better designs and intended for general consumers.

That said, most of the AR presence remained niche and towards B2B solutions as the industry awaits for more clarity on the mainstream future use cases. While many await for Apple AR glasses to show the way, we do not think the product will be out until 2021 at the earliest if not 2022.

**Figure 17: Lenovo ThinkReality A6 AR glasses**



Source: UBS

**Figure 18: Human Capable Norm Glasses**



Source: UBS

## Automotive

### Sony showcasing automotive tech capabilities

Sony announced during its press conference its Vision-S electric concept car. The concept vehicle comes with strong emphasis on safety and Sony's intent to demonstrate its automotive sensor capabilities in full stretch – equipped with in total 33 automotive sensors (13 cameras, 17 radars, and 3 LiDARs) inside and outside the vehicle to provide oval sensing in the context of Sony's "Safety Cocoon" concept. By combining the use of camera, radar, and LiDAR altogether and using the combined raw data generated to extract the optimal amount of features, Sony claims its Sensor Fusion technology improves recognition accuracy further vs conventional method, even in challenging external conditions.

Sensor fusion in Auto is a long term narrative to Sony's semi growth. Today, we are not counting on a strong growth story from auto, even though we are quite positive on smartphone demand for next 2~3 years, as 90% of Sony's CMOS sensor business today comes from smartphones. Sony has little market share in Auto CMOS sensor with Omnicision and Onsemi dominating the market. We think the main technology specification for Auto (less resolution, severe test process) does not match with Sony's process today (high resolution). When ADAS with sensor Fusion becomes ready in the future, we believe it will then turn into a key driver with Sony aggressively gaining market share.

### Hyundai gets elevated with Uber

Hyundai Motor, in cooperation with Uber Elevate, made an eye-catching announcement of its air mobility concept S-A1. The concept product uses 9 smaller propellers to make the noise quiet enough for urban use, and relies on Hyundai's manufacturing experience and capability to make it safe and affordable.

**Figure 19: Sony Vision-S electric concept car**



Source: UBS

**Figure 20: Hyundai Motor S-A1**



Source: UBS

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<b>Neutral</b>	FSR is between -6% and 6% of the MRA.	41%	29%
<b>Sell</b>	FSR is > 6% below the MRA.	15%	20%
Short-Term Rating	Definition	Coverage <sup>3</sup>	IB Services <sup>4</sup>
<b>Buy</b>	Stock price expected to rise within three months from the time the rating was assigned because of a specific catalyst or event.	<1%	<1%
<b>Sell</b>	Stock price expected to fall within three months from the time the rating was assigned because of a specific catalyst or event.	<1%	<1%

Source: UBS. Rating allocations are as of 31 December 2019.

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<b>Applied Materials Inc</b> <sup>16b, 20</sup>	AMAT.O	Sell (CBE)	N/A	US\$61.47	10 Jan 2020
<b>Casetek Holdings</b>	5264.TW	Sell	N/A	NT\$45.85	10 Jan 2020
<b>Catcher Technology</b>	2474.TW	Buy	N/A	NT\$236.00	10 Jan 2020
<b>Chipbond Technology</b>	6147.TWO	Sell	N/A	NT\$64.90	10 Jan 2020
<b>Global Unichip</b>	3443.TW	Buy	N/A	NT\$250.50	10 Jan 2020
<b>GlobalWafers</b>	6488.TWO	Neutral	N/A	NT\$379.00	10 Jan 2020
<b>GoerTek</b>	002241.SZ	Sell	N/A	Rmb21.28	10 Jan 2020
<b>Hirose Electric</b>	6806.T	Sell	N/A	¥14,200	10 Jan 2020
<b>Infineon Technologies AG</b> <sup>18</sup>	IFXGn.DE	Buy	N/A	€21.42	10 Jan 2020
<b>KLA Corporation</b> <sup>16b</sup>	KLAC.O	Sell	N/A	US\$173.01	10 Jan 2020
<b>LAM Research Corp</b> <sup>16b</sup>	LRCX.O	Sell	N/A	US\$294.34	10 Jan 2020
<b>Lens Technology</b>	300433.SZ	Buy	N/A	Rmb16.05	10 Jan 2020
<b>LG Display</b> <sup>16b</sup>	034220.KS	Neutral	N/A	Won15,900	10 Jan 2020
<b>LG Innotek</b>	011070.KS	Buy	N/A	Won148,500	10 Jan 2020
<b>Melexis NV</b>	MLXS.BR	Sell	N/A	€67.25	10 Jan 2020
<b>Murata Manufacturing</b>	6981.T	Buy	N/A	¥6,884	10 Jan 2020
<b>Nokia</b> <sup>13, 16b</sup>	NOKIA.HE	Buy	N/A	€3.65	10 Jan 2020
<b>NVIDIA Corp</b> <sup>16b, 22</sup>	NVDA.O	Buy	N/A	US\$244.32	10 Jan 2020
<b>O-Film Tech</b>	002456.SZ	Sell	N/A	Rmb16.01	10 Jan 2020
<b>Pegatron</b>	4938.TW	Sell	N/A	NT\$67.00	10 Jan 2020
<b>Samsung SDI</b>	006400.KS	Buy	N/A	Won249,000	10 Jan 2020
<b>Semiconductor Manufacturing Intl Corp</b> <sup>2, 4, 5, 16a, 20</sup>	0981.HK	Neutral (CBE)	N/A	HK\$12.96	10 Jan 2020
<b>Sharp</b>	6753.T	Sell	N/A	¥1,734	10 Jan 2020
<b>Sony</b> <sup>7, 13, 16b, 22</sup>	6758.T	Buy	N/A	¥7,843	10 Jan 2020

Company Name	Reuters	12-month rating	Short-term rating	Price	Price date
<b>Sunny Optical Technology</b> <sup>4, 16a</sup>	2382.HK	Buy	N/A	HK\$142.00	10 Jan 2020
<b>Taiwan Semiconductor Manufacturing</b> <sup>16b</sup>	2330.TW	Buy	N/A	NT\$339.50	10 Jan 2020
<b>TDK</b>	6762.T	Buy	N/A	¥12,550	10 Jan 2020
<b>Texas Instruments Inc</b> <sup>16b</sup>	TXN.O	Sell	N/A	US\$130.00	10 Jan 2020
<b>Wistron Corporation</b>	3231.TW	Sell	N/A	NT\$28.75	10 Jan 2020

Source: UBS. All prices as of local market close.

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