The Source Code

2021 Outlook: Let's Get Cyclical

Last year at this time, we were saying that the economic outlook really hinged on the outcome of China trade negotiations and that we wanted to stay cautious on cyclical names. That turned out beneficial because of COVID-19. Now we believe that the economic outlook hinges on COVID-19 vaccine efficacy and availability, but we are turning bullish on cyclically sensitive software, as the J.P. Morgan economists see the economic upturn starting in the second quarter.

- **In 2020, our coverage delivered 62% through the end of November, as compared to 12% for the S&P 500**. It has been another tremendous year for software, as demand held strong throughout the pandemic and valuations expanded significantly with capital coming in from other sectors.

- **Vaccine efficacy and questions over sector rotation will be key to 2021 performance**. Looking ahead, there is a scenario where improving economic expansion could motivate capital to rotate back out of software in favor of lower valuation cyclical segments that will benefit from economic improvement. Much of that will hinge on the success of vaccines to effectively open up the economy more broadly.

- **Turning positive on cyclically sensitive software – upgrading ALTR, ADSK, CDNS, PTC, VRSN, WIX, INTU.** The economic expansion is expected to be driven by the manufacturing sector, and that should favor the design software names in our coverage. On the SMB front, we have already started to see increasing business starts that could continue into 2021 on the back of favorable interest rates and the potential for a more open economy post COVID-19.

- **Downgrading premium multiple names and secularly challenged – CRWD, OKTA, NET, ZM, DOCU, AVLR, VEEV, CHKP, PANW, FTNT, SCWX, PS, MODN, SSNC**. Looking back at 2009-2010 coming out of the economic downturn, the highest multiple names as a group underperformed the software industry. We believe this occurred as the good news on performance had already been factored into premium valuation stocks, while an improving economy offered potential to boost fundamentals and create a reversion to the mean trade.

- **Top picks – Varonis (VRNS) and RingCentral (RNG).** Both companies have the potential to show accelerating revenue growth, VRNS on the back of its subscription transition and healthy demand for data protection solutions and RNG from the increasing contribution of the partnership agreements signed over the last 12 to 15 months. RNG is well-positioned to capitalize on the secular trend of telephony to the cloud, where there are over 400 million legacy on-premise users who could transition to the cloud in coming years.

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SMid Cap Research
THINK BIG, BUY SMALL

See page 148 for analyst certification and important disclosures.

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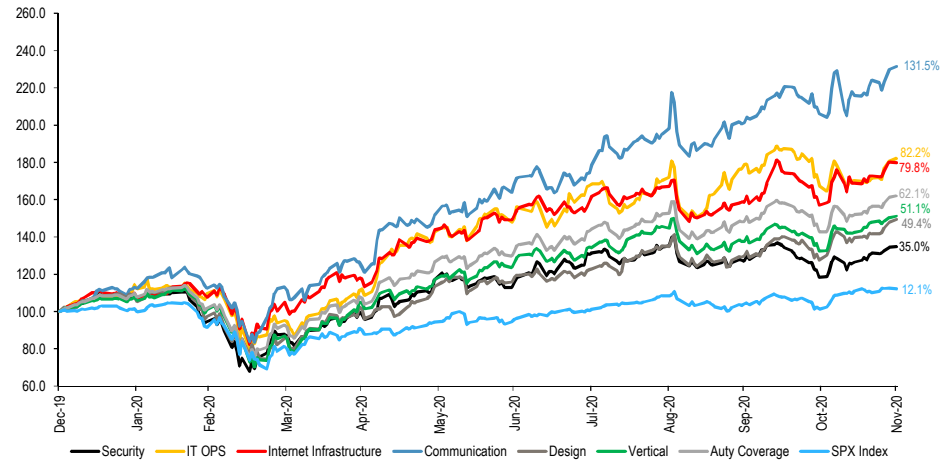
Executive Summary

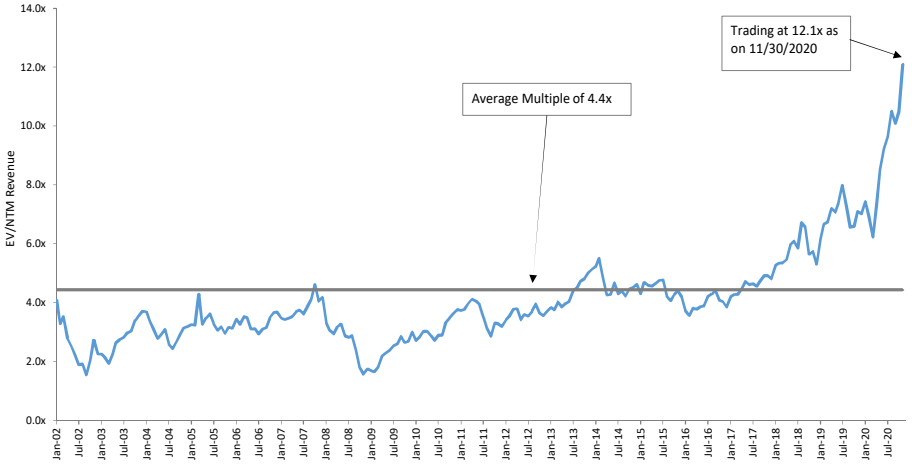
In 2020 we saw another year of significant outperformance from the software sector as the shift to work from home/anywhere and digital transformations supported demand, while growth, durable cash flow and highly visible business models attracted capital. The industry now stands significantly above its long-term average valuations on revenue and cash flow. While we expect the demand environment heading into 2021 to be good, we believe effective vaccines will help open up and drive global coordinated economic expansion that favors more cyclically sensitive companies. Our focus heading into 2021 as it relates to the stocks we favor will be on the cyclically sensitive design and SMB exposed vendors, combined with subscription transition and other names with potential revenue acceleration. We are deemphasizing our bullish stance on stocks trading over 20x revenue, as the highest multiple stocks in software tended to underperform in 2010 coming out of the 2009 recession.

Figure 1: 2020 Performance by Segment



Source: Bloomberg Finance L.P. as of 11/30/2020.

Figure 2: Valuation at All Time Highs



Source: Company reports, J.P. Morgan estimates, Bloomberg Finance L.P.

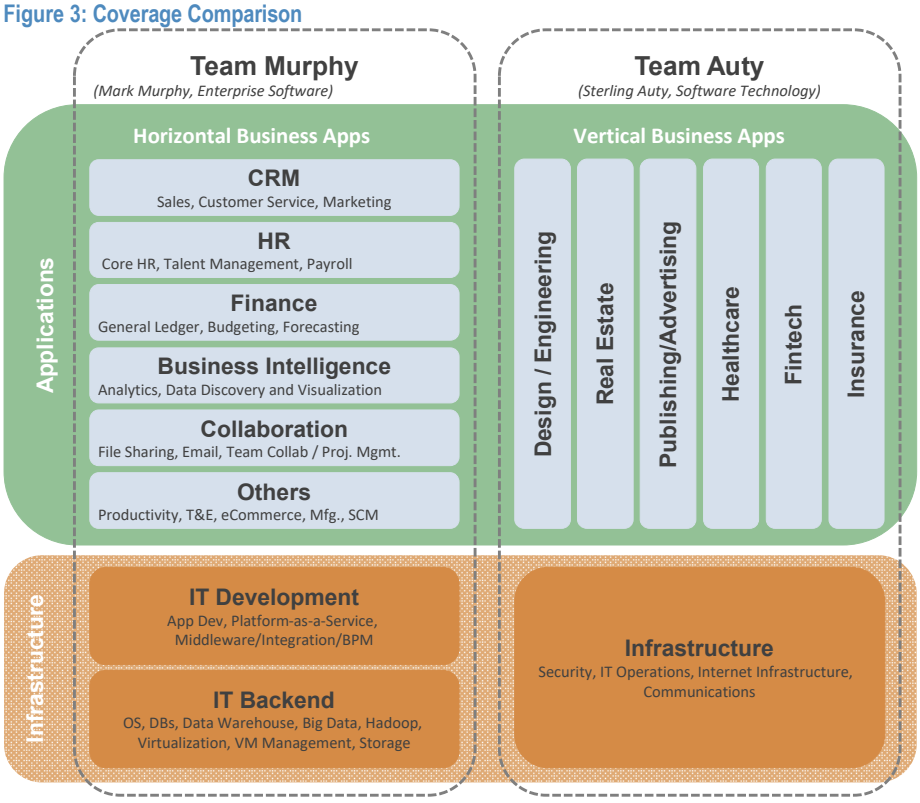
Table 1: Software Coverage Universe

Segment	Stocks	Outlook
Vertical Applications		
Publishing & Advertising	ADBE	Improvement in marketing and advertising on the back of economic expansion could lead to better demand for Adobe Digital Experience, while the new Workfront acquisition finally brings a truly synergistic product that connects Creative Cloud and the Digital Experience sides of the business.
Design	ADSK, ALTR, ANSS, AZPN, CDNS, PTC, SNPS	The manufacture and construction sectors are expected to be a core engine for economic expansion favoring MCAD and simulation solutions. EDA being an early cycle cyclical industry has already experienced an uptick, so we will be watching the durability of that demand.
Financial Services	AVLR, INTU, QTWO, SSNC	Improving economic outlook should benefit e-commerce transactions, and low interest rates favors new business creation that could help AVLR and INTU. QTWO could see improving demand for its lending and account opening solutions, while SSNC will be looking for a rebound in its investment management business and continued AUM growth.
Healthcare/Life Sciences	VEEV	A lot will depend on the outcome of the runoff elections in Georgia. A blue sweep could bring risk of drug price reform pressuring core pharmaceutical customers. But a mix result or red sweep could keep that risk in-check allowing government funding of NIH to help spur increase research that benefits the clinical portion of the Vault product line.
Online Learning	PS	Couple more quarters of potential deceleration as the subscription model looks for a turn. Improving employment and economy where companies can look to invest in training solutions is what will be needed as 2021 progresses.
eSignature	DOCU	International expansion, electronic notary, and penetration into the US federal sector should all help topline growth in 2021.
Real Estate	CSGP, RP	Expansion down-market and multifamily housing, addition of residential solutions, and the Ten-X acquisition for the sale of distressed properties benefit the growth profile in 2021 for CSGP. RP will be looking to get past the contact center headwinds and focusing on chat bots and other leasing solutions that could help propel organic growth back into the double digits.
Insurance	GWRE, DCT, SPNS	The key question will be the pace of cloud migrations and whether the hardening phase in P&C can continue to provide the healthy financial reserves that make it easier for carriers to move forward on system modernization projects. GWRE will continue to modernize its platform, DCT will look to expand internationally, and SPNS will aim to capitalize on 2020 acquisitions to further its European presence and shift to product/cloud revenue.
Infrastructure		
Security	CHKP, CYBR, CRWD, FEYE, FTNT, MIME, OKTA,PANW, QLYS, SCWX, TENB, TUFN, VRNS, ZS	Increasing percentage of cybersecurity budgets will likely shift to cloud security at the expense of on-premise network security and messaging security. Growing adoption of security solutions that support a Zero Trust for SASE architecture that includes identity, endpoint, and access control solutions.
IT Operations	DDOG, DT, EVBG, JAMF, FROG, NEWR, NOW, PD, SWI	Digital transformations should continue to be a key topic as companies across all industries in the economy look to automate more business processes utilizing software developed for those specific purposes. Workloads will continue to shift to the cloud, but companies will focus increasingly on managing cloud container and virtual host expansion to avoid unintended costs.
Internet Infrastructure	AKAM, NET, GDDY, VRSN, WIX	Improving small business creation could increase demand for domain names, website creation tools, e-commerce platforms, payment solutions, web performance and security. But a more open economy and tougher compares for CDN traffic as Disney +, Apple and other OTT launches annualize will need 5G and 4K pickup to help growth.
Communications	DOX, FIVN, RNG, VG, LPSN, ZM	The secular shift to the cloud and adoption of UCaaS/CCaaS are likely to continue as companies prepare to handle more flexible work arrangements and future pandemic environments. Adoption of 5G creates new project opportunities with carriers.

Price and Revenue Management	PRO, MODN	The demand for pricing and revenue solutions is slowing, with both PRO and MODN seeing customers look to ramp deal structures, which has stunted bookings and RPO growth. For PRO, we view the vaccine timing as a positive for its travel/airline customers, but industry and JPM analysts do not anticipate pre-COVID traffic levels for a number of years.

Source: J.P. Morgan Research.

Figure 3: Coverage Comparison



Source: J.P. Morgan Research

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Cycle and Investing in Software

Our J.P. Morgan U.S. Economics team is forecasting continued economic contraction through the March quarter but then significant expansion beginning in the June quarter, with GDP growth finishing at 3.4%.

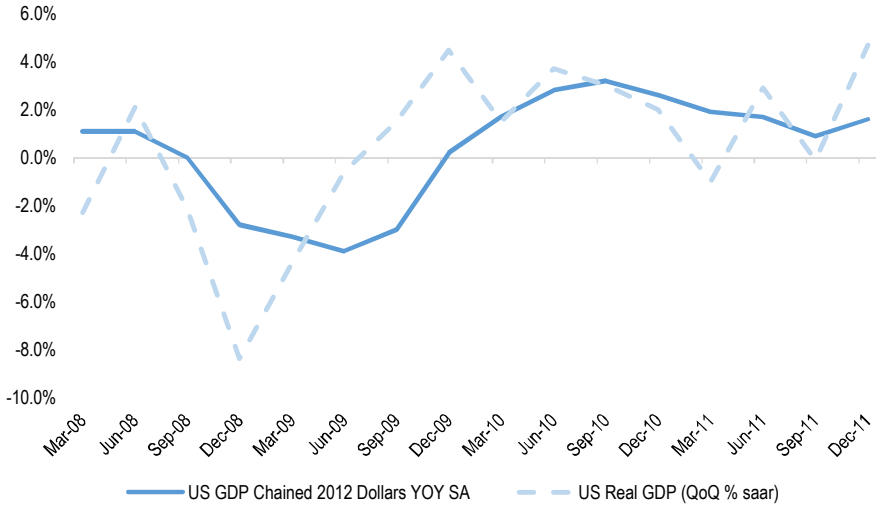
Table 2: JPM US Economic Forecasts

		Forecasts						
	3Q20	4Q20	1Q21	2Q21	3Q21	4Q21	2020 %q4/q4	2021 %q4/q4
Real GDP (%q/q, saar)	33.1	2.8	-1.0	4.5	6.5	3.8	-2.8	3.4
Real consumer spending (%q/q, saar)	29.2	2.7	0.7	4.2	5.1	3.4	-2.3	4.0
Core PCE prices (%q/q, saar)	3.5	1.5	1.6	1.6	1.7	1.7	1.5	1.6
Unemployment rate (%, qtr avg)	8.8	7.1	7.4	6.8	5.9	5.6		
Fed funds target (%, top of range)	0.25	0.25	0.25	0.25	0.25	0.25		

Source: J.P. Morgan US Economic Research Estimates

This reminds us of 2009 and 2010, as you can see in the chart of GDP below.

Figure 4: GDP Growth 2008-2011



Source: Bloomberg Finance L.P.

What did not work in 2010 is premium valuation software stocks

Looking back at 2010 as a reference point, we found that the 20 most expensive names on a revenue multiple basis actually underperformed the overall software industry, as shown in Table 3 below.

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Table 3: Most Expensive Names in 2009 Underperformed in 2010

Ticker	2010 Performance	2009 EV/Sales
MELI	28.5%	8.8x
ANSS	19.8%	6.6x
VMW	109.8%	6.6x
CAVM	58.1%	6.5x
AKAM	85.7%	3.7x
DLB	39.7%	6.2x
CNQR	21.5%	6.1x
RHT	47.7%	5.9x
ATHN	-9.4%	5.7x
SAP	9.6%	5.2x
CHKP	36.5%	5.2x
AZPN	29.6%	5.1x
ADBE	-16.3%	5.1x
FIRE	-3.0%	4.9x
N	56.4%	4.8x
ORCL	28.6%	4.7x
CTXS	0.0%	4.0x
NUAN	17.1%	4.0x
MSFT	-6.5%	3.9x
TYPE	22.9%	3.8x
Average	28.8%	5.3x
Software Universe	44.3%	3.1x
Underperformers	15	
Outperformers	5	

Source: Bloomberg Finance L.P.

Top performers in 2010 mainly traded below industry multiples

We then looked at the 20 best performing stocks in 2010 and found the EV/Sales valuation tended to be at or below the overall software industry average. Interestingly, the industry average revenue multiple was 3.1x as compared to 12.1x at the end of November this year. The conclusion we draw is that we believe the market starts to focus on the improving economy driving fundamentals for the lower multiple stocks, causing a reversion to the mean trade.

Table 4: 2010 Outperformers Traded Below Industry Multiple

Ticker	2010 Performance	2009 EV/Sales
APKT	383%	3.1
RVBD	206%	2.8
RP	181%	NA
BSFT	165%	NA
ZIXI	150%	2.6
SPRT	145%	1.1
LOGM	122%	3.5
VMW	110%	6.6
TIBX	105%	2.1
DMRC	100%	NA
TIVO	95%	6.4
ARBA	88%	2.7
AKAM	86%	3.7
FTNT	84%	3.3
CRM	79%	NA
SMSI	72%	2.0
SNCR	69%	2.8
CALD	67%	0.8
ULTI	66%	3.0
VRNT	65%	1.8
Average	122%	3.0

Source: Bloomberg Finance L.P.

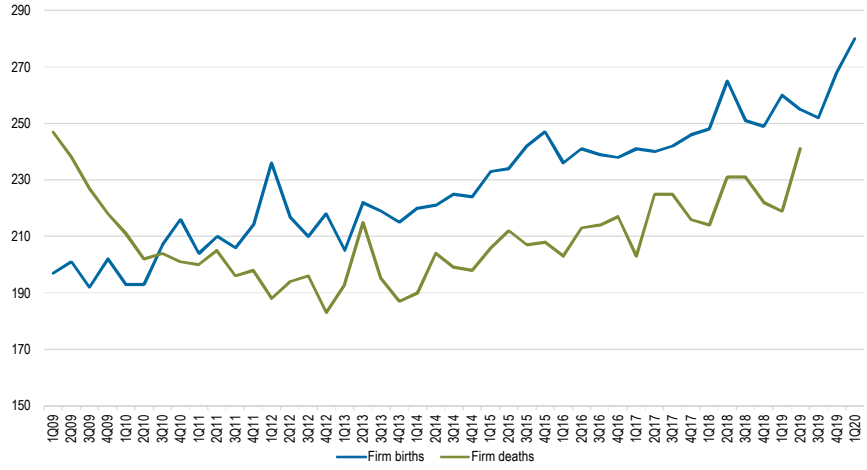
Prefer cyclically sensitive names like design and SMB-exposed stocks

Heading into an expansionary phase in the economy, we believe cyclically sensitive names like design and SMB-exposed companies could see improving growth profiles that create stock-price outperformance. Our J.P. Morgan economics team expects the manufacturing sector to be the core engine of expansion throughout 2021, and we are already seeing signs of new business creation in the data and believe that can continue on the back of low interest rates in the new year.

Births and deaths heading in a positive direction

The Bureau of Labor Statistics tracks the number of new companies created (births) and the number of businesses that close (deaths) on a quarterly basis. The deaths are reported on a three-quarter lag basis, but we can already see positive trends in births. This can provide in improving backdrop for SMB-exposed software companies.

Figure 5: Business Births and Deaths by Quarter – Births Growing



Source: BLS.gov.

New business applications spiked in 3Q20

Another supporting data point that we have heard investors talking about comes from the Census Bureau, which showed a significant spike in new business applications during the September quarter.

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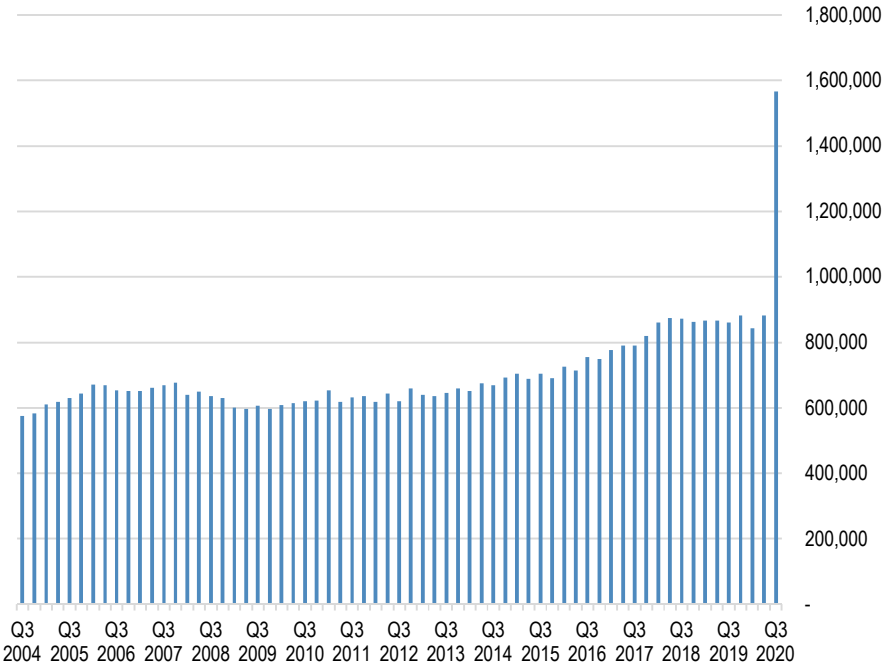
Figure 6: New Business Applications



Source: Census.gov.

Bull and Bear Case

On the following pages, we outline the bull and bear case for each of our stocks under coverage. This helps investors get a quick synopsis of how other investors are looking at each name.

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Table 5: Bull & Bear Arguments across Software Technology

Company	Ticker / Price	Rating	Bull	Bear
Publishing & Advertising				
Adobe	ADBE / $495.28	OW	– Dominant Creative Cloud competitive position – Operating margins over 40% and still expanding – Potential to grow through both volume and price increases	– Creative Cloud growth has decelerated below 20% – Digital Experience growth and execution has been inconsistent
Online Learning				
Pluralsight	PS / $18.10	UW	– Secular trend towards self-driven online learning and away from instructor led training – Competitive position	– Decelerating revenue growth – Inconsistent execution – Consumer exposure and growth
Electronic Signature				
DocuSign	DOCU / $234.82	N	– Secular adoption of the signature – Category leader – International expansion – E notary	– Competition with Adobe – Agreement cloud adoption has not been faster – Valuation
Design				
Altair	ALTR / $55.08	OW	– A rebound in automotive and aerospace manufacturing spurs demand – Revenue acceleration led by software subscriptions – Cross-selling data and engineering	– Second wave leads to another downshift in manufacturing spend – Cash flow margin expansion does not materialize as expected
Ansys	ANSS / $341.28	UW	– Broadest portfolio in simulation – Margins can weather any downturn – M&A firepower to pick up attractive assets that come for sale	– Organic revenue far below the industry growth rates – Margin compression does not lead to growth pick up – Most expensive name in the industrial peer group
Aspen Technology	AZPN / $133.78	N	– Energy spend rebounds with oil prices – APM turns pipeline into outperformance for annual customer spend – Attractive valuation relative to peers	– Big bookings year got off to a slow start – Regulatory pressure causes customers to tighten spending – Accounting issues pose some risk
Autodesk	ADSK / $284.38	OW	– AEC leader – Margin expansion – Cash flow growth – Construction growth opportunity	– CFO departure – Near term cash flow pressure on shorter payment terms
Cadence Design	CDNS / $118.41	OW	– Outgrowing the overall EDA market and gaining traction in digital – Margins already at competitor's aspirational levels – Adjacent products become material in 2021	– Margins may compress in 2021 as regular expense growth resumes – Expensive relative to history
PTC	PTC / $111.35	OW	– Manufacturing improvement good for MCAD – Manufacturing digital transformation leading to digital twin, IoT, and augmented reality adoption – Margin expansion	– Investors question if FY24 targets are achievable
Synopsys	SNPS / $238.76	OW	– Cash flow growth accelerating into mid-20%s – Fusion platform gaining traction – Software Integrity nearing the bottom	– Largest customer still lagging market growth – Expensive relative to historical average

Note: stock prices as of 12/08/2020. Source: J.P. Morgan Research

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Table 6: Bull & Bear Arguments across Software Technology (cont'd)

Company	Ticker / Price	Rating	Bull	Bear
Financial Services				
Avalara	AVLR/ $169.94	N	– Secular adoption of sales tax solutions – International expansion – Move up into enterprise –	– Investors worry Wayfair ruling tailwind is fading – Questions over e-commerce exposure and sensitivity to transaction volumes
Intuit	INTU / $372.35	OW	– Dominant Tax franchise – Margin profile and outlook – International expansion – Shift to the cloud in small business franchise	– Macro headwinds to small business franchise – Would government start to offer own tax solution
Q2 Holdings	QTWO / $114.73	OW	– Lifetime customer value – stickiness of solution – Expanding up market through Precision Lender and Cloud Lending	– CFO transition – Gross margins
SS&C Technologies	SSNC / $73.26	N	– Positioned to accelerate revenue growth in 2021 – Value stock in a growth sector – M&A provides a clear catalyst	– No large acquisitions made recently meaning synergies behind them – Active management under continued pressure
Healthcare / Life Sciences				
Veeva Systems	VEEV / $269.54	UW	– Best balance of growth and margins – Consistent execution – Expansion outside of life sciences	– Valuation – Competition in CRM
Real Estate				
CoStar Group	CSGP / $872.54	OW	– Competitive position – Multifamily housing growth and expansion down market – Expansion into single-family housing and distressed property sales	– Valuation – COVID-19 impact on commercial real estate
RealPage	RP/ $69.32	N	– Valuation – Consistent organic growth – Margin expansion potential	– Contact center revenue declines – Organic growth slipped below 10%

Note: stock prices as of 12/08/2020. Source: J.P. Morgan Research

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Table 7: Bull & Bear Arguments across Software Technology (cont'd)

Company	Ticker / Price	Rating	Bull	Bear
Insurance				
Duck Creek	DCT/$39.58	N	– Perceived leader in cloud SaaS for P&C – Revenue growth accelerated – Duopoly in P&C software	– Valuation – Gross margins – P&C carrier claims payout with COVID-19, wildfires, and tropical storms
Guidewire	GWRE / $126.43	OW	– Leader in P&C software – Duopoly in P&C software – Opportunity in customer base to convert to cloud	– Cloud adoption trailed expectations – Gross margins – Long-term ARR forecast
Sapiens	SPNS/ $27.98	OW	– Leading vender in both P&C, Life & Annuity, and reinsurance – Revenue mix shifting toward software – Global presence	– High services revenue mix – Acquisition dependence
Security				
Check Point Software	CHKP / $123.16	UW	– Margin profile – Share repurchase – Improving channel program	– Low single digit revenue growth – Trailing in cloud security strategy – Big firewall refreshes happening less as customers shifting focus to the cloud
CyberArk Software	CYBR / $113.34	OW	– Privileged access management leader – Subscription transition – Margin profile	– Growth decelerating into transition – More competition in the cloud
CrowdStrike	CRWD/ $177.48	N	– Growth at scale – Leading disruptor in endpoint security – Cloud opportunity expands the TAM 10x	– Valuation
FireEye	FEYE / $15.52	OW	– Mandiant brand seen as leader in incident response – Splitting company into legacy product and Mandiant services opens opportunity to create strategic value – Billings improvement	– Legacy product business is drag on growth – Inconsistent channel execution
Fortinet	FTNT / $131.66	UW	– SD-WAN growth opportunity – Growth at a reasonable valuation – Operating margin cash flow profile	– Big firewall refreshes happening less as customers shifting focus to the cloud – Growth more consistently in the mid-teens while bulls still expecting 20%+

Note: stock prices as of 12/08/2020. Source: J.P. Morgan Research

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Table 8: Bull & Bear Arguments across Software Technology (cont'd)

Company	Ticker / Price	Rating	Bull	Bear
Security (cont'd)				
Mimecast	MIME / $48.06	UW	– Valuation – Moving up market – Product expansion	– Office 365 tailwind fading as penetration grows – FX volatility
Okta	OKTA / $251.13	N	– Leader in Identity – Consistent top line growth – Customer identity (CIAM) market potential	– Valuation
Palo Alto Networks	PANW / $310.22	UW	– Emerging cloud security portfolio – Margin expansion – Valuation	– Big firewall refreshes happening less as customers shifting focus to the cloud –
Qualys	QLYS / $94.25	UW	– Margins – most profitable SaaS company – New product categories expand TAM	– Revenue growth deceleration – Competition
SecureWorks	SCWX / $12.71	UW	– Leading managed security service provider – Growing product business – Dell ownership/partnership	– Revenue growth deceleration
Tenable	TENB/ $38.45	OW	– Leader in vulnerability management – Operating margin expansion – Channel execution improvement	– Competition – VC ownership
Tufin Software	TUFN/ $9.00	OW	– Valuation – Large under-penetrated market	– Inconsistent sales execution – Perpetual license model more volatile
Varonis	VRNS/ $132.75	OW	– Subscription transition – Accelerating revenue – Margin expansion	– Hard to pin down true customer spending growth – ASC 606 keeps this from being smooth ratable revenue recognition
Zscaler	ZS/ $184.60	OW	– Accelerating growth to over 50% at $800M run rate – Category leader – Sales execution under current CRO	– Valuation – Growing number of competitors
IT Operations				
Dynatrace	DT/ $40.76	OW	– Taking share in APM space – Top line growth – Margin profile	– VC ownership overhang – Competition with Datadog
Datadog	DDOG/ $99.85	N	– Growing over 60% at $800M run rate – Leading infrastructure monitoring – Operating leverage	– Valuation – Pace of revenue growth slowdown the last two quarters
Jamf	JAMF/ $31.75	OW	– Clear leader in managing Apple devices in enterprise and education – Apple share gains in devices – Work from home tailwind	– Will Apple or Microsoft be competitive threat
JFrog	FROG/ $68.57	OW	– Leader in artifact repository segment of DevOps – $15B TAM – Growing over 30% with attractive estimate set up	– Valuation – Will Microsoft / Github be a competitive threat
Everbridge	EVBG/ $125.82	N	– Leader in mass notification and critical event management – Upsell to critical event management in customer base – EU country notification potential wins	– Valuation – PagerDuty and EVBG on potential competitive collision course
New Relic	NEWR / $64.07	UW	– Valuation – Still get solid customer feedback on core APM	– Upwards of $25M of ARR could move down to free offering – Take three more quarters to get customer base on new pricing

				– Gross margins under pressure from new pricing structure
PagerDuty	PD/$41.02	OW	– Business metrics inflecting higher – Management tone more positive about acceleration – Valuation relative to SaaS group	– Everbridge and PD on potential competitive collision course
ServiceNow	NOW/ $542.25	N	– Consistent growth performer – Margin profile – Size of TAM	– Exposure to heavily impacted COVID-19 industries like airlines – Valuation
SolarWinds	SWI/ $23.70	OW	– Some of the best margins in software – Splitting off MSP business is value creating	– SMB exposure – Top line growth
Internet Infrastructure				
Akamai Technologies	AKAM / $104.10	OW	– Growth accelerating on OTT – Security growing >20% – Margin expansion	– Margin expansion run its course – 2021 tough compares for OTT
Cloudflare	NET/$83.55	N	– Revenue growth accelerated to over 50% – Teams and Cloudflare One expand market – Unique position to capture security, edge computing, web acceleration and perimeter networking market share	– Valuation
GoDaddy	GDDY / $87.31	OW	– Largest registrar – benefit from SMB pick up – Margin expansion on registry acquisition – Consistent cash flow compounder	– Competition in website building space
VeriSign, Inc.	VRSN / $206.92	OW	– Competitive position – Operating margins – Pricing power	– Regulatory risk – New gTLD competition

Note: stock prices as of 12/08/2020. Source: J.P. Morgan Research

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Table 9: Bull & Bear Arguments across Software Technology (cont'd)

Internet Infrastructure (cont'd)				
Wix.com	WIX / $251.17	OW	– Revenue/collections growth – Cash flow margin improvement – Wix payments potential	– Competition – Gross margin pressure from payments
Communications				
Amdocs	DOX/ $67.30	OW	– Revenue accelerating in FY21 – 5G product portfolio gives them a long runway to benefit from the rollout – Stabilization at large customers	– Value rotation is short lived – Customer consolidation hits managed services revenue
Five9	FIVN / $151.20	OW	– Leading shift to the cloud for contact center – Enterprise revenue growth – Partnerships with AT&T, Zoom driving growth	– Gross margins – Valuation
LivePerson	LPSN/ $56.52	N	– Accelerating top line – Gainshare 15% of business and potentially could get much bigger – Large opportunity to displace spending on call center agents	– Consistency of top line and margin
RingCentral	RNG / $347.43	OW	– Leading shift to the cloud for telephony (business phones) – Partnership program – AT&T, Avaya, ATOS, Alcatel Lucent, Vodafone – Enterprise revenue growth	– Partnerships appear bought with upfront payments making investors question margin profile – Valuation
Vonage	VG/$13.42	N	– Business segment growth – Management change catalyst	– Consumer business revenue growth drag – Business products focused in different segments of market (SMB vs. mid-market)
Zoom Video	ZM/$412.00	N	– Fastest revenue growth at scale in history of software – Margins scale to over 40% – Expanding into UCaaS (telephony)	– Valuation – 38% of revenue from companies with less than 10 employees has high churn and investors concerned that post COVID-19 the revenue will drop from this segment
Price and Revenue Management				
Model N	MODN / $34.00	UW	– Exposed to two cyclically insensitive verticals – Life science regulation a tailwind for adoption	– Subscription revenue growth disappointing in FY21 – Ramped deals becoming more the norm – Bookings and RPO metrics fell off in 2H20
PROS Holdings	PRO / $43.30	UW	– Should see positive trends from successful vaccine – Dynamic pricing through e-commerce in secular adoption phase	– Travel customers under pressure for many years – Margin profile does not allow for investment through down cycle

Note: stock prices as of 12/08/2020. Source: J.P. Morgan Research

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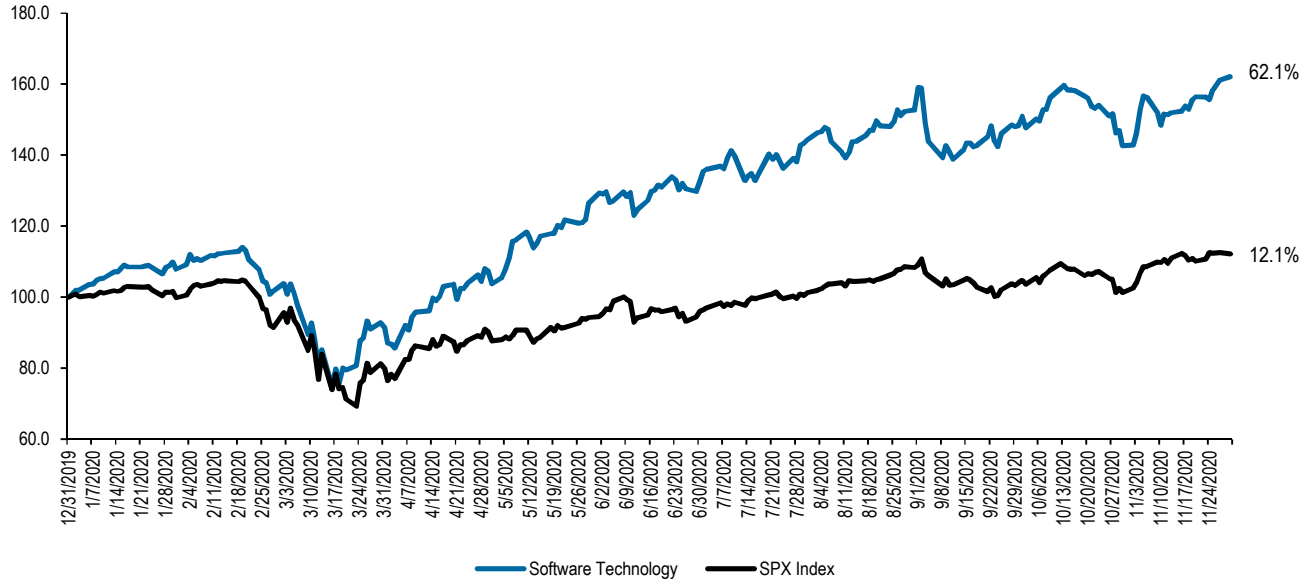
Valuation – Coverage Outperforms Market

Year-to-date performance remains over 60% for our coverage index

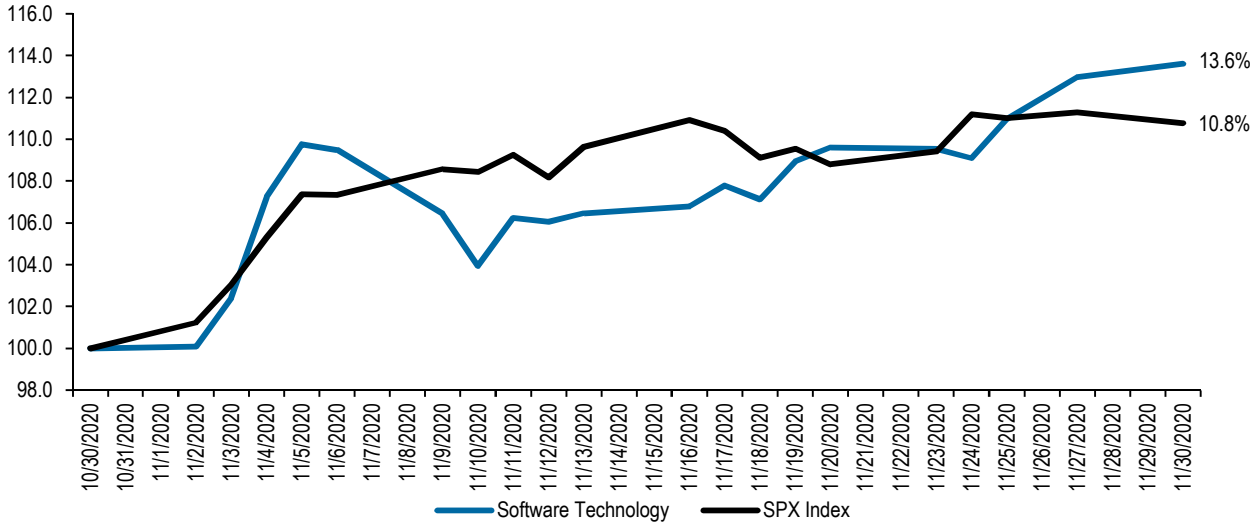
Once again our Software Technology coverage significantly outperformed the S&P 500 during 2020. Our coverage remained up 62.1% year to date through November as compared to 12.1% for S&P 500. On monthly basis, our coverage outperformed S&P 500 after three months returning 13.6% vs. 10.8% for market in November.

Figure 7: YTD performance of companies in our coverage compared to S&P 500



Source: J.P. Morgan Research, Bloomberg Finance L.P. as of 11/30/2020.

Figure 8: In November, our coverage outperformed S&P 500



Source: J.P. Morgan Research, Bloomberg Finance L.P. as of 11/30/2020.

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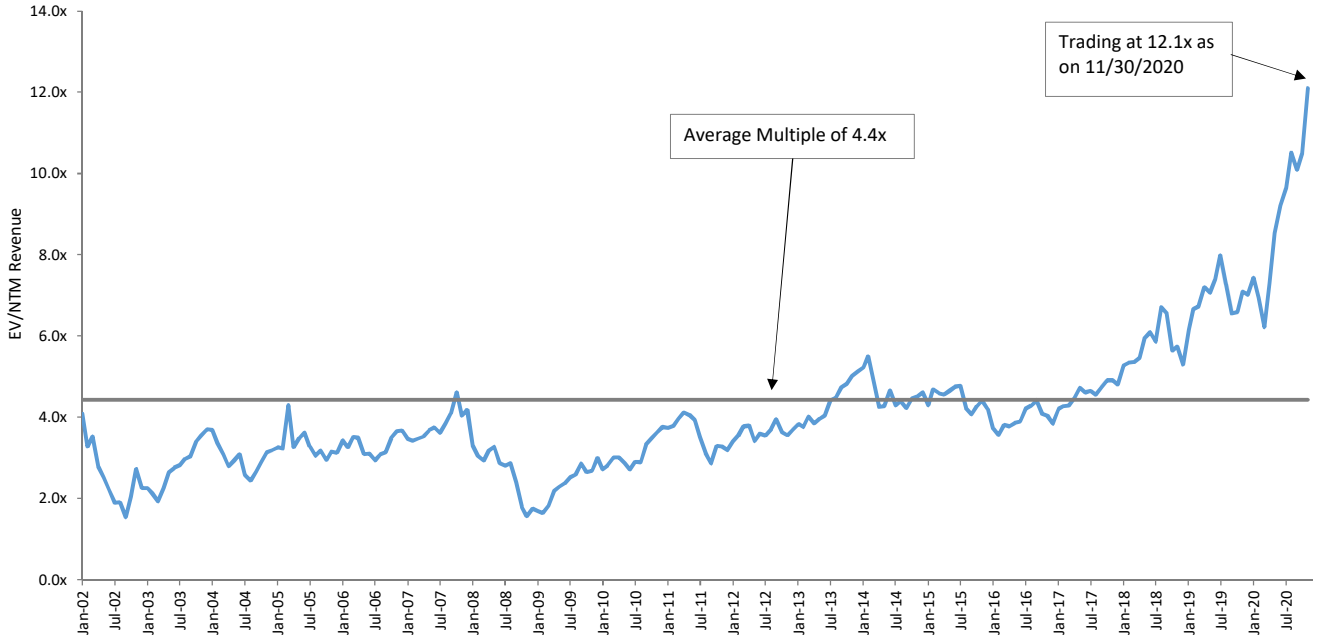
Revenue multiples still growing, reaching all-time high despite dip in March

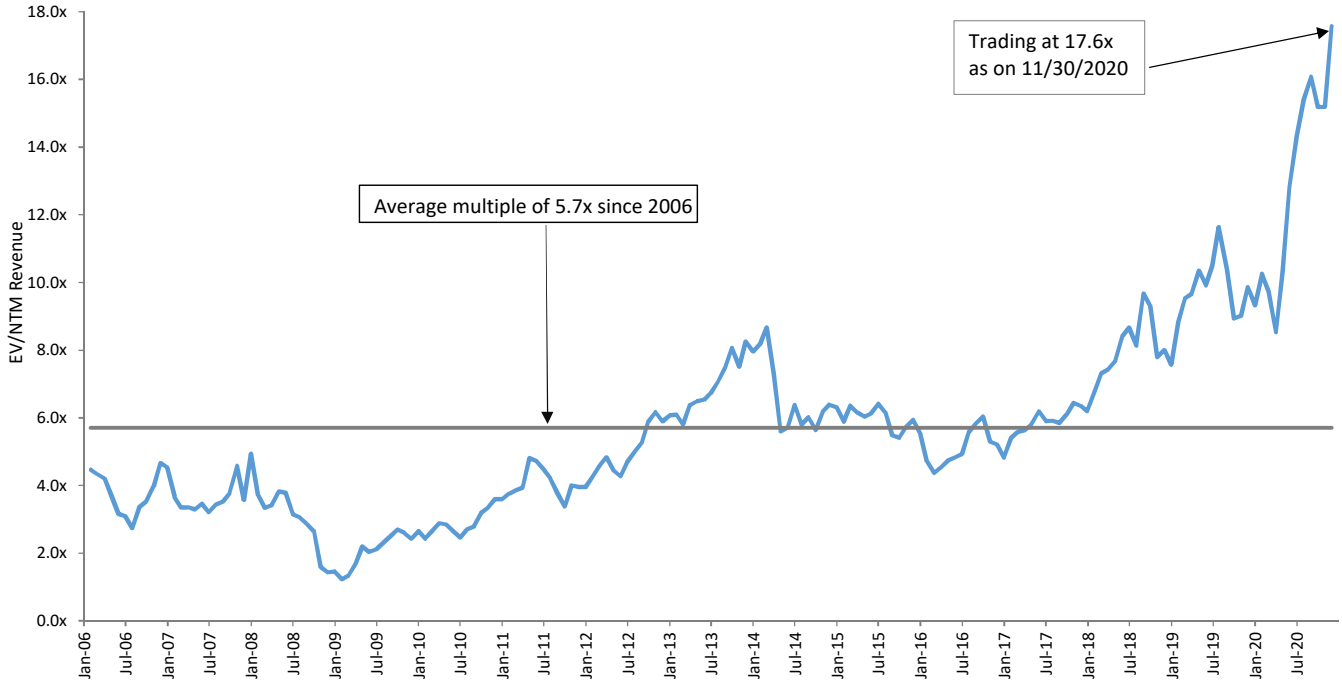
Looking at valuations, the entire software universe is trading at 12.1x and SaaS at 17.6x NTM revenue an all-time high.

Figure 9: Forward EV/Sales multiples for the entire software space is trading at 12.1x, all time high since 2002



Source: Company reports, J.P. Morgan estimates, Bloomberg Finance L.P.

Figure 10: Forward EV/Sales multiple for the pure SaaS space is 17.6x, all-time high since 2006



Source: Company reports, J.P. Morgan estimates, Bloomberg Finance L.P.

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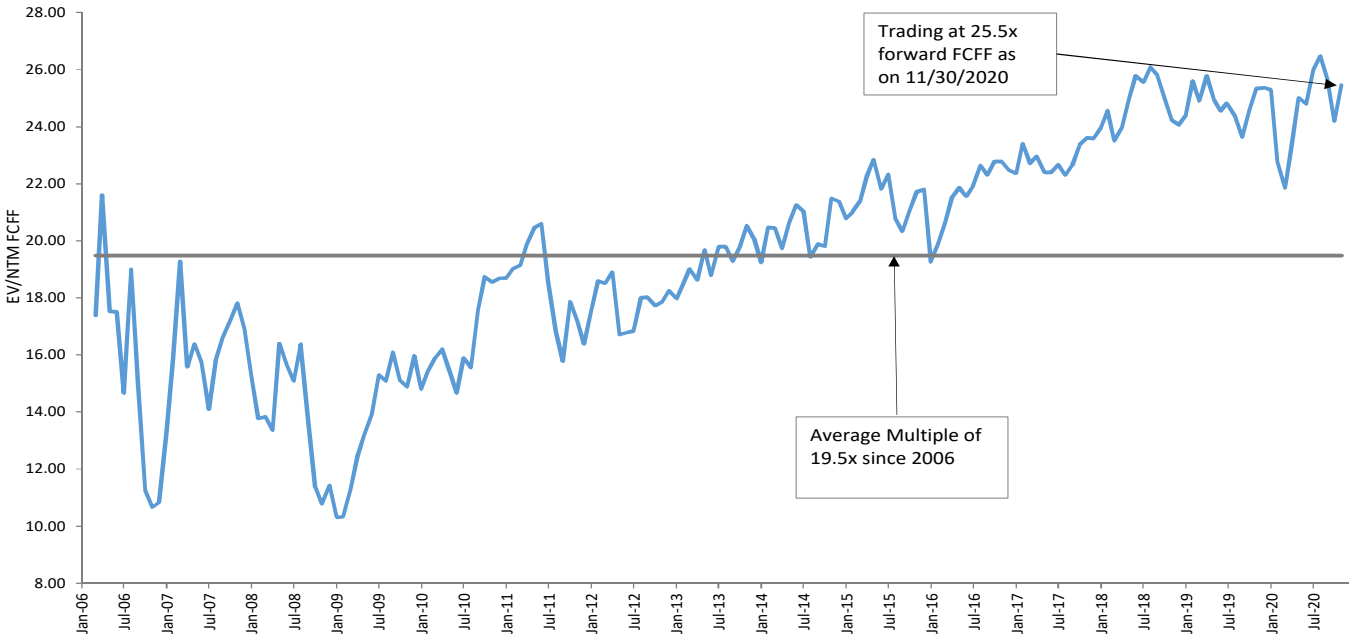
Free cash flow multiples are compressing on improved margins

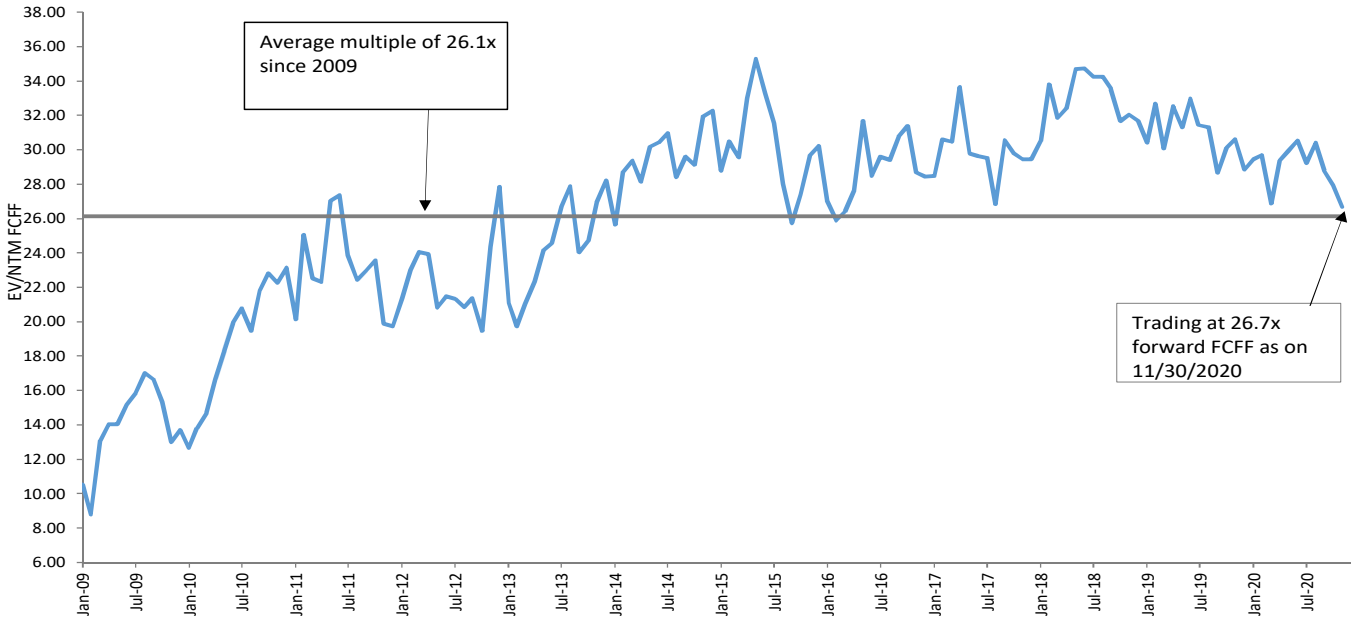
On the free cash flow basis, software is trading at 25.5x, modestly up from last month, while SaaS is trading at 26.7x, down from last month and close to the long-term mean multiple of 26.1x.

Figure 11: Forward EV/FCFF multiples for the entire software space is 25.5x



Source: Company reports, J.P. Morgan estimates, Bloomberg Finance L.P.

Figure 12: Forward EV/FCFF multiples for the pure SaaS space is trading at 26.7x



Source: Company reports, J.P. Morgan estimates, Bloomberg Finance L.P.

Table 10: Average Forward EV/Sales multiples comparison for all software

Current	12.11x
Average multiple over the last:	
1 year	8.79x
3 years	7.12x
5 years	5.97x
10 years	5.04x
15 years	4.38x
18 years	4.15x
24 years (maximum) - annual mean	4.29x

Source: Bloomberg Finance L.P. and J.P. Morgan Research

Table 11: Average Forward EV/Sales multiples comparison for pure SaaS

Current	17.57x
Average multiple over the last:	
1 year	12.89x
3 years	10.18x
5 years	8.30x
10 years	7.08x
15 years	5.69x
18 years	5.35x
24 years (maximum) - annual mean	4.51x

Source: Bloomberg Finance L.P. and J.P. Morgan Research

Table 12: Average Forward EV/Sales multiples (Growth Adjusted) comparison for all software

Current	31.55x
Average multiple over the last:	
1 year	3.51x
3 years	1.74x
5 years	1.44x
10 years	1.10x
15 years	1.08x
18 years	1.03x
24 years (maximum) - annual mean	0.79x

Source: Bloomberg Finance L.P. and J.P. Morgan Research

Table 13: Average Forward EV/Sales multiples (Growth Adjusted) comparison for pure SaaS

Current	0.70x
Average multiple over the last:	
1 year	0.53x
3 years	0.40x
5 years	0.33x
10 years	0.45x
15 years	0.45x
18 years	0.61x
21 years (maximum) - annual mean	0.67x

Source: Bloomberg Finance L.P. and J.P. Morgan Research

Table 14: Average Forward EV/FCFF multiples comparison for all software

Current	25.47x
Average multiple over the last:	
1 year	24.69x
3 years	24.73x
5 years	23.71x
10 years	21.57x
12 years (maximum)	19.67x

Source: Bloomberg Finance L.P. and J.P. Morgan Research

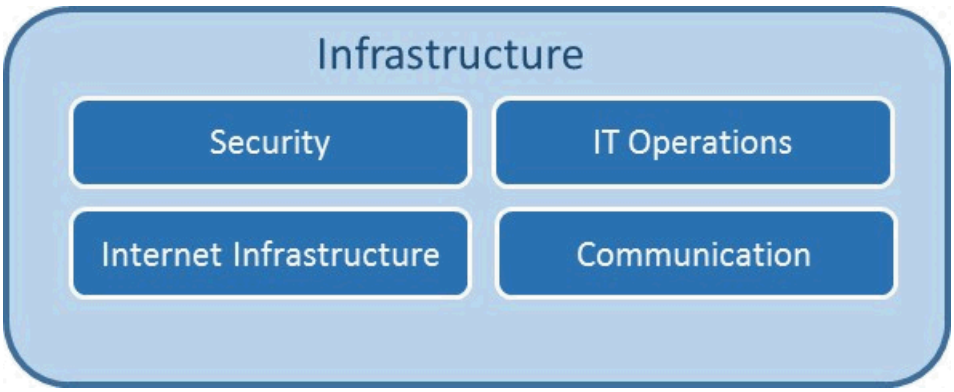
Table 15: Average Forward EV/FCFF multiples comparison for pure SaaS

Current	26.67x
Average multiple over the last:	
1 year	28.97x
3 years	30.96x
5 years	30.31x
10 years	28.06x
12 years (maximum)	25.60x

Source: Bloomberg Finance L.P. and J.P. Morgan Research

Infrastructure

Figure 13: Software Technology Infrastructure Coverage



Source: J.P. Morgan.

Security – Shift to Cloud and Zero Trust

Cybersecurity appears to be on the cusp of another significant generational change, driven by the growing shift in compute workloads to the cloud, along with the associated data, creating the impetus for a Zero Trust model. We believe this will help accelerate the shift in spending away from legacy vendors that focused almost entirely on customer premise and perimeter solutions and towards modern notes for the cloud security offerings. In the context of our broader cyclical view in this report, we would not characterize 2021 as offering the best backdrop for the security sector as a whole. We typically expect security to perform well during the actual downturn, as investors expect durability of demand since companies are unlikely to sacrifice spending on security despite a slowdown in the economy. But as the economy bottoms and turns higher, incremental spending typically shifts towards revenue-generating technologies and activities more than security. That means we expect 2021 to be more of a bottom-up company-specific stock selection market for security stocks.

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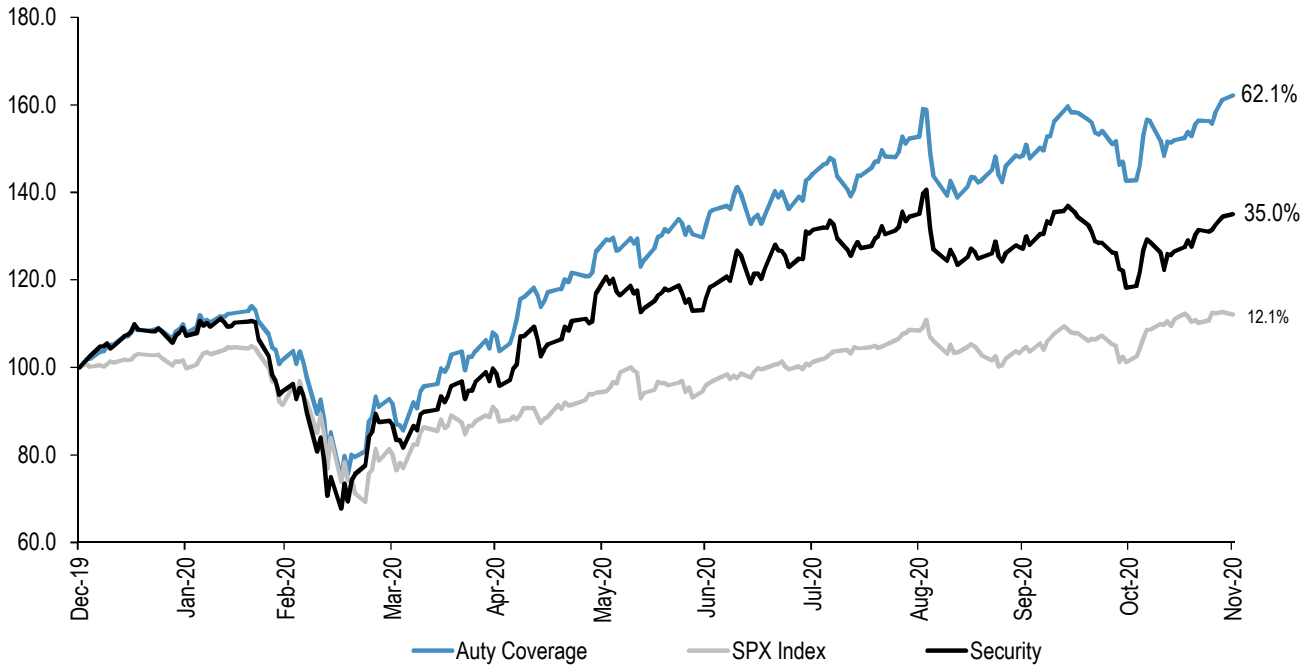
Figure 14: Security Software Performance Relative to S&P 500



Source: J.P. Morgan Research, Bloomberg Finance L.P. as of 11/30/2020.

Security Landscapes 2021

The figures below outline various segments of the cybersecurity market, including the size, technologies covered, and vendors that compete in each area. We start with an overall view of cybersecurity.

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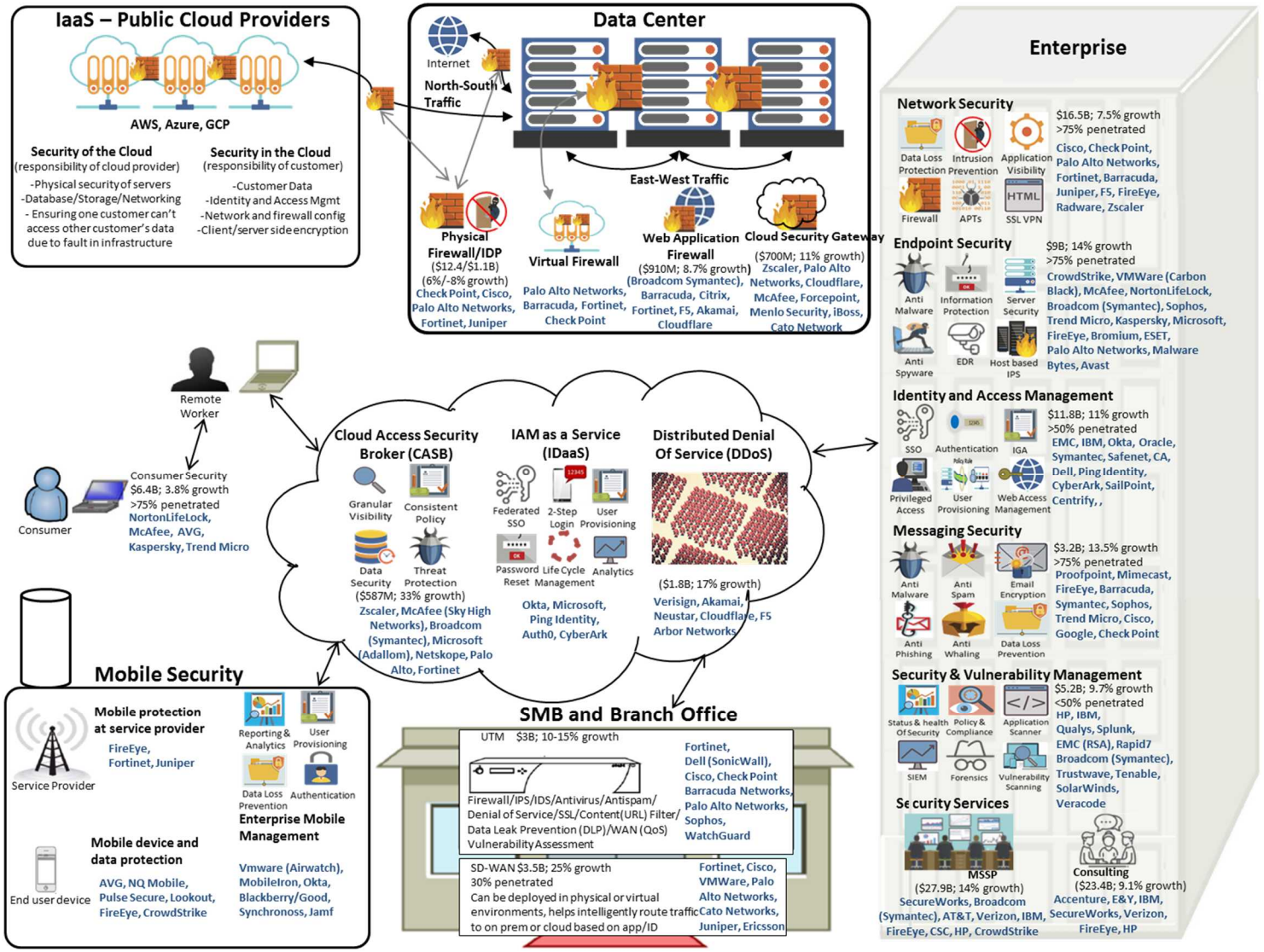
Figure 15: Security Landscape



Source: IDC, Gartner, J.P. Morgan Research

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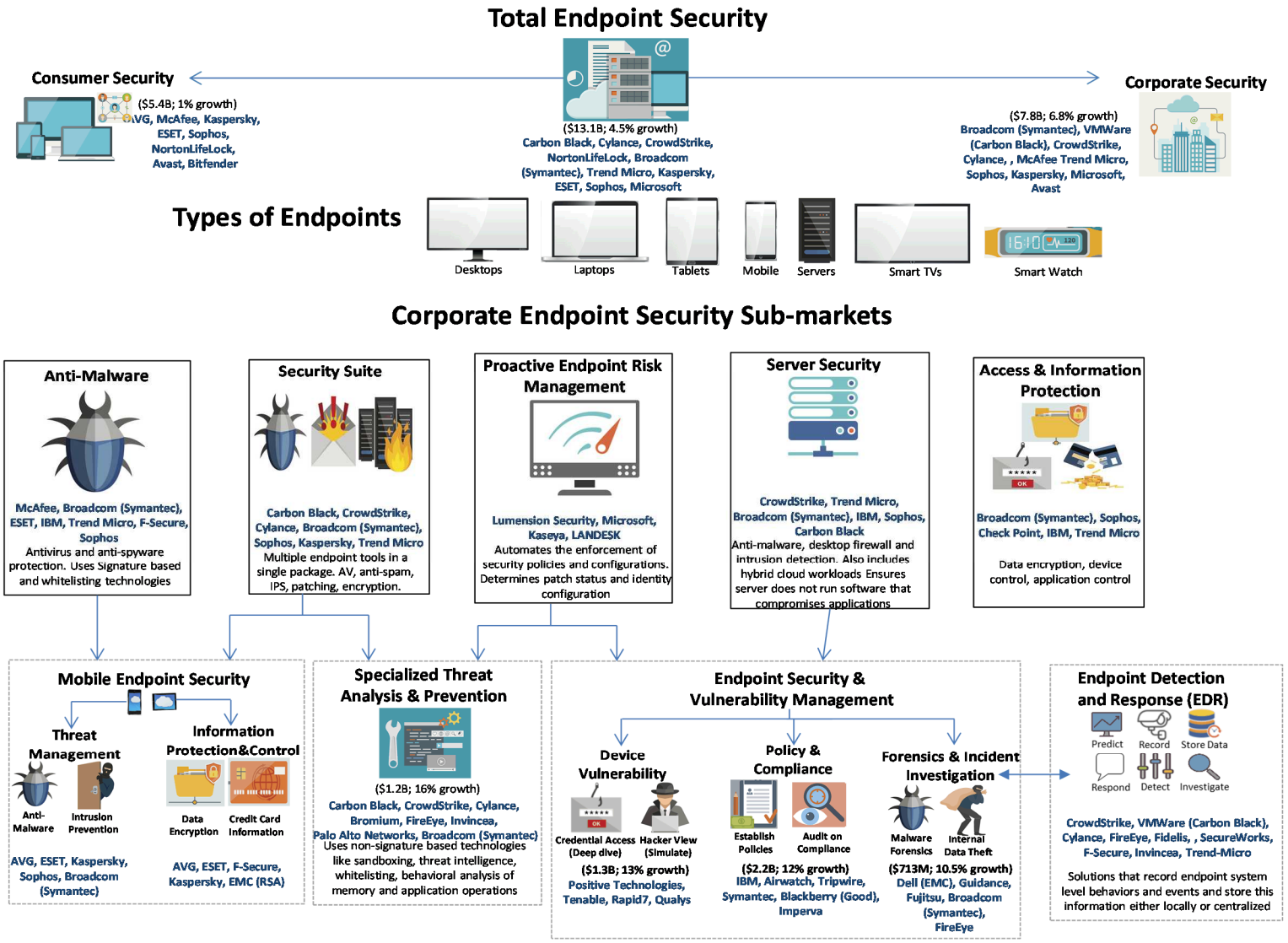
Figure 16: Endpoint Security Landscape



Source: IDC, Gartner, J.P. Morgan Research

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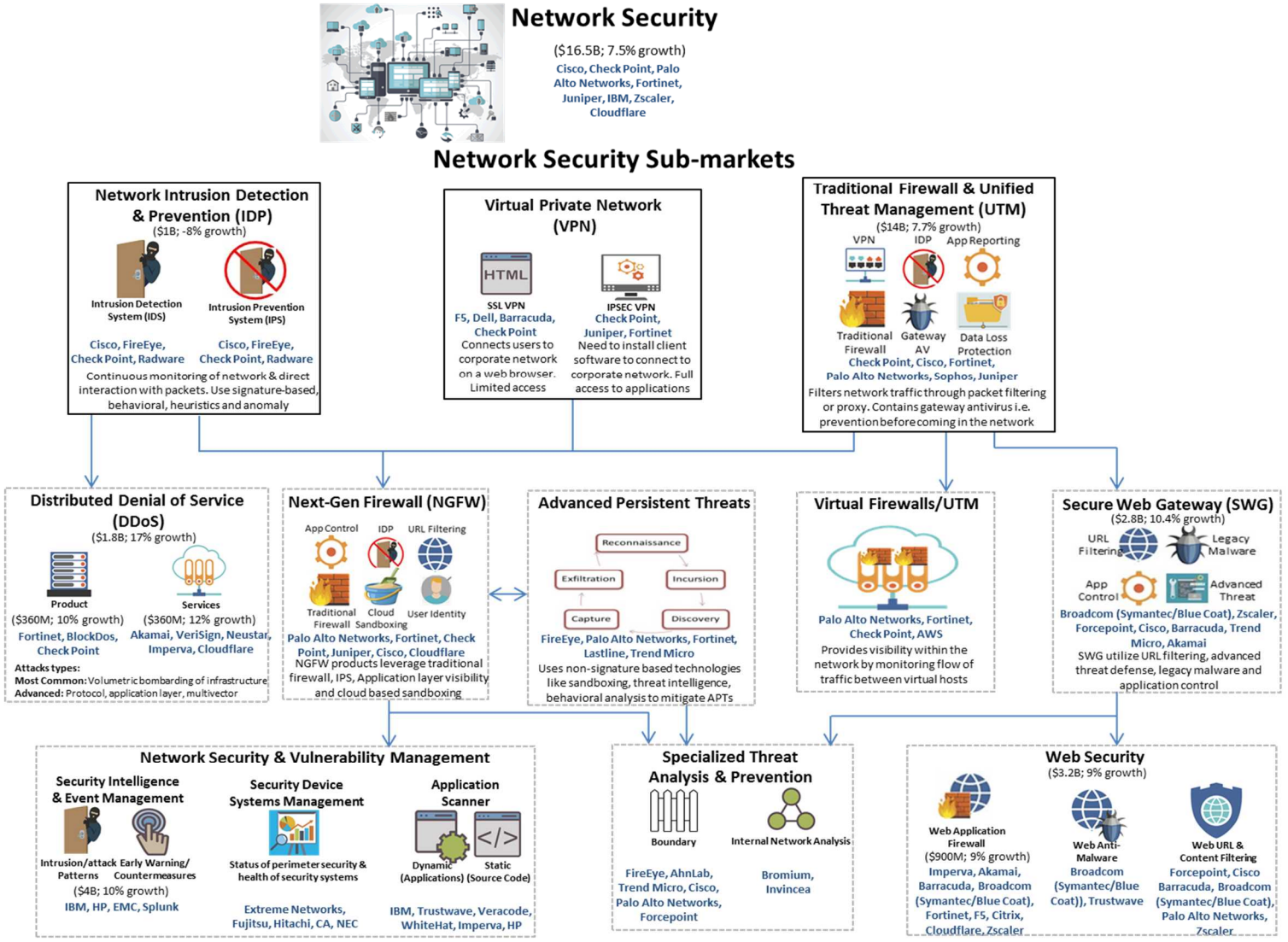
Figure 17: Network Security Landscape



Source: IDC, Gartner, J.P. Morgan Research.

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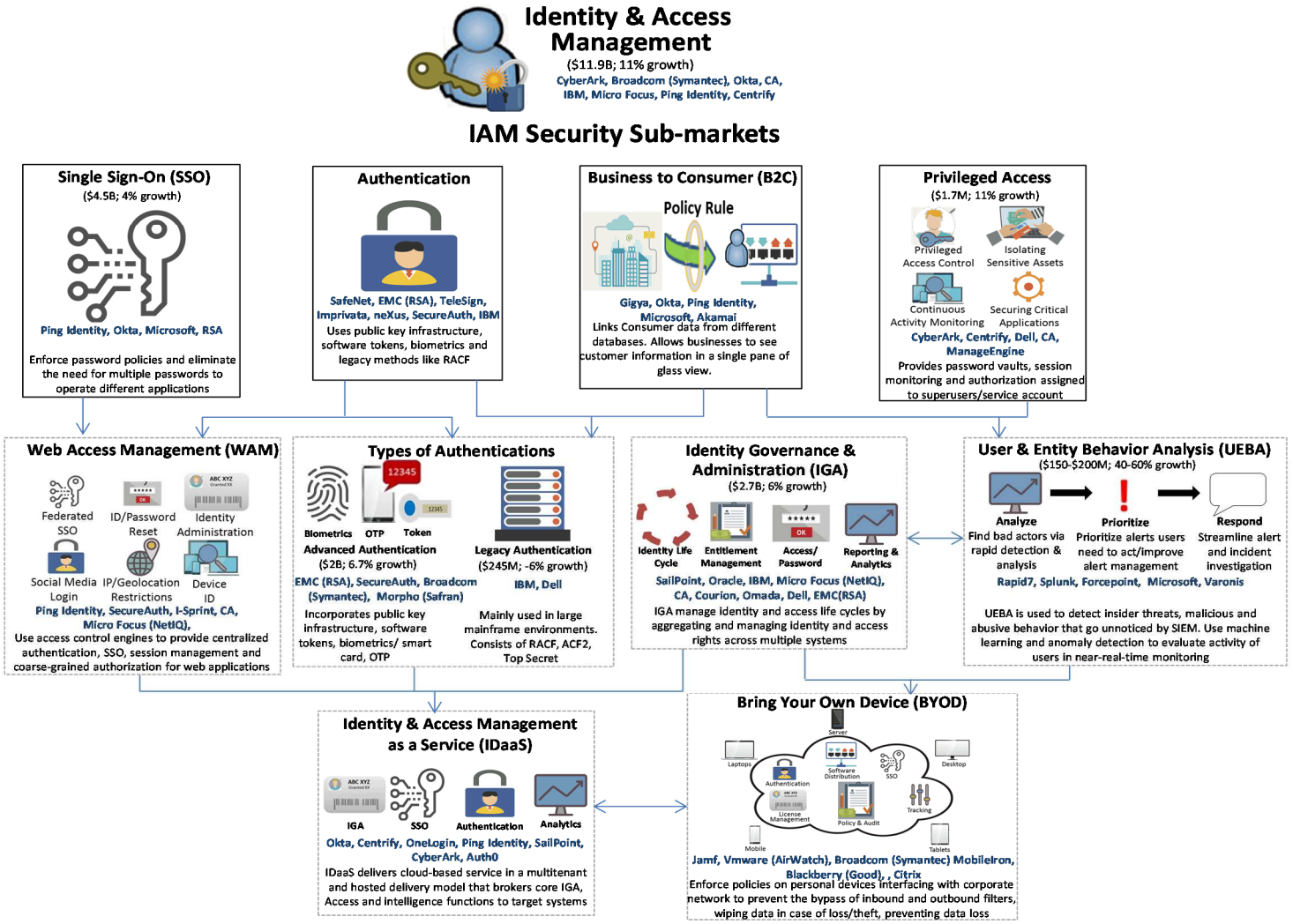
Figure 18: IAM Security Landscape



Source: IDC, Gartner, J.P. Morgan Research.

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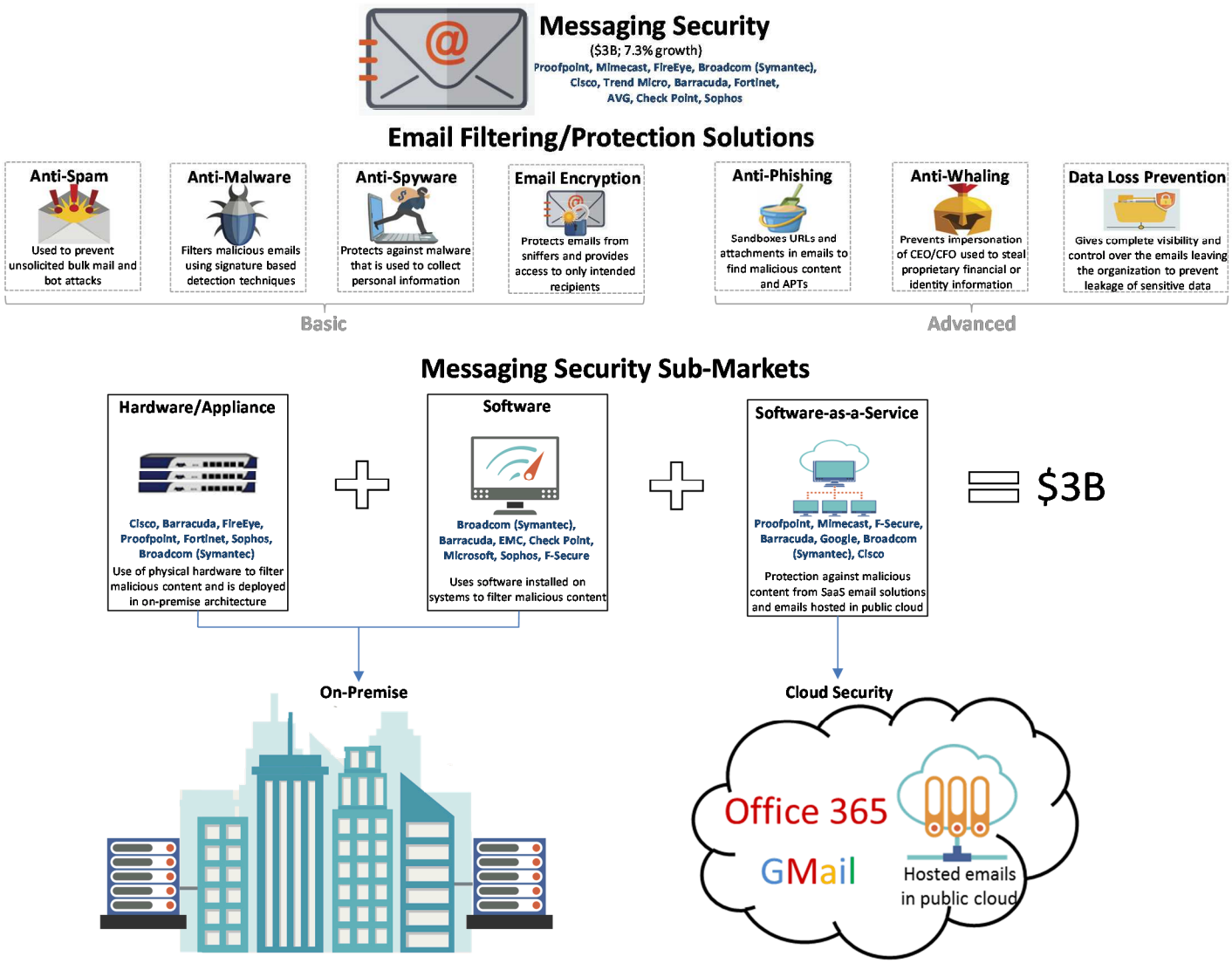
Figure 9: Messaging Security Landscape



Source: IDC, Gartner, J.P. Morgan Research.

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$68B Core Security Market TAM Growing ~10%

Core security spend is estimated to reach $68B in 2020, and that is expected to grow at a 9.7% CAGR through 2024. After adding security services that include Consulting, IT Outsourcing, etc., the security market TAM is $132M and expected to grow at an 8.4% CAGR through 2024. In the table below, we display spend by each sub-segment of security.

Table 16: Security Spend by Segment – $68B Core Cybersecurity Market

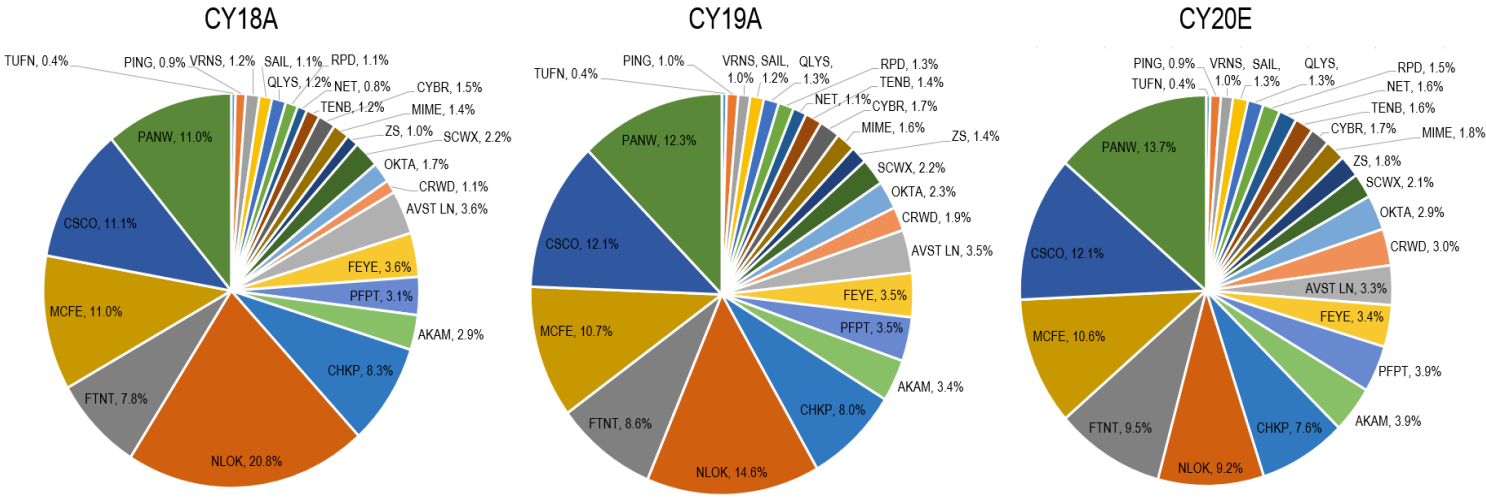
Macro Market	Market	2018 YR	2019 YR	2020 YR	2021 YR	2022 YR	2023 YR	2024 YR	19-24 CAGR
Consumer	Consumer Security Software	6,229	6,334	6,424	6,629	6,943	7,278	7,619	3.8%
Enterprise	Application Security	2,814	3,095	3,291	3,567	3,895	4,235	4,577	8.1%
	Cloud Security	298	439	587	801	1,073	1,420	1,856	33.4%
	Data Security	2,339	2,710	2,940	3,332	3,799	4,326	4,878	12.5%
	Identity Access Management	9,741	11,001	11,885	13,325	14,989	16,743	18,570	11.0%
	Infrastructure Protection	15,896	18,752	20,212	22,902	26,239	30,043	34,314	12.8%
	Integrated Risk Management	4,279	4,555	4,803	5,258	5,723	6,192	6,650	7.9%
	Network Security Equipment	13,143	14,830	15,525	16,869	18,028	19,085	20,060	6.2%
	Other Information Security Software	2,042	2,206	2,279	2,425	2,600	2,801	3,040	6.6%
Core Security Spend		**56,782**	**63,922**	**67,946**	**75,109**	**83,289**	**92,124**	**101,564**	**9.7%**
Enterprise	Security Services	58,253	61,922	63,970	68,091	73,735	80,117	87,154	7.1%
Total Security Spend		**115,035**	**125,844**	**131,916**	**143,200**	**157,024**	**172,241**	**188,718**	**8.4%**

Source: Gartner Forecast: Information Security and Risk Management, Worldwide, 2018-2024, 3Q20 Update

Market share shifting to the disruptors in the Security Market

The cybersecurity landscape continues to evolve, and that evolution is coming at the expense of legacy vendors that once were leaders in their space. Traditional firewall vendors like Palo Alto, Fortinet, and Checkpoint, we believe, will increasingly see part of customer spend shift over to solutions provided by cloud security vendors like Zscaler, Cloudflare, or even Palo Alto Prisma. On the endpoint side, Symantec's market share continues to bleed, and that is causing disruption in the market, allowing newer gen players to take advantage of a possible drop in quality that is often seen when security assets are joined into a non-security company. CSCO's security revenue in the past was growing in the high-teens off the back of acquisitions, but CY20E called for security growth to slow to ~8% given pandemic pressure on enterprise spending. To help investors understand the shifts occurring in the current security market, we created a pie chart with 22 pure play public cybersecurity vendors, as well as security revenue broken out by players like AKAM and CSCO.

Figure 19: Cybersecurity Market Share Shift from CY18-CY20E



Source: Company Reports, Bloomberg, J.P. Morgan Research.

CIO Survey Points to IAM as #1 priority, Endpoint and DLP Jump

J.P. Morgan's 2020 CIO Survey, published in June, pointed to Identity and Access Management (IAM) as the top cyber security priority for CIOs, following the same ranking in 2019. Identity became a critical pillar for enterprises during COVID-19 as employees went to a remote distributed environment and as more applications moved to the cloud. Endpoint security rose from #4 in 2019 to #2 in top security priorities this year, which we believe to be due to increased laptop deployments in WFH as well as the acceleration of cloud workload migration, which providers like CrowdStrike help protect. COVID-19 has also accelerated the use of collaboration tools like Microsoft Teams and cloud repositories like OneDrive, which creates risk around internal and external users having permission to access data they should be able to access. As a result, DLP rose from the #7 to #4 top security priority in 2020, reflecting what we believe to be robust demand for solutions offered by vendors like Varonis (VRNS/OW). The biggest drop in security priority was Email Security, which dropped to #7 in 2020 from #2 in 2019. Much of the growth in the email security space has been driven by the migration to Office 365, and we believe that >75% of that migration is complete. Our research shows that during COVID-19 enterprises did not look to change their email security solutions in place, as the focus shifted to securing remote workforce environment. The email security group has underperformed both the security and software spaces in 2020, as growth in both MIME and PFPT has been slowing (recall our downgrade of MIME to UW in August).

Table 17: IAM remains #1 Security Priority, DLP and Endpoint Increase Importance in Security Priorities

Top Three Security Priorities	2019 Rank	2019 Responses	2020 Rank	2020 Responses	Vendors to Benefit
Identity & Access Mgmt	1	40.2%	1	40.0%	Okta, Ping, Microsoft, CyberArk (Idaptive)
Endpoint Security	4	33.6%	2	36.9%	Crowdstrike, Vmware (Carbon Black), Blackberry (Cylance), McAfee
Cloud Security	3	33.6%	3	36.2%	Zscaler, Crowdstrike, Palo Alto Networks, Cloudflare, Akamai
Data Leak Prevention (DLP)	7	21.3%	4	34.6%	Varonis, Mimecast, Zscaler, Proofpoint
Vulnerability Management	5	31.1%	5	31.5%	Qualys, Tenable, Rapid7
Network Security (IDS/IPS)	6	27.9%	6	23.8%	Fortinet, Palo Alto, Checkpoint, Cisco, Zscaler, Cloudflare, AWS
Email Security	2	37.7%	7	23.1%	Proofpoint, Mimecast
Privilege Access	10	16.4%	8	22.3%	CyberArk
Security Policy	8	21.3%	9	20.8%	Fortinet, Palo Alto, Checkpoint, Zscaler, Cloudflare, Tufin
Firewall (Refresh)	9	18.0%	10	15.4%	Fortinet, Palo Alto, Checkpoint, Cisco
Network Access Control	11	13.9%	11	13.1%	
IoT security	13	11.5%	12	8.5%	Forescout, Tenable, Palo Alto, Barracuda
Web Application Firewall	12	12.3%	13	7.7%	Cloudflare, Akamai, Fortinet, AWS, Fastly (Signal Sciences), Barracuda
Visibility	14	10.7%	14	6.2%	
Sandbox	15	1.6%	15	2.3%	

Source: J.P. Morgan CIO Survey

Traditional network security firewall vendors like FTNT and PANW saw tailwinds during COVID-19 as enterprises increased capacity for VPN remote access. Our CIO Survey points to continued increase in spend with vendors like FTNT and PANW; however, we point out that both vendors saw a decrease in percent of respondents indicating an increase in spending relative to 2019. Fortinet is benefiting from SD-WAN traction that has driven product growth in the double digits while growth in cloud security products is offsetting PANW's product revenue bleeding. Cloudflare is making its move upmarket as current paying customers represent just 16% of F1000 companies, reflected in the ~90% of respondents that do not currently use their solutions. We believe there is long runway for growth, especially with the recent Cloudflare Teams/One offering, which could help drive enterprise penetration.

Table 18: 2020 Spending Plan for Select Cybersecurity Vendors

2020 Spending Plan	Cloudflare	CrowdStrike	Fortinet	Palo Alto Networks
We don't use this v endor	89.2%	83.1%	66.9%	59.2%
Reduce spending by >10%	0.0%	0.0%	3.8%	2.3%
Reduce spending by 0-10%	0.0%	0.8%	0.8%	0.8%
Maintain consistent spending	9.2%	9.2%	20.8%	23.1%
Increase spending by 0-10%	1.5%	5.4%	5.4%	10.8%
Increase spending by >10%	0.0%	1.5%	2.3%	0.8%
2020 Net percent of respondents indicating expected increases in spending by vendor	**1.5%**	**6.2%**	**3.1%**	**11.5%**
2019 Net percent of respondents indicating expected increases in spending by vendor	**NA**	**NA**	**5.7%**	**13.1%**

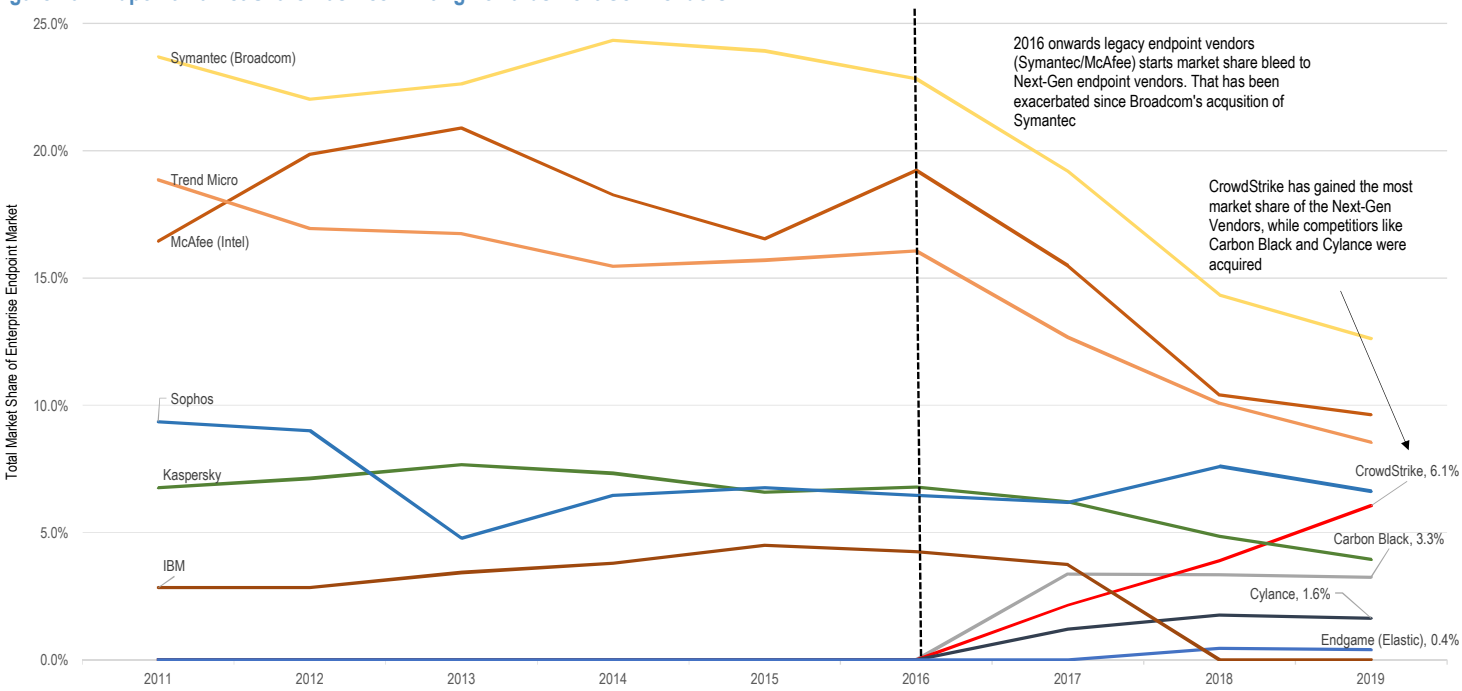
Source: J.P. Morgan 2020 CIO Survey.

Endpoint Security – Share Shift Continues

Figure 20 shows that 2016-2017 proved to be the turning point for market share leaders like McAfee and Symantec. These legacy vendors traditionally provided

signature-based antivirus software and have suffered from newer entrants providing cloud-based AI/ML endpoint security (EDR). The acquisition of Symantec's business by Broadcom has created a large opportunity for market share shifts in the endpoint security market. Our analysis of endpoint market share data shows that CrowdStrike has been the biggest beneficiary of this shift, and the most effective of the public next gen vendors in capturing market share, while other competitors like Carbon Black and Cylance have been acquired by companies whose primary market is not security. While the endpoint market is growing 10-15% annually, CRWD's superior technology and go-to-market is leading to growth of +80% at a ~$800M run rate, followed only by other private players in the space that are also benefitting from the market share opportunity.

Figure 20: Endpoint Market Share Has Been Tilting Towards Next Gen Vendors



Source: J.P. Morgan Research, Gartner.

Table 19: Historical Enterprise Endpoint Market Vendor Revenues

Vendor	2011	2012	2013	2014	2015	2016	2017	2018	2019	17-19 CAGR
Carbon Black							144.6	188.7	226.1	25.0%
CrowdStrike							92.0	220.0	421.9	114.1%
Cylance							52.0	98.8	113.6	47.8%
Endgame (Elastic)								24.8	27.4	
IBM	82.1	88.7	107.8	124.2	148.7	148.2	160.0			
Kaspersky	195.5	222.6	241.0	239.6	218.1	236.9	266.1	272.9	274.4	1.5%
McAfee (Intel)	475.6	620.7	656.3	596.7	547.8	672.0	662.9	585.1	670.0	0.5%
Sophos	270.3	281.3	150.4	211.2	223.6	225.5	265.0	427.9	460.8	31.9%
Symantec (Broadcom)	684.8	688.0	710.4	795.0	791.9	797.5	822.1	807.1	877.7	3.3%
Trend Micro	545.3	529.7	526.2	505.0	519.8	561.2	542.6	567.5	593.8	4.6%
Total Enterprise Endpoint Market	**2,891.6**	**3,125.1**	**3,141.7**	**3,268.4**	**3,310.8**	**3,495.0**	**4,282.6**	**5,629.2**	**6,956.5**	

Source: J.P. Morgan Research, Gartner.

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Endpoint Security from Cloud

Endpoint agent runs on endpoint (PC/server), collects all data to the cloud and processing/analytics is done in the cloud

Endpoint Security for the Cloud

Protects workloads that are in the cloud (Virtual Machines, Cloud Instances, Containers) from malware

What is a Cloud Workload?

Anything relating to supporting an application in the cloud, including interactions with the networks, users, etc. Includes cloud servers, databases, containers, virtual machines.

Container (for deep dive see 2019 Outlook)

Allows developers to develop, test or package applications on any machine and then port it to the choice of deployment. Allows application package to include the OS, application code, system libraries and other important tools that make them agnostic on which environment they are running on.

Pricing here for cloud workload protection

Securing Cloud Workloads Is the Long-Term Opportunity in Endpoint

Historically, the endpoint was a multibillion dollar market primarily providing Anti-Virus on desktops, laptops, and on-premise servers. During COVID-19, we believe there was increased demand in this traditional endpoint market, as enterprises deployed laptops for employees to work from home. We estimate that there is ~$2B of legacy endpoint revenue just from the top three legacy vendors that players like CrowdStrike and other private vendors have the opportunity to capture. But the bigger opportunity, in our view, is in cloud workload protection.

There has been a vast increase of workloads relative to traditional endpoints given the proliferation of the cloud and cloud applications. Technologies like containers and kubernetes have made cloud deployments even easier and quicker than before. In fact, recent customer data shown from CrowdStrike points to cloud workloads outnumbering traditional endpoints by 4:1 to as much as 36:1 in some cases. As a result, CrowdStrike believes that for every traditional endpoint, there is 10x the number of cloud workloads. Here, we note that this does not necessarily equate to a market opportunity that is 10x larger than current endpoint market forecasts. Customers can spin up and spin down cloud instances resulting in what is referred as an ephemeral or temporary workload. In that case, pricing is comprised of an annual fee plus fees based on consumption/length of deployment. Overall, we believe this is a bigger opportunity longer term for aspiring next generation endpoint vendors than just the displacement of Symantec and McAfee

Table 20: Cloud Workload Opportunity Bigger than Legacy Replacement (in $billions)

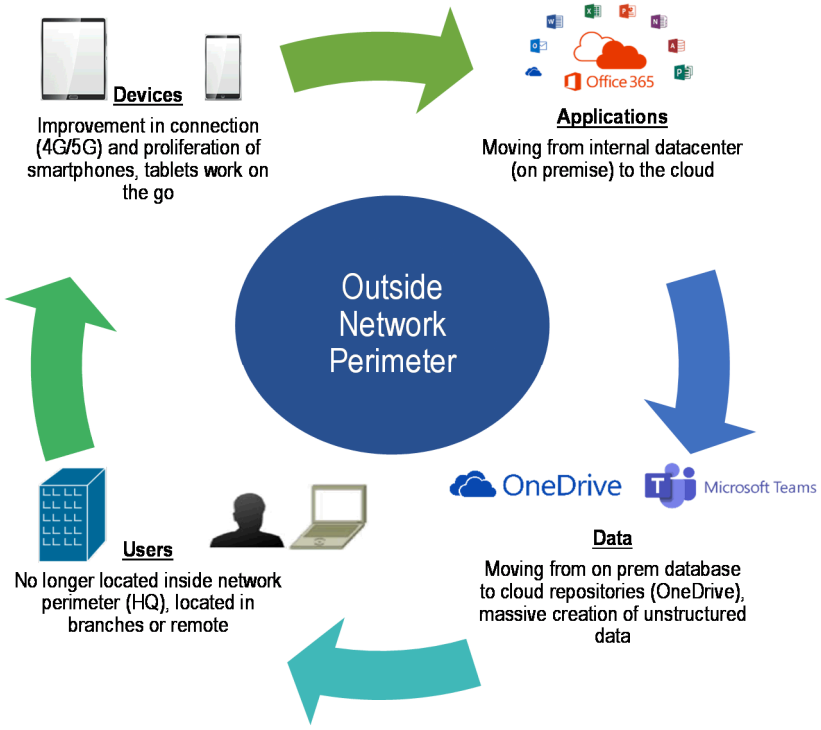
	2020	2023	CAGR
Current Cloud Security Spend			
IaaS and PaaS Vendor Revenue Estimate, IDC	106.4	217.7	27.0%
Worldwide Hybrid Cloud Security Revenue Estimate, IDC	1.2	2	18.6%
Cloud Security Spend as % of Cloud IT Spend	1%	1%	
CrowdStrike Estimate			
Cloud Security Opportunity % of Cloud IT Spend	1.1%	5.7%	
Cloud Security Opportunity CrowdStrike Estimate	1.2	12.4	117.8%
Traditional Endpoint Opportunity			
2019 Legacy Endpoint Opportunity (Top 3 Vendors)	2.1		

Source: J.P. Morgan Research, IDC, Gartner, CrowdStrike.

The Shift to Zero Trust Network Architecture

In traditional network architecture, the firewall was the primary node of security enforcement. Users behind firewalls were considered trustworthy with the data they were allowed to access. However, over time it became clear that insiders were just as much a risk as outsiders – just look at the Verizon breach report through the years. In addition to these inside attacks, applications began moving to the cloud, and with them went the data. This created a structure that traditional security is not equipped to handle. So rather than focusing on a secure perimeter, the Zero Trust model works on the idea that no user, whether internal or external, should be treated differently in terms of the amount of trust that is allocated to that user.

Figure 21: Applications, Data, Users, and Devices Outside of Network Perimeter

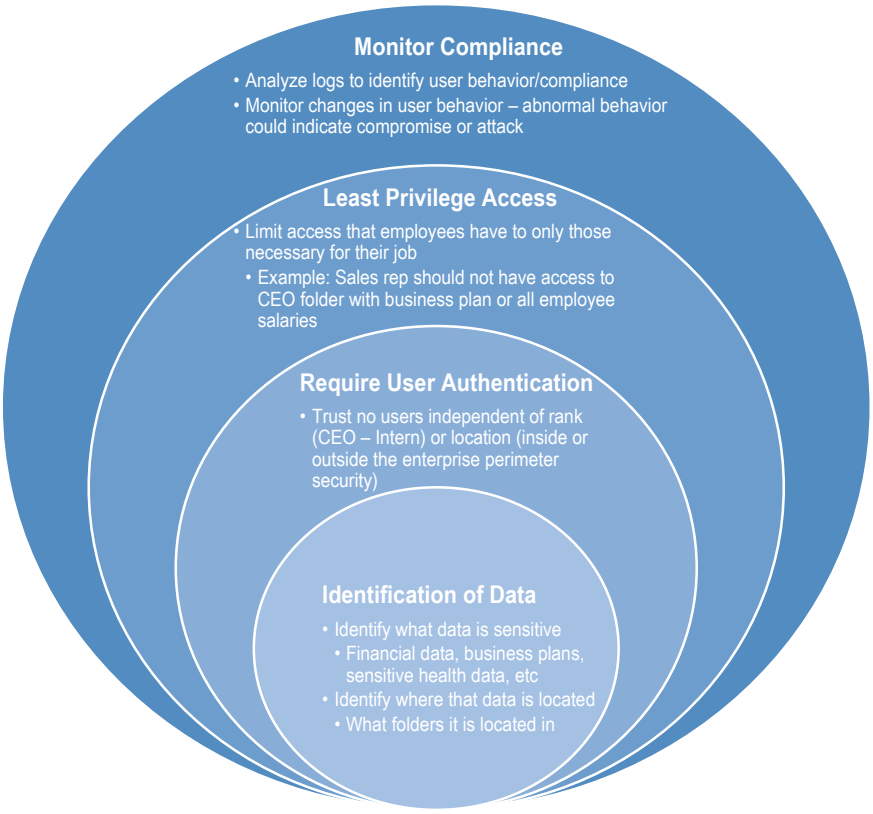


Source: J.P. Morgan Research.

Who Wins in a Zero Trust World?

In a Zero Trust Model, both users behind (inside HQ) and in front (outside HQ) of the firewall (even the CEO) must prove their identity before being trusted with access to data. A key is also making sure each user has their access limited to only what they need to do their job. Identity authentication and data protection are key cogs in a Zero Trust Model, and that is driving demand for solutions from vendors in our coverage like Okta (Identity) and Varonis (Data Loss Prevention). Cloud network security vendors also play an important role in the Zero Trust Model, enforcing security from user traffic destined to the cloud or public internet. Here, we see Zscaler and Cloudflare as beneficiaries in the spend that is now shifting away from traditional network security perimeter firewalls (FTNT, CHKP, PANW) to cloud delivered network security. This helps maintain the efficiencies in cloud application performance by eliminating the need to backhaul traffic to run security protocols at the security stack at Headquarters. The concept around a distributed workforce has been around for some time, but COVID-19 has accelerated the acceptance of work from home or work from anywhere, further contributing to increased importance of enforcing security in a Zero Trust Model.

Figure 22: Identity and Data Protection are Keys to Zero Trust



Source: J.P. Morgan Research.

Cloud Security – Shared Responsibility Model

The shift to the public cloud brings many benefits, including lower cost than private cloud/on-prem, standardized workload for applications, and shift of infrastructure maintenance cost to the cloud service provider. Most of the cloud providers run what is called a shared responsibility model, where compliance and security is something that is shared between the customer and the cloud provider. In the case of AWS's model, AWS is responsible for securing the cloud infrastructure that maintains the cloud services, while customers are responsible for securing the traffic going to the cloud, data stored in the cloud, and workloads being deployed in the cloud.

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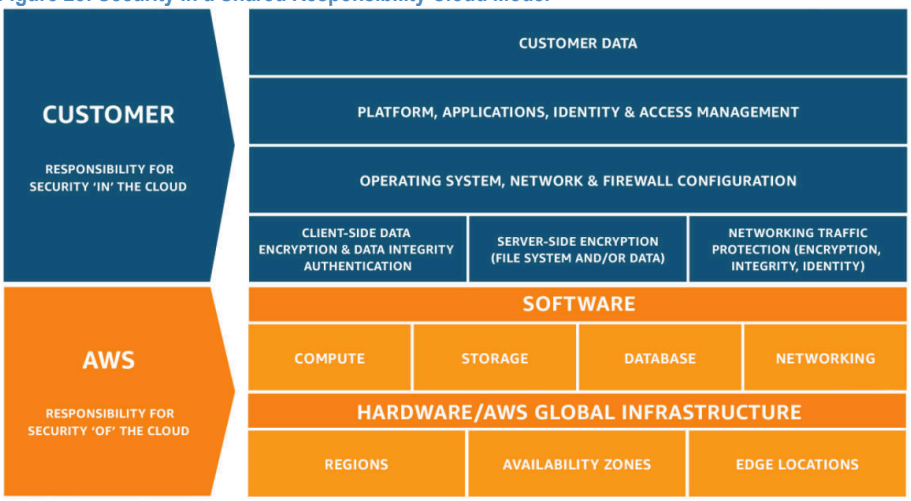
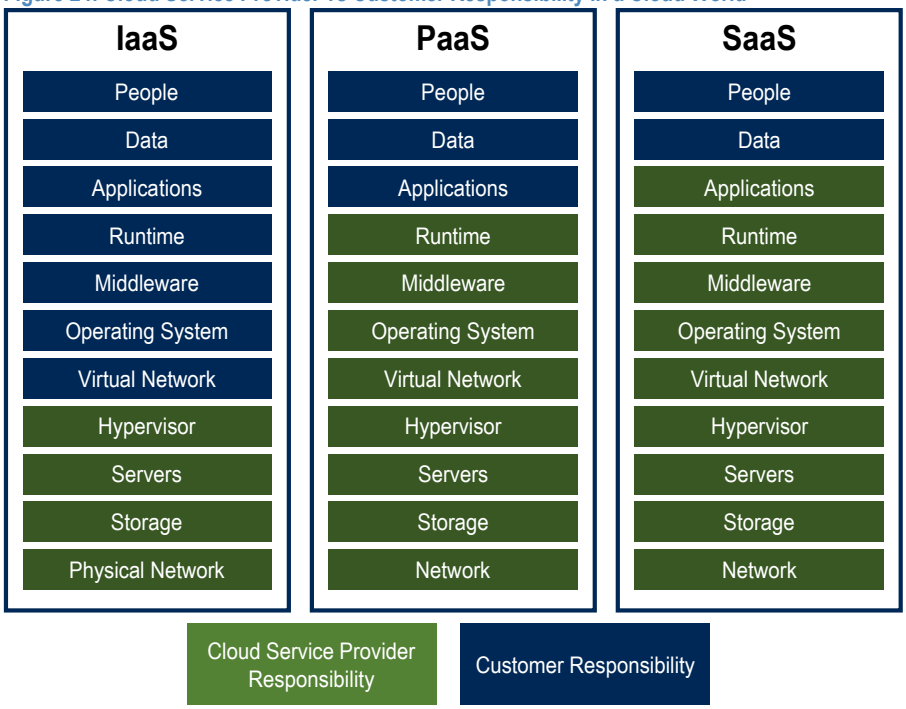
Figure 23: Security in a Shared Responsibility Cloud Model



Source: AWS.

While customers' responsibilities depend on whether they are using cloud for infrastructure (IaaS) or for applications (SaaS), they are ultimately responsible for securing what they put in the cloud and that involves data and people.

Figure 24: Cloud Service Provider vs Customer Responsibility in a Cloud World



Source: J.P. Morgan Research, Gartner, US Department of the Interior.

We have done deep dives into specific portions of Cloud Security (See CDN/Cloud Security Primer here and SD-WAN Primer here). Given the various customer responsibilities and definitions of cloud security, we thought it would be helpful to outline in a consolidated manner all the different solutions and vendors that address different things inside of an enterprise network, as seen in Figure 25.

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The Different Types of Cloud Security

Figure 25: Securing the Cloud Chart

Market Dynamics & Vendors

Cloud Access Security Broker (CASB)
- **Market Size:** $590M **Growth:** 33% **Penetration** 20%
- **Vendors:** Cisco (CloudLock) Forcepoint, Fortinet, Netskope, McAfee (Sky High Network), Microsoft, Proofpoint, Zscaler

Cloud Secure Web Gateway (SWG)
- **Market Size:** $1.4B **Growth:** +20% **Penetration** 40%
- **Vendors:** Broadcom (Symantec), Cato Networks, Cisco, Cloudflare, iBoss, Palo Alto Networks (Prisma Access), McAfee, Menlo Security, Zscaler

Cloud Workload Protection
- **Market Size:** $1.2B **Growth:** +20% **Penetration** <5%
- **Vendors:** CrowdStrike, McAfee, Palo Alto Networks (Prisma Cloud), Qualys, Trend Micro, VMware (Carbon Black), Zscaler (Edgewise)

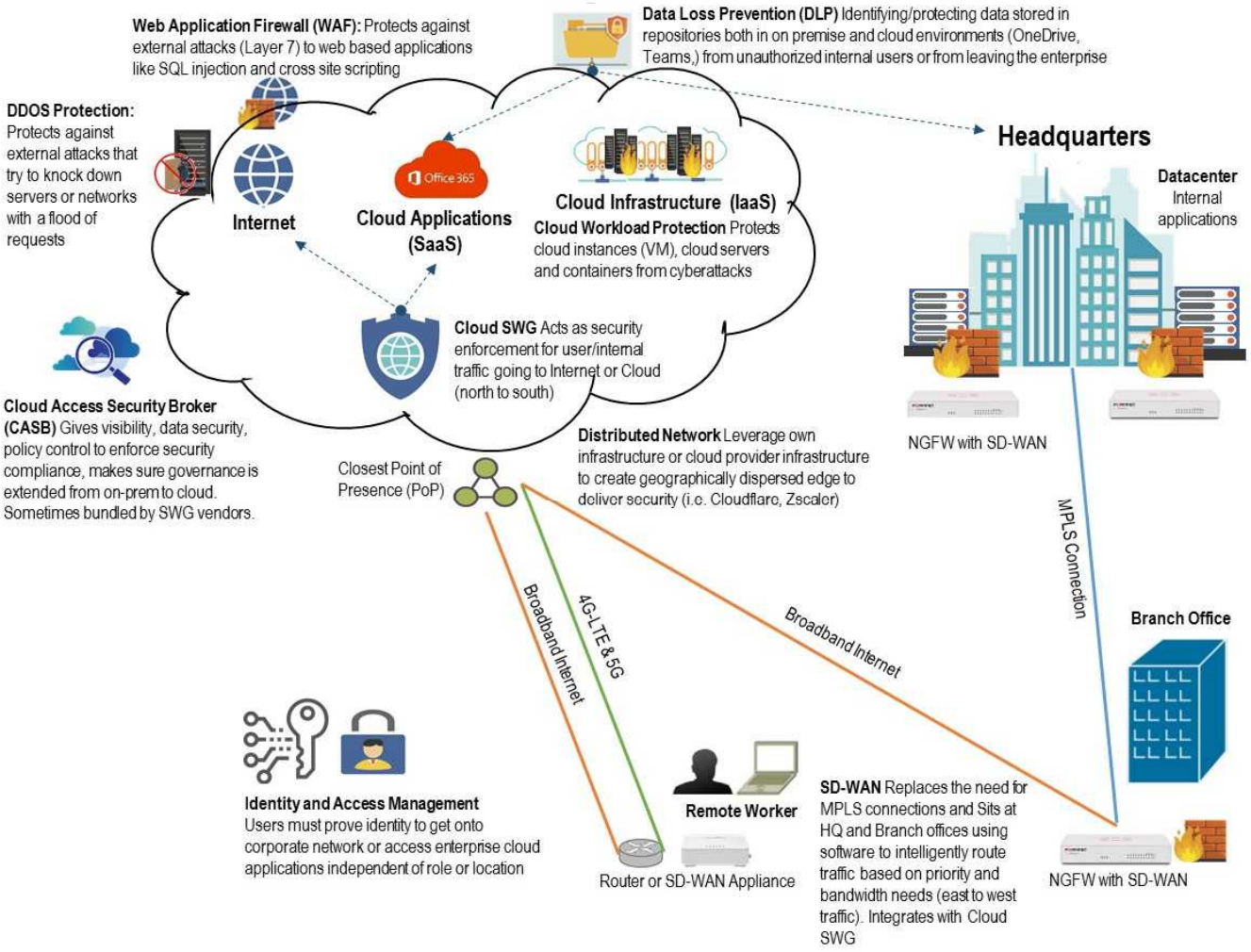
Distributed Denial of Service (DDOS) Protection
- **Market Size:** $1.5B **Growth:** 16% **Penetration** >50%
- **Vendors:** Akamai, AWS, Cloudflare, Fastly, F5, Neustar, Imperva

Data Loss Prevention (DLP)
- **Market Size:** $1.5B **Growth:** 11.5% **Penetration** <40%
- **Vendors:** Broadcom (Symantec), Digital Guardian, Forcepoint, McAfee, Sailpoint, Varonis

Next-Gen Firewall (NGFW)
- **Market Size:** $12.4B **Growth**: 6% **Penetration**: >75%
- **Vendors:** Barracuda Networks, Cisco, Check Point, Fortinet, Forcepoint, Juniper, Palo Alto Networks

Software Defined Wide Area Networking (SD-WAN)
- **Market Size:** $3.5B **Growth**: 24% **Penetration**: 35%
- **Vendors**: Cisco (Viptela), Cato Networks, Fortinet, HPE (Silver Peak), Palo Alto Networks, VMWare (VeloCloud),

Web Application Firewall (WAF)
- **Market Size:** $910B **Growth:** 9% **Penetration:** >75%
- **Vendors:** Akamai, AWS, Barracuda, Cloudflare, Fortinet, F5, Fastly (Signal Sciences), Imperva



Source: J.P. Morgan Research, Gartner, IDC.

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Deals in Cybersecurity – IPO and M&A

This year saw Palo Alto continue its 2019 acquisition trend, buying three new companies for a total of $1.5B. SD-WAN was a hot area for M&A, with at least four transactions, as providers look to compete for the +$20B in MPLS spend and trend towards the cloud. In terms of IPOs, MCFE came back public for the second time at an $8.6B market cap. Growth in the company is coming from the Consumer segment, while the Enterprise segment faces heated competition and since pricing shares have underperformed.

Table 21: Notable M&A Deals in Cybersecurity

Announced Date	Acquirer	Target	Target Description	Deal Value ($M)	Transaction Multiple
11/20/2020	FireEye	Respond Software	Automates Security Alerts	186	20x TTM Sales
11/11/2020	Palo Alto Networks	EXPANSE	Attack Surface Management	800	11.9x NTM Sales
10/27/2020	Akamai	Asavie Technologies	IoT and 5G Security	155	
10/19/2020	Juniper	128 Technology	SD-WAN	450	11x NTM Sales
9/23/2020	Crowdstrike	Preempt Security	Zero Trust and Conditional Access	96	
9/17/2020	Cradlepoint	Ericsson	SDWAN	1100	8x TTM Sales
9/16/2020	Checkpoint	Odo Security	Secure Remote Access	30	
8/27/2020	Fastly	Signal Sciences	Web Application Security	775	~18x NTM Sales
8/24/2020	Palo Alto Networks	Crypsis Group	Security Consulting	265	-
7/30/2020	Mimecast	MessageControl	Messaging Security	17	
7/20/2020	Fortinet Inc	OPAQ Networks	Secure Access Service Edge	8	
7/13/2020	HPE	Silver Peak	SD-WAN Provider	925	7x TTM Sales
5/28/2020	Zscaler	Edgewise Networks	App to App Security	31	
5/13/2020	CyberArk	Idaptive	IAM SaaS player	70	~4x EV/ARR
5/8/2020	Proofpoint	The Defence Works	Security Awareness Training	3	
4/28/2020	Rapid7	DivvyCloud	Cloud Security/Container Security	145	
4/9/2020	Zscaler	Cloudneeti	CSPM	9	
3/31/2020	Palo Alto Networks	CloudGenix	SDWAN	420	~5x TTM Billings
3/16/2020	Hellman & Friedman	Checkmarx	Application Security	1150	
2/18/2020	STG	RSA	IAM Vendor	2075	
2/6/2020	Advent	Forescout	Device Security, Visibility, and Control	1316	3.9x NTM Sales
2/4/2020	Lexisnexis Risk Solutions	Emailage	Transaction/Fraud Security	480	
1/21/2020	FireEye	Cloudvisory	Cloud Security		
1/13/2020	Lexisnexis Risk Solutions	ID Analytics (NortonLifeLock)	Credit and Risk Fraud Analytics	375	6.25x TTM Sales
1/7/2020	Cloudflare	S2 Systems	Browser Isolation	40	
1/7/2020	Accenture	Symantec Services Business	Services Business		
1/6/2020	Insight Partners	Armis	IoT Security	1100	
1/6/2020	Mimecast	Segasec	Digital Threat Protection	24	
12/9/2019	F5	Shape Security	Credential and Fraud Portection	1000	9.5x NTM Sales

Source: J.P. Morgan Research, Bloomberg L.P, Crunchbase and Company Filings.

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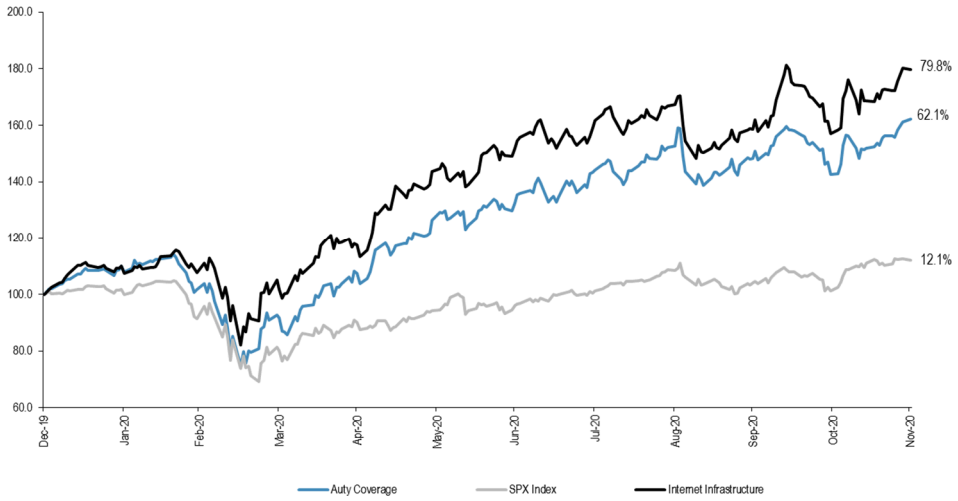
Internet Infrastructure – Naming Could Improve with Better Economic Outlook

The Internet Infrastructure segment of our coverage is comprised of companies participating in Naming (domain name registration, website building, e-commerce, and other services surrounding the creation, operation/management, and marketing of the website) and content delivery (CDN and associated cloud security). Earlier in the pandemic, the Naming segment came under particular pressure over concerns around small business closures, but has proven resilient despite the economic backdrop. There has been significant divergence in the performance of stocks in the Naming segment, but we believe an improving economy likely provides an environment for improving demand and stock performance for names in the space. The CDN segment has enjoyed significant tailwinds throughout the pandemic that we believe are reflected in the stock performances.

The figure below shows the performance of our Internet Infrastructure coverage group relative to our overall coverage and the S&P, as of 11/30/20.

Figure 26: Internet Infrastructure Performance Relative to S&P 500.



Source: J.P. Morgan Research, Bloomberg as of 11/30/2020.

Naming – Registry and Registrar, an Introduction

A domain name is a digital presence on the Internet with a specific address so that others can access it online. The Domain Name System (DNS) makes it easier to find a given location on the Internet by associating a string of letters, called a domain name, to an IP address. For example, instead of searching for the intersection of West 46th Street and 7th Avenue (IP Address), it is much easier to locate Times Square (domain name) on Google Maps.

gTLD – Generic Top-Level Domain

DNS – Domain Name System

DNS root zone – Top-level DNS zone in the namespace of the Internet

Root zone operator – Responsible for the day-to-day management of the DNS root zone

Root zone maintainer – Provides services for the signing management of the root zone (DNSSEC seal)

IANA – Internet Assigned Numbers Authority

ICANN – Internet Corporation for Assigned Names and Numbers

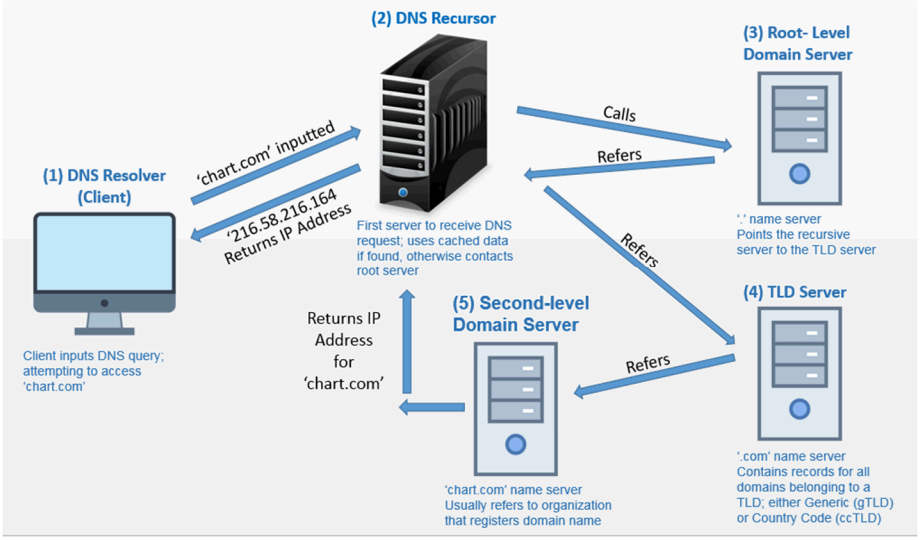
NTIA – National Telecommunications and Information Administration

DNSSEC – Technology that digitally signs DNS answers for validity check.

Different parties work together to maintain a functioning DNS

Getting a domain name requires: 1) selecting the registrar; 2) selecting which top-level domain (TLDs such as .com) and second-level domain to use (like 'jpmorgan' in jpmorgan.com); and 3) deciding the number of years to register the domain name. A Registrar processes the registration for the selected domain name, and does it through Registry, the entity that maintains the DNS database for the selected domain name. After the registration process is complete, the registrant has a functioning address for its entity located in the DNS, enabling other users to access its contents. When a user types in a domain name uniform resource locator (URL) in the browser like www.jpmorgan.com, the DNS server provides the IP address to locate the website in the internet, which leads the user to the name server that in turn delivers content to the user. A high-level representation of what happens when a client initiates a DNS query is shown in Figure 27. There are ~700 unique registrars, while the registries like VeriSign enjoy exclusive registry rights to certain TLDs like .com and .net, which eliminates competition. Third-party registrars have to pay the registry for each name they register using one of registry's TLDs. On the back end, there are key components of the DNS root zone managed by ICANN and VeriSign to manage the changes and to ensure that the zone file runs smoothly, which we explain below.

Figure 27: The Life-Cycle of a DNS Query



Source: J.P. Morgan Research.

Internet activity depends on proper root zone management

A root zone management system is a set of tools that allows a number of parties to collaboratively manage the DNS root zone. These parties perform administrative roles that are collectively called the Internet Assigned Numbers Authority (IANA) functions. IANA functions include:

- The maintenance of the registry of technical Internet protocol parameters;
- The administration of certain responsibilities associated with Internet DNS root zone; and
- Allocation of Internet numbering resources.

The system enables registries to submit change requests, communicate those requests to the Root Zone Operator (ICANN), and implement them through Root Zone Maintainer (VeriSign) if the requests are consistent with TLD policies.

Regulation Update – VRSN Price Increases on the Horizon

In November 2018, the National Telecommunications and Information Administration (NTIA) within the U.S. Department of Commerce agreed to extend and amend VeriSign's Cooperative Agreement for managing the .com domain name. The amendment repealed Obama-era price controls to allow VRSN to increase prices by 7% in the final four years of the six-year .com Registry Agreement. The amendment also clarifies vertical integration restrictions in the sector, now opening up the potential for VRSN to own registrar operations for TLDs that are not .com. We believe this price increase should not impact registrars, as they are likely to pass on this increased costs to the customers, like they did for the last couple of price increases before 2012. But if VeriSign decides to enter the registrar segment, it could have a meaningful impact on the competitive landscape of the overall naming industry.

Background on the Cooperative Agreement

In 2016, ICANN extended the .com Registry Agreement through November 2024, allowing VeriSign to act as the sole registry operator for .com. At this time, the Cooperative Agreement (CA) provided that the maximum price of a .com domain name should not exceed $7.85 for the term of the Registry Agreement. The CA was set to expire on November 30, 2018, unless the Department of Commerce (DOC) renewed the term and subsequently capped pricing. On November 1, 2018, VRSN and the NTIA announced an amendment that would grant VRSN pricing flexibility to increase .com prices by allowing the company to modify its .com RA with ICANN.

New Cooperative Agreement allows 7% price increase in four of the six years

Amendment 35 permits VRSN to raise .com domain name prices up to 7% per year in each of the final four years of the six-year .com Registry Agreement. Explaining its decision to grant pricing flexibility, the DOC stated that social media, ccTLDs, and new gTLDs have created "a more dynamic DNS marketplace," making it necessary for VRSN to have pricing flexibility. The agreement also simplifies the renewal process, giving automatic approval unless a change is sought in any of the key elements including pricing.

VRSN freezes prices through March, commits to increases by Oct. 25, 2021

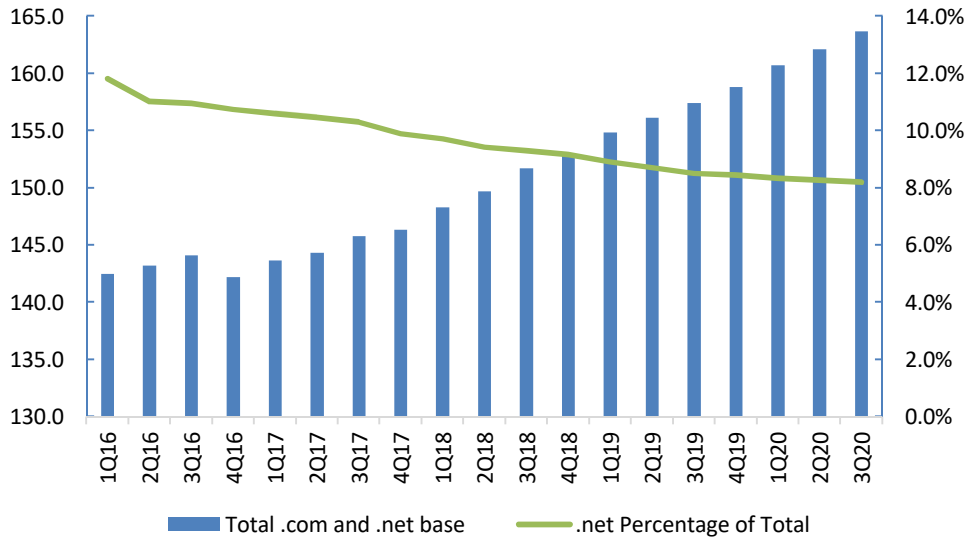
In January 2020, ICANN put out for public comment its agreement with VeriSign that amended the Registry Agreement for .com to officially grant pricing power to VRSN. Though the processing of these public comments took slightly longer than initially expected, the final Staff Report was published on March 26, and the official passing of the amendment to raise .com prices was announced just one day later. Right around that time, however, VeriSign announced its decision to freeze prices for all TLDs through the end of 2020 in response to the economic uncertainty caused by COVID-19 and later announced that it would extend these price freezes through March 31. We were not surprised by the decision to freeze prices, as management has traditionally been conscientious of the economic environment and the conditions for its ultimate domain end customers. On the second quarter earnings call in July, management committed to utilizing its first .com price increase prior to the October 25, 2021 deadline, and reiterated this intention on its most recent call. The company

is still obligated to notify the public of increases at least six months in advance, but we believe it is unlikely that management will announce increases before the end of calendar year 2020.

.net base declining as a percentage of total and price increases for .net not likely

After raising prices for .net by 10% per year for seven straight years, VeriSign did not raise prices any further in 2019, perhaps due to the shrinking .net base. We do not expect pricing changes for .net in the near term, as price increases could cause the base to erode further. The declining .net base as a percentage of VeriSign's overall domain portfolio is shown graphically in Figure 28, below. While the company's total .com and .net domain base has grown from 142.5M names in 1Q16 to 163.7M in 3Q20, the majority of this growth has come from .com, as the representation of .net has shrunk from 11.8% to 8.2% over that same time period.

Figure 28: Declining Percentage of .net in VRSN's Total Domain Base



Source: VeriSign Zone File, Company Reports.

Background on .web arbitration proceedings between Afilias and ICANN

At an auction in July 2016, Nu Dot Co LLC won the right to operate the .web TLD after offering the highest bid of $135M, chiefly funded by VeriSign. In 2018, losing bidder Afilias filed a form of arbitration proceeding against ICANN, alleging that the agreement between VRSN and Nu Dot Co violated ICANN's new gTLD Applicant Guidebook and that the proposal should therefore be disqualified. Though Afilias initially moved to oppose VeriSign's and NDC's participation in the Independent Review Process (IRP), in February the IRP Panel decided to allow these companies to participate in certain aspects of the IRP. The arbitration proceedings between Afilias and ICANN began on August 3rd of this year, and management indicated that a final decision could come later this year or early in 2021.

.web opportunity could be very important to the franchise going forward

Due to the ongoing arbitration proceedings mentioned above, it remains to be seen whether VRSN will invest in .web, and to what extent. If management does invest in .web, we expect to see them allocate a significant amount of sales and marketing expenditure to building out the domain name, and margin expansion to slow proportionately to the level of investment. We also believe that .web could be very

important to the VeriSign franchise going forward given that .com's growth into perpetuity is not guaranteed. While older generations may have an affinity towards using traditional domain names like .com, younger generations do not have this same loyalty and instead are increasingly seeking out novel TLDs.

Vertical Integration and Industry Consolidation Begins

GDDY enters registry operations through April acquisition of Neustar registry

In early April of this year, GoDaddy announced its plan to acquire Neustar's registry business and later unveiled the purchase price of $218M. This acquisition brings in a robust portfolio of TLDs, such as .biz, .co, .in, .nyc and .us, in addition to the support of over 215 total TLDs and roughly 12 million domains. Also included in the Neustar registry business was its Managed Registry Services business, which provided registry management for over 130 brand TLDs and 70 generic TLDs. In addition to expanding GDDY's domain name base, the acquisition, which closed in early August, adds backend registry technology and domain security systems. Our notes from covering Neustar when public and the 10Q published in August 2017 suggest that the registry business was then generating north of $120M and carried EBITDA margins north of 50%. However, since GoDaddy's business was a significant revenue source for the Neustar registry, it is unclear how much of this revenue remains. GoDaddy will operate the newly acquired registry technology under the name GoDaddy Registry and independently of its existing registrar business.

Possibility for VeriSign to own registrar operations other than .com

In addition to allowing for price increases, Amendment 35 also clarifies vertical integration restrictions on VeriSign's ability to own ICANN-accredited registrars, stating that VRSN is only restricted from owning registrar operations for .com. Consequently, this opens up the potential for VRSN to own registrar operations for new TLDs such as .web and .net. VeriSign abandoned its registrar functionalities in 2003 with the sale of Network Solutions, and a 2012 agreement precluded the company from acting as both a registry and registrar. Since the registrar industry has proven to be more stable and lucrative than the last time VRSN participated in it, we believe it is possible that VRSN will seek to obtain both registry and registrar capabilities for new TLDs, which would bring VRSN into direct competition with leading registrars such as GoDaddy. When we ask VeriSign management if they intend to become more vertically integrated, the answer continues to be that they are not in a position to give guidance, but that vertical integration is not a new idea. We do not believe there is much to read into in that comment.

GoDaddy acquisition could mark the beginning of a consolidation trend

GDDY's acquisition of the Neustar registry business could represent an offensive move by the company in response to VeriSign's clarified ability to pursue the strategy of vertical integration. More generally, the acquisition could mark the beginning of a consolidation trend of vertical integration between registries and registrars, which would give the companies the ability to control both ends of the underlying operations and to keep both the retail and wholesale prices of domains. Out of the two, the registry business has shown far superior margin potential, and that could be enhanced by a company like GoDaddy providing both the supply and go-to-market channel on these domains. Overall, a key question for any company entering the registry space, including GoDaddy, will be how it manages the agreements with other registrars on the domains for which it provides registry services.

Maturity of TLD space could give potential for roll-up by one vendor

The dynamic domain marketplace that exists today did not begin in earnest until 2012, when a new program allowing companies to apply for TLDs led to the entrance of thousands of unique TLDs in the marketplace. We believe the abundance of new domains that have become available over the last eight years creates opportunities for companies to increasingly pursue vertical integration and become the sole provider of solutions centered on select domains. More specifically, a company could choose to roll up a variety of these TLDs under a singular brand image and heavily market the brand as a new and popular Internet destination. Though we have not seen any notable registries or registrars move in this direction to date, we see it as a potential trend that could emerge going forward in response to the underlying dynamics and sheer number of TLDs available today.

Domain Registration Remains Strong amid COVID-19, Tracking Ahead of 2019 Levels

After a slowdown in domain registrations in 2019, a result of the growing emerging market mix, name additions bounced back in 2020 and are now tracking ahead of both 2017 and 2019 levels. This favorable outcome in domain registrations occurred in spite of the backdrop of economic uncertainty that emerged at the onset of COVID-19 in March. Though the renewal rate dipped to 72.8% in the June quarter on the back of lower first-time renewals, this rate had already bounced back by 600 basis points by the September quarter. The resilience of the domain market was evident in VeriSign's recorded new (gross) domain registrations, which came in at multi-year highs of 11.1M and 10.9M in the second and third quarters, respectively. In both periods, management indicated that the strongest regions for growth were North America, EMEA, and APAC. This strength also manifested in the company's FY20 domain base growth expectations, as it raised guidance to 2.75-4% in the second quarter and 3.5-4% in the third quarter, in response to consecutive quarters of strong net additions and a domain environment that was healthier than once feared.

VRSN zone file shows YTD domain additions tracking ahead of 2019 and 2017

When analyzing the impact of the recent economic environment on the Internet Infrastructure industry, one of the best places to look is VeriSign's zone file, which tracks the company's daily domain name additions, particularly for .com and .net. Our analysis of these additions to date shows sustained strength in domains since the onset of COVID-19. In fact, .com and .net additions for 2020 are tracking ahead of 2019 and 2017 levels, as seen below in Figure 29. To date in 2020, the zone file has shown cumulative .com and .net additions of 5.8M, ahead of 2019 and 2017 levels of 5.4M and 4.2M, and slightly behind 2018 cumulative additions of 6.1M. Figure 29 below shows these levels through the end of October. When analyzing the additions on a monthly basis rather than on a cumulative basis, we see that for six singular months of 2020 including February, June, August, and September, 2020 .com and .net additions came in ahead of 2019 levels.

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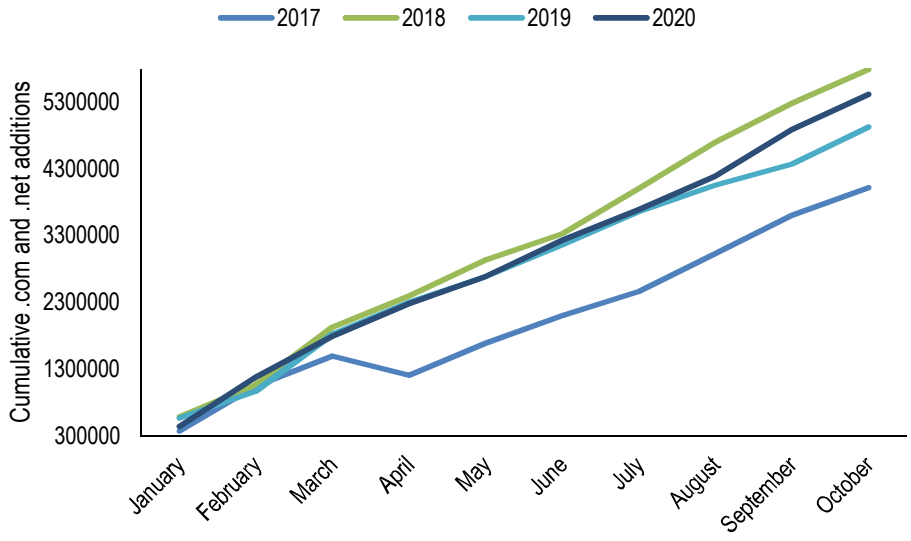
Figure 29: 2020 YTD Cumulative Additions Tracking Ahead of 2019



Source: VeriSign Zone File.

Cyclically sensitive nature of the domain naming business

Almost 100% of VeriSign's revenue relates to domain registry operations, with the only non-domain-related revenue coming from backend operations for other registries, root zone maintenance, and certain consulting services. Recall that the domain naming business is cyclically sensitive, as the total name base typically grows at around GDP plus 200 basis points. The past two quarters have demonstrated very erratic movement in real GDP, with the second quarter showing the most severe pandemic-induced contraction on record and the third quarter showing a 33% annual increase. This historic third-quarter growth recovered two-thirds of the economic output lost due to the pandemic during the first half of the year, which took 4 times longer to occur in the 2008-2010 recovery. Though the naming business has not entirely mirrored this movement in recent months, its usual cyclical patterns should return as GDP stabilizes and the economy begins to reopen.

This cyclicality manifested in the Global Financial Crisis as well, as growth slowed for both total domain registrations across all TLDs and registrations of .com and .net specifically (see Table 22). After registrations for all TLDs and the .com and .net base grew nearly ~28% and ~24% in 2007, respectively, this growth declined by nearly half in 2008 and 2009.

Table 22: Domain Name Additions Show Cyclicality in Global Financial Crisis

	2006	2007	2008	2009	2010	2011
Registrations across all TLDs	120	153	177	192	205.3	225
YOY Growth		*27.5%*	*15.7%*	*8.5%*	*6.9%*	*9.6%*
Registrations of .com and .net	65.0	80.4	90.4	96.7	105.2	113.8
YOY Growth		23.7%	12.4%	7.0%	8.8%	8.2%

Source: VeriSign Domain Name Industry Brief, Company Data.

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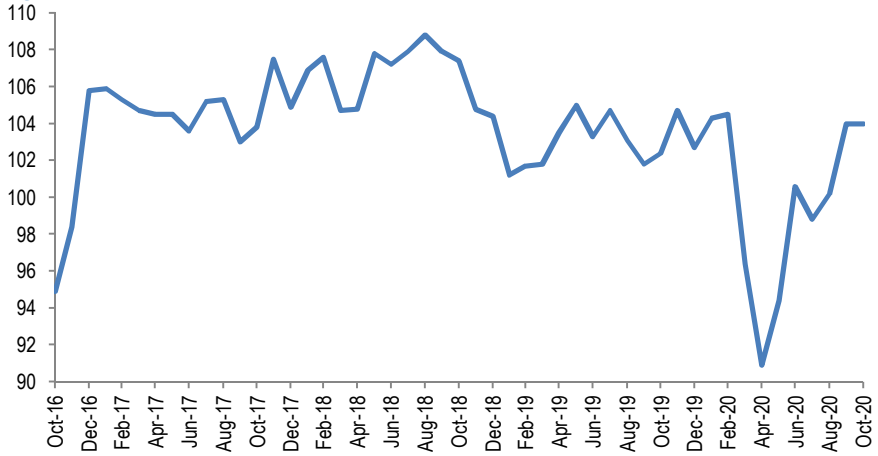
Domain resilience propelled by digital transformation of small businesses

Demand for domains has remained strong despite recent economic uncertainty, in part due to the fact that COVID-19 has required millions of small businesses to close their physical locations. As a result, for many businesses to stay up and running, their operations and marketplaces have had to be shifted online. A small scale study conducted by Clutch.co in January 2018 suggests that this shift to digital may be a first for many businesses, citing that only 64% of small businesses had a website. Though more businesses have undoubtedly moved online since that time, it is likely that there is still a significant percentage of businesses that have not digitally transformed. Today, small businesses benefit from the ability to more easily move their business models to digital, with new-age features like online purchasing and advanced commerce capabilities. Wix and GoDaddy have already seen this trend manifest in their businesses, with GDDY citing a 90% annual increase for net additions of its commerce tier in the second quarter and WIX's e-commerce growth rate more than doubling that of the overall business in the most recent quarter. Going forward, we expect to see further innovation and entrepreneurship among individuals who are looking to make the most of the current situation, and continuation of the digital shift as a result.

NFIB Small Business Optimism Index returning to 2019 levels

Another data source that is valuable in evaluating small business sentiment is the NFIB Small Business Optimism Index. This index is a compilation of small business survey results ranging from expansion expectations to hiring plans and sales forecasts. Two additional factors that had significant influence on the index's movement in 2020 were the economic uncertainty related to COVID-19 as well as the recent presidential election. At the onset of the pandemic in March, the index plummeted 8 points to 96.4, before falling to 90.9 in April, representing its lowest level since March 2013. The following months saw a quick rebound in the index as portions of the economy reopened, the stock market erased its 2020 losses, and sentiment improved. The index now stands comparable to 2019 levels, coming in at 104 for two consecutive quarters in September and October. A more granular look at the October survey shows that 33% (seasonally adjusted) of small business owners had job openings and 18% planned to create new jobs over the next three months, indicating that SMBs are not only stabilizing, but looking to expand.

Figure 30: NFIB Small Business Optimism stands at 104 for two consecutive quarters



Source: SBOITOTL Index, Bloomberg Finance L.P.

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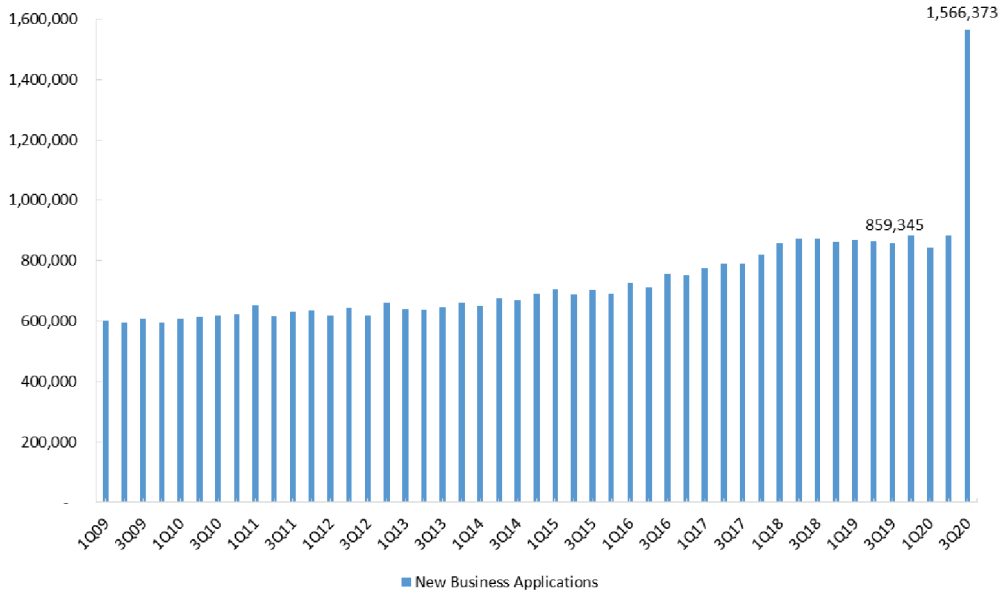
U.S. Census Bureau sees 700,000 YOY increase in business applications in 3Q20

Recent data show that in 3Q20, there were over 700,000 more applications to form a new business than in 3Q19. As seen in Figure 31, below, 1.57M new business applications were filed in the most recent quarter, representing a 182.3% increase over 3Q19's level of 859K. This surge in applications occurred just two quarters into the COVID-19 pandemic, indicating that our initial concerns surrounding lagged business weakness are not manifesting in the way that we once feared. It also stands in contrast to the Global Financial Crisis, when applications plummeted. Though there may be a lag between business applications and the actual formation of the business, these data are a very positive sign for business creation sentiment.

Figure 31: Business Applications Grew by 700,000 Annually in 3Q20



Source: U.S. Census Bureau.

New gTLDs saw uptick at beginning of 2020 before flattening in recent months

New gTLD growth showed the same pattern in both 2019 and 2018 – while registration was flat for much of the year, it showed a significant bounce back in the last three months of the year. In 2020, we saw this pattern invert, where growth in new gTLDs in the first few months of the year was followed by a slowdown and slight decline in the later months. The number of new gTLD domains has declined by roughly 3M over the past two months, falling from 35.5M in mid-September to 32.5M as of late November, as seen in Figure 32. It appears that .icu, a gTLD owned by the ShortDot SA domain registry, is responsible for a significant portion of the overall decline, as its registrations fell by over 1M since mid-September. Since becoming generally available in May 2018, .icu has been the fastest growing new gTLD, expanding from 1M domains in July 2019 to over 6M domains by mid-2020. Therefore, its relative slowness in the back half of the year could just signify that the domain market is letting some necessary air out of the gTLD.

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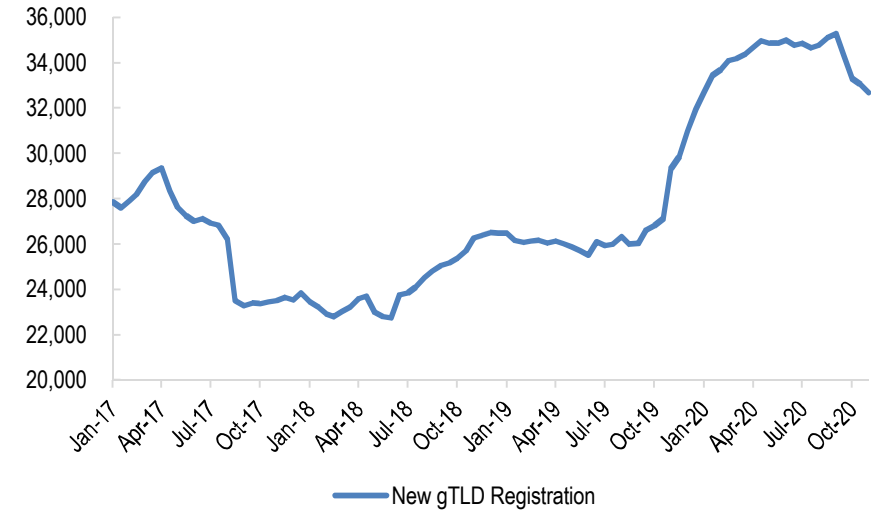
Figure 32: Total new gTLD registration in 2020

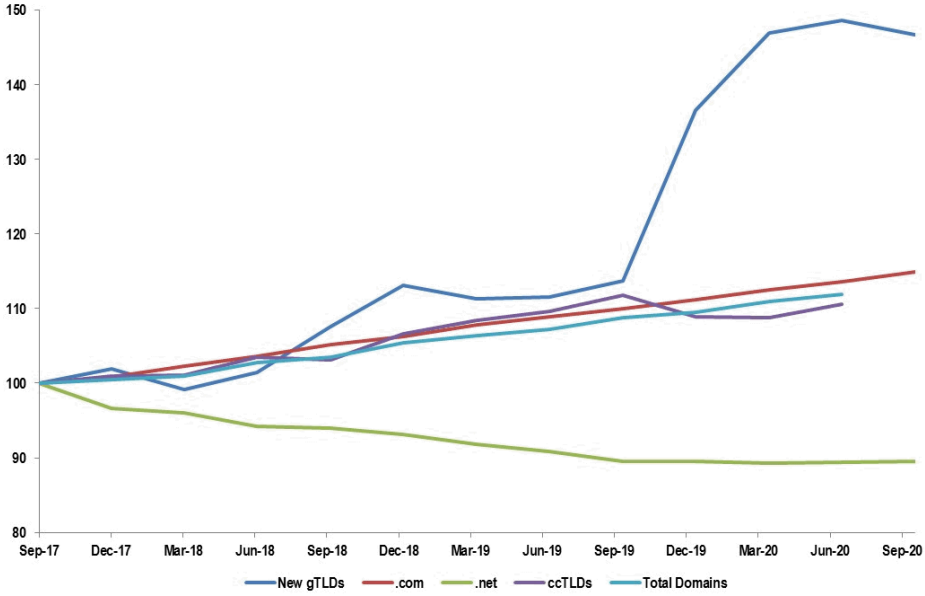


Source: ntldstats.com; data as of 11/19/20 (in thousands).

New gTLD growth could indicate a more permanent shift in consumer demand

Figure 33 shows the comparison of new gTLDs versus .com, .net, ccTLDs (country level domains like .tk, .uk) and total domain names (data normalized for September 30th, 2017). Despite the very recent slowdown in new gTLD growth, this graph shows that overall new gTLD growth in recent years has significantly outpaced the growth of other domains including .com. The rapid adoption of unique gTLDs could be indicative of consumer demand shifting away from straightforward domain functionality, including traditional TLDs like .com and .net, to enhanced and differentiated domain functionality. We believe that now more than ever, consumers who are looking to register domains do not feel obligated to use the .com industry standard and instead are seeking out novel domains to make their brands stand out.

Figure 33: New gTLDs outpace growth of .com, .net, ccTLDs and Total Domains



Source: ntldstats.com, VeriSign Zone File, VeriSign Domain Name Industry Brief.

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Registrars – Space Is More Differentiated than Investors Think

We often get questions from investors related to the crowded nature of the registrar space, the total number of registrars, and how the space is differentiated when you include the website builders and hosting providers. For several years now, we have attempted to shed light on these topics by tracking the number of accredited registrars in existence according to the ICANN website. This year's count of 649 accredited registrars reflects that the space remains just as crowded as in years past.

ICANN website points to 649 unique accredited registrars, similar to 2019

The ICANN website includes a public list of companies accredited by ICANN to act as registrars in one or more generic top-level domains (gTLDs). Since many of the registrars have the same underlying URL, we filtered through the list to find the number of unique and non-overlapping URLs. An increasing number of accredited registrars are attributable to companies that register recently dropped (non-renewed) names into inventory that they can then sell in the after-market. An example of this is DropCatch.com, which accounts for over one thousand registrar names associated with the URL www.NameBright.com. We counted all of the DropCatch names as a single registrar, and also removed any registrars that contained nearly the same URL as another, such as Dynadot, Dynadot0, Dynadot1, etc.

After sorting the list with the aforementioned methods, we arrived at a total of 649 unique accredited registrars. It is important to note that this number may be lower due to the fact that ICANN lists Wild West Domains and GoDaddy.com as separate registrars, while they belong to the same company. The number of unique accredited registrars has been steadily declining in the past several years, dropping from 888 in 2012, but this year's count of 649 suggests that the number has remained relatively stable over the last calendar year. In Table 23 we summarize our findings since 2012.

Table 23: Unique Accredited Registrars and Geographic Distribution

Year	Unique Registrars	Countries Represented						
		US	Canada	China	HK	India	Germany	UK
2012	888	459	117	36	4	17	23	19
2013	819	451	39	44	6	14	24	21
2014	749	354	26	67	8	14	26	24
2015	820	424	23	63	21	15	27	20
2016	757	290	21	71	27	63	27	21
2017	724	243	21	86	33	60	27	20
2018	653	197	21	78	33	59	24	22
2019	647	169	20	79	39	60	23	23
2020	649	186	17	77	42	60	23	21

Source: ICANN, J.P. Morgan Research.

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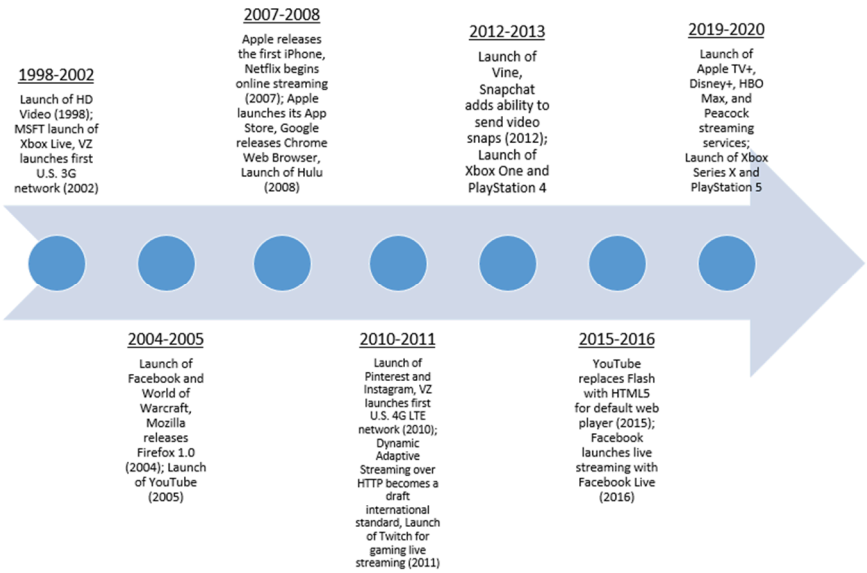
Content delivery – Two Console Releases and Unprecedented E-commerce Activity

Figure 34: Timeline of CDN Catalysts over the Years



Source: J.P. Morgan Research.

The amount of content on the Internet has exploded over the last decade. Figure 34 above shows a brief history of top CDN catalysts throughout the years, stemming from the release of HD video in 1998 to the release of various video streaming services and gaming consoles in 2020. Key drivers of Internet traffic growth have included Apple's iPhone launch, the progression from 3G to 5G, the launch of YouTube, various multiplayer video game releases, and live streaming on platforms like Facebook. Estimates from Cisco indicate that these levels are not slowing down anytime soon, as the company predicts that more IP traffic will flow across the Internet from 2017-2022 than in the whole history of the Internet. Cisco's Visual Networking Index (VNI) Forecast projects global IP traffic to grow at a CAGR of 26% from 2017 to 2022, driven by mobile data growing the fastest at a CAGR of 46%, and fixed Internet growing at 26%. This forecast is shown below in Table 24.

Cisco estimates that CDNs will carry 72% of all Internet traffic by 2022

Global IP traffic is expected to reach 396 exabytes per month by 2022, tripling from 122 exabytes per month in 2017. This estimate is equivalent to 4.8 zettabytes of traffic per year by 2022, and content delivery networks (CDNs) are well-positioned to be the distribution channel for this traffic. In fact, Cisco estimates that CDNs will carry 72% of all Internet traffic by 2022. By distributing content to the servers that are closest to the end user who is requesting the content, CDNs can be effective in reducing webpage load times and moving large, content-rich media or video game files with reduced lag.

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Table 24: Cisco Estimates for Global IP Traffic for 2017-2022

IP Traffic, 2017–2022	2017	2018	2019	2020	2021	2022	CAGR (2017-2022)
By Type (Petabytes [EB] per Month)							
Fixed Internet	85	107	137	174	219	273	26%
Managed IP	26	31	35	40	44	45	11%
Mobile data	12	19	29	41	57	77	46%
By Segment (EB per Month)							
Consumer	100	129	167	212	267	333	27%
Business	22	27	34	42	52	63	23%
Total IP traffic	**122**	**156**	**201**	**254**	**319**	**396**	**26%**

Source: Cisco Visual Networking Index.

Price declines offset by explosions in volume create revenue growth for CDNs

Since 2015, the content delivery industry has suffered from increasing competition and the lack of catalysts that would require fast, reliable and scalable services. Prices have been steadily declining by ~20% per year for the last 10-15 years, meaning revenue growth for CDNs involves volume growth offsetting these declines. The fact that CDN revenue continues to increase is indicative of the explosion in volume of traffic that is occurring over these channels. While this level of pricing commoditization has occurred for quite some time, CDN demand does ebb and flow based on volume drivers in the market. For example, when HD content hit its inflection point, vendors saw a significant increase in volumes and a subsequent spike in revenue. More recent drivers of volume demand include the explosions within OTT video streaming services, online gaming, and work-from-home demand amid COVID-19.

Online gaming growing equally as fast as OTT video, at a CAGR of 21.6%

With the recent and upcoming releases of numerous OTT video streaming services, such as Peacock's official launch in July, streaming wars have escalated, and the OTT media services market has become more saturated than ever. Though we believe traditional CDNs like Akamai and Fastly are positioned to benefit from growth within OTT video for an extended period of time, media streaming is not the only area of growth for the market. In fact, IDC estimates that the sub-sector of online gaming is growing equally as fast as OTT video, at a CAGR of 21.6% through 2024. CDN vendors are directly positioned to benefit from growth in online gaming, as they provide faster execution of downloadable content (DLC) and are increasingly necessary in executing cloud-hosted multiplayer games with low latency. By utilizing a distributed network of servers that brings content closer and more accessible to the end user, CDNs are capable of delivering multiplayer game content simultaneously across different geographies, with faster loading and update times.

Table 25: Content Delivery Network Revenue by Service Type, 2019-2024E ($M)

Service Segment	2019	2024E	*2019-2024E CAGR*
OTT Video	4,408.1	11,882.0	*21.9%*
Web, Email, and Data	1,904.9	3,170.0	*10.7%*
Online Gaming	511.3	1,362.1	*21.6%*
File Sharing	59.1	74.3	*4.7%*
Total	**6,883.4**	**16,488.4**	***19.1%***

Source: IDC CDN Market Forecast, 2020.

After seven years, Sony and Microsoft release new gaming consoles

Though the gaming industry sees frequent video game releases, releases of new consoles are much rarer and occur only a handful of times per decade. The most recent occurrence happened to be in November 2020, as Sony's PlayStation 5 and Microsoft's Xbox Series X consoles launched just two days apart on November 12th and November 10th, respectively. These consoles are set to replace their predecessors, PlayStation 4 and Xbox One, which were both launched seven years ago in November 2013. The gaming industry generates a significant amount of internet traffic and relies heavily on CDNs to manage this traffic. Recall that a software update for a modern game can generate an amount of traffic that is equal to roughly 30,000 webpage visits.

Sony PlayStation 5 game installation sizes range as high as 133 GB

Sony does not have an in-house CDN, so it will rely on third-party CDNs like Akamai, Lumen (CenturyLink), and Limelight Networks for downloads on its new console. Information on the installation sizes of certain PlayStation 5 games shows install sizes ranging as high as 105GB for the game "Spider-Man: Miles Morales Ultimate Launch Edition" and 133GB for "Call of Duty: Black Ops Cold War." If you take the average file size for the games as roughly 60GB, this indicates that the gigabytes delivered for a singular game download are 27x larger than 60 minutes of video streamed at 5Mbps. Though Microsoft primarily relies on Azure Front Door for delivery of its content, it also uses third-party CDNs for delivery of certain static content like Windows updates. While it is difficult to estimate the exact impact of new consoles on Akamai, as the number of consoles being produced and the targeted regions for selling have not been disclosed, the company should see good contribution and related upside in the coming quarters.

Deloitte and Adobe forecasting online sales growth of ~30% over 2020 holidays

In addition to Akamai seeing contribution from two new gaming consoles in the fourth quarter of 2020, the company should also see strong contribution from a holiday season of unprecedented e-commerce activity. Foot traffic in brick and mortar businesses will likely be muted by concerns surrounding COVID-19, meaning many will go online to execute their holiday shopping. In its annual holiday retail forecast, Deloitte estimates that e-commerce sales during the November to January timeframe will grow by 25-35% annually to reach $182-196B. This is nearly double the growth rate seen in 2019, when sales increased 14.7%.

Similarly, Adobe predicts online sales growth of 33% this holiday season, expanding to $189M total. Though Cyber Monday sales came in at the low end of Adobe's forecasted range of $10.8-11.4B, at $10.8B, the company believes this holiday season will be less defined by singular days of e-commerce spikes and instead be at elevated levels throughout the entire season ("Goodbye Cyber Week, Hello Cyber Months"). Deloitte's retail survey indicates that 51% of holiday shoppers feel anxious about shopping in stores and 65% prefer shopping online to avoid crowds. The gap between online and in-store spending has accelerated in 2020, with online share of spend increasing by 500 basis points and in-store falling by 800 basis points, as seen in Figure 35 below.

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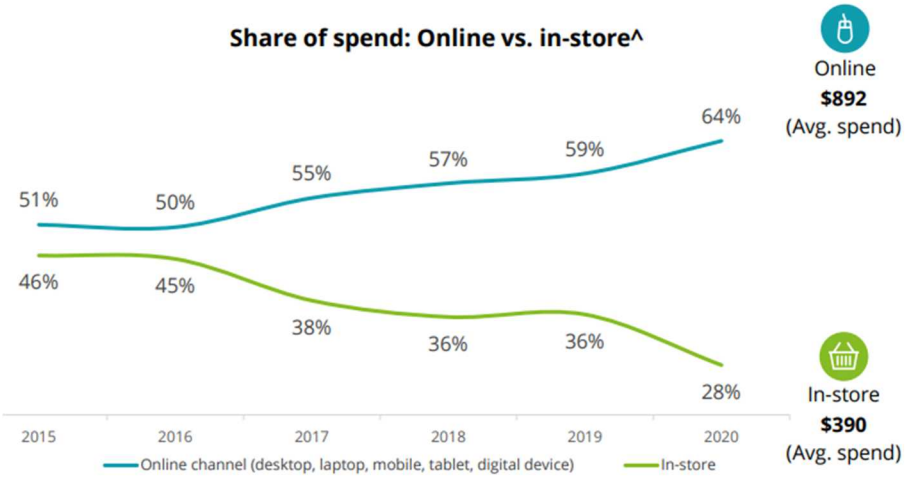
Figure 35: 64% of Shoppers Prefer to Shop Online in 2020



Source: 2020 Deloitte Holiday Retail Survey.

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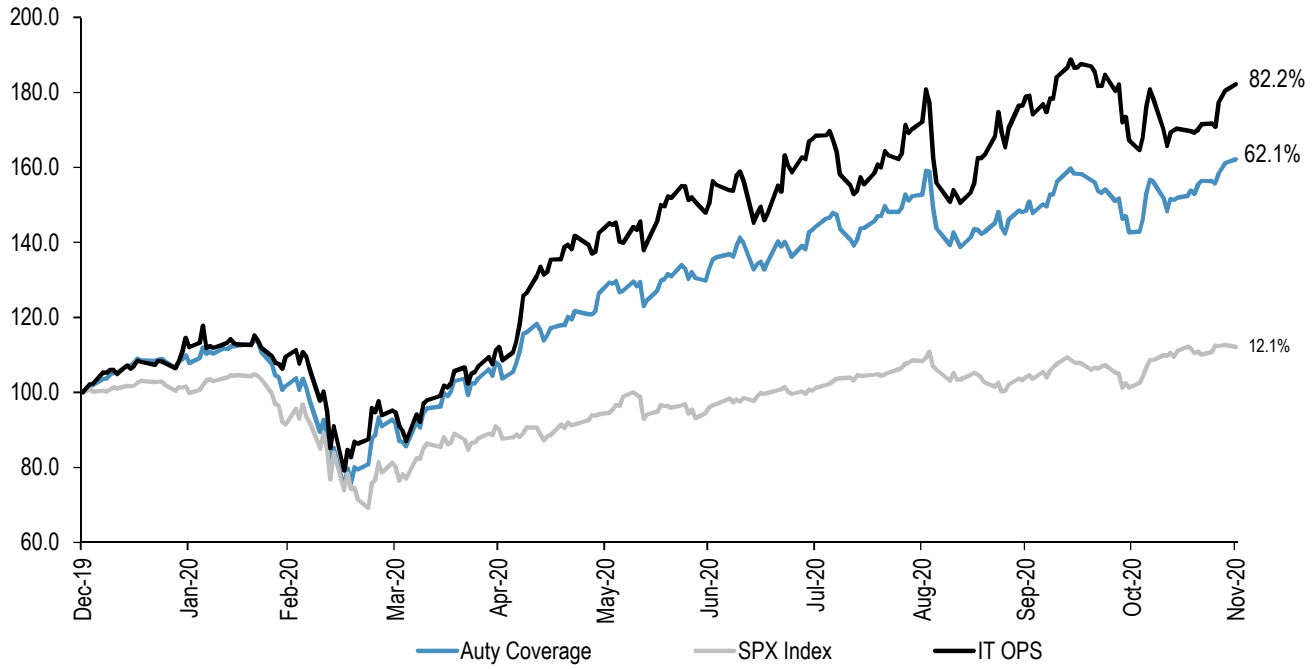
IT Operations – Accelerating Digital Transformations

Digital transformations are one of the biggest topics in tech across all industries. Automating business process through the development of new software and the shift to the cloud brings with it a new set of monitoring, management, workflow and alerting challenges. Growth in this segment is one of the highest in our coverage, and we do not anticipate that changing in 2021. The biggest challenge is that valuation for many of the names reflect a lot of that opportunity already.

Figure 36: IT Operations Performance Relative to S&P 500



Source: J.P. Morgan Research, Bloomberg Finance L.P. as of 11/30/2020.

$50B IT Operations Market Spend Growing at ~7%

When looking at both IT Operations (DDOG, DT, NEWR, SWI, NOW) and Application Development (MSFT, JFROG, TEAM) markets, spend is estimated to be $49.3B in 2020, and that is expected to grow at a 6.5% CAGR through 2024. While there is an increasing need to streamline efficiency and automation in enterprises, growth in spend in the IT Operations segment is being capped by the budget pressures enterprises have seen due to COVID-19. In Table 26 we attempt to frame the opportunity in a segment build in what we view as one of the most attractive sectors in our coverage given tailwinds from continued cloud migrations and DevOps processes.

Table 26: Breakout of Gartner IT Operations Market Forecast

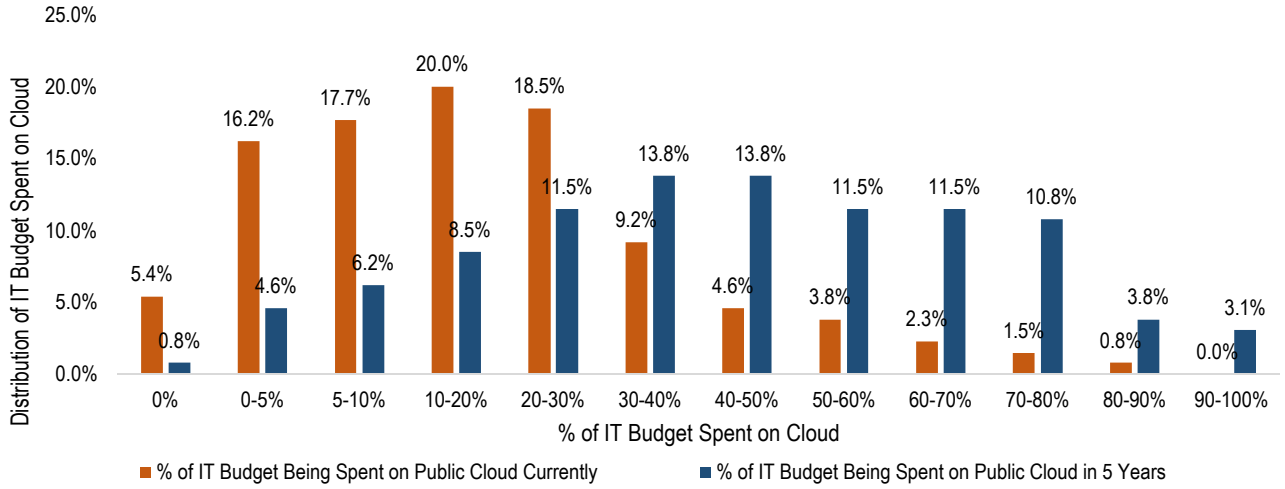
Market	Subsegment	2018 YR	2019 YR	2020 YR	2021 YR	2022 YR	2023 YR	2024 YR	19-24 CAGR
Application Development	AD Mainframe Tools	1,560.3	1,547.7	1,493.9	1,557.3	1,563.1	1,593.9	1,629.5	1.0%
	Other AD	1.4	1.3	1.4	1.4	1.4	1.4	1.4	0.8%
	Create	7,813.9	8,999.7	8,587.6	8,865.3	9,356.0	10,151.1	11,081.1	4.2%
	Plan	1,483.1	1,799.1	1,832.1	1,945.7	2,121.1	2,341.3	2,614.6	7.8%
	Verify	1,891.8	2,063.6	2,127.1	2,212.8	2,324.4	2,491.9	2,697.6	5.5%
Application Development Total		**12,750.4**	**14,411.3**	**14,042.0**	**14,582.4**	**15,366.0**	**16,579.5**	**18,024.2**	**4.6%**
IT Operations	Performance Analysis: AIOps, ITIM and Other Monitoring Tools	5,485.4	6,151.8	6,157.2	6,681.7	7,153.0	7,546.6	7,434.4	3.9%
	ITOM Mainframe Tools	2,726.5	2,735.1	2,726.8	2,769.2	2,826.6	2,895.9	2,968.9	1.7%
	Performance Analysis: NPMD	2,706.0	2,900.3	2,892.9	3,105.8	3,398.6	3,751.7	4,025.1	6.8%
	Performance Analysis: APM	4,045.3	4,743.2	5,008.0	5,480.6	6,302.1	6,930.3	7,409.1	9.3%
	Delivery Automation	9,385.3	10,504.8	10,959.5	11,865.7	12,859.0	14,402.2	16,102.1	8.9%
	Experience Management: ITSM	3,982.8	4,852.1	5,070.2	5,429.0	5,984.0	6,740.9	7,603.0	9.4%
	Experience Management: SAM, ITAM and ITFM	1,379.9	1,596.6	1,480.9	1,531.9	1,765.5	1,990.3	2,219.9	6.8%
	Other ITOM	1,078.9	1,026.3	957.6	1,001.8	1,098.6	1,219.6	1,369.3	5.9%
IT Operations Total		**30,790.1**	**34,510.2**	**35,253.1**	**37,865.8**	**41,387.4**	**45,477.4**	**49,131.6**	**7.3%**
Grand Total		**43,540.5**	**48,921.5**	**49,295.1**	**52,448.3**	**56,753.4**	**62,057.0**	**67,155.8**	**6.5%**

Source: Gartner Forecast: Infrastructure Software Markets, Worldwide, 2018-2024, 3Q20 Update, J.P. Morgan Research.

How Far Along Are We in the Shift to the Cloud?

The COVID-19 pandemic has accelerated the enterprise shift to the cloud, and that has been echoed by the likes of AWS Head Andy Jassy and Okta CEO Todd Mckinnon. The sudden need to manage and secure a distributed workforce as well as the inability to increase capacity in datacenters due to shelter in place orders forced enterprises to accelerate their capacity in the cloud. This is evidenced in the 79% of respondents in our 2020 CIO survey conducted in June that said COVID-19 is accelerating digital transformation and move to public cloud, including 36% of respondents increasing spend in these areas for 2020 and beyond even with IT budget compressing. The amount of IT budgets in 2020 increased to +20% compared to 2019's figure of 17.6%, and CIOs indicated that spend on cloud is expected to reach ~44% of IT spend in five years. Figure 37 below shows the distribution of responses on IT Budget spent on Cloud currently and in five years.

Figure 37: Cloud Increasing as Percentage of Total IT Budget



Source: J.P. Morgan CIO Survey.

Spend on public cloud is expected to grow from $291B in 2020 to $568B in 2024. We believe it is important to look at public cloud in the context of global IT budget to analyze how much is being spent in cloud. Looking at 2020, spend in public cloud accounts for only 8.1% of Overall IT Spending estimates by Gartner. Cloud infrastructure (IaaS) only makes up for 1.6% of current IT spend, and that is estimated to grow at 22% through 2024. All this to say that while COVID-19 has accelerated enterprises to think about their cloud environments, we are still at the infancy states of transformation, and that should provide enough room for vendors in the space to continue to grow.

Table 27: Cloud Infrastructure Spend Forecasted to Outpace Public Cloud and Overall IT Spend (in $ billions)

Public Cloud Spend Segment	2018 YR	2019 YR	2020 YR	2021 YR	2022 YR	2023 YR	2024 YR	CAGR 18-24
Cloud Application Infrastructure Services (PaaS)	28.6	41.3	48.9	62.0	76.3	94.3	117.5	26.6%
Cloud Application Services (SaaS)	93.5	114.0	115.2	133.9	156.3	182.5	214.7	14.9%
Cloud Business Process Services (BPaaS)	47.3	50.6	50.8	53.8	56.5	60.2	65.0	5.4%
Cloud Management and Security Services	12.3	14.8	17.6	20.1	23.3	26.5	29.2	15.5%
Cloud System Infrastructure Services (IaaS)	34.7	48.8	57.3	72.9	91.3	112.0	137.9	25.8%
Cloud Desktop as a Service (DaaS)	0.3	0.7	1.4	2.3	3.0	3.5	3.6	53.4%
Total Public Cloud Spend	**216.7**	**270.4**	**291.2**	**345.1**	**406.8**	**479.0**	**567.9**	**17.4%**

IT Spend Segment	2018 YR	2019 YR	2020 YR	2021 YR	2022 YR	2023 YR	2024 YR	CAGR 18-24
Communication Services	1,382	1,373	1,333	1,370	1,426	1,474	1,513	1.5%
Data Center Systems	213	215	208	219	228	236	245	2.4%
Devices	714	712	616	641	663	685	695	-0.5%
IT Services	993	1,040	992	1,033	1,106	1,195	1,301	4.6%
Software	427	477	459	492	545	613	696	8.5%
Total Overall IT Spend	**3,728.2**	**3,816.3**	**3,608.8**	**3,754.8**	**3,968.8**	**4,203.7**	**4,449.0**	**3.0%**

	2018 YR	2019 YR	2020 YR	2021 YR	2022 YR	2023 YR	2024 YR	CAGR 18-24
Total Public Cloud Spend as % of Total Overall IT Spend	5.8%	7.1%	8.1%	9.2%	10.2%	11.4%	12.8%	14.0%
Total Cloud Infrastructure as % % of Total Overall IT Spend	0.9%	1.3%	1.6%	1.9%	2.3%	2.7%	3.1%	22.2%

Source: J.P. Morgan Research, Gartner: Forecast: Public Cloud Services, Worldwide, 2018-2024, 3Q20 Update, Gartner: Forecast IT Spending, Worldwide, 3Q20 Update.

The Three Pillars of Monitoring

With several of the large monitoring players now public (NEWR, DDOG, DT, SUMO, SWI, SPLK), we have had increased investor interest in the space and the competitive dynamics in the monitoring space. There are three primary pillars to monitoring: APM (application performance monitoring), Infrastructure Monitoring, and Logging. There are several estimates from both industry participants and vendors that size the IT Operations Market as anywhere from $10B to $40B. Despite a decent number of competitors in the monitoring market, we believe that the market is large enough for multiple vendors to have success over the next 2-3 years before different platform solutions start to become up to par with the best in breed in each class. Figure 38 shows the competitive landscape and market sizing of the different areas of the market.

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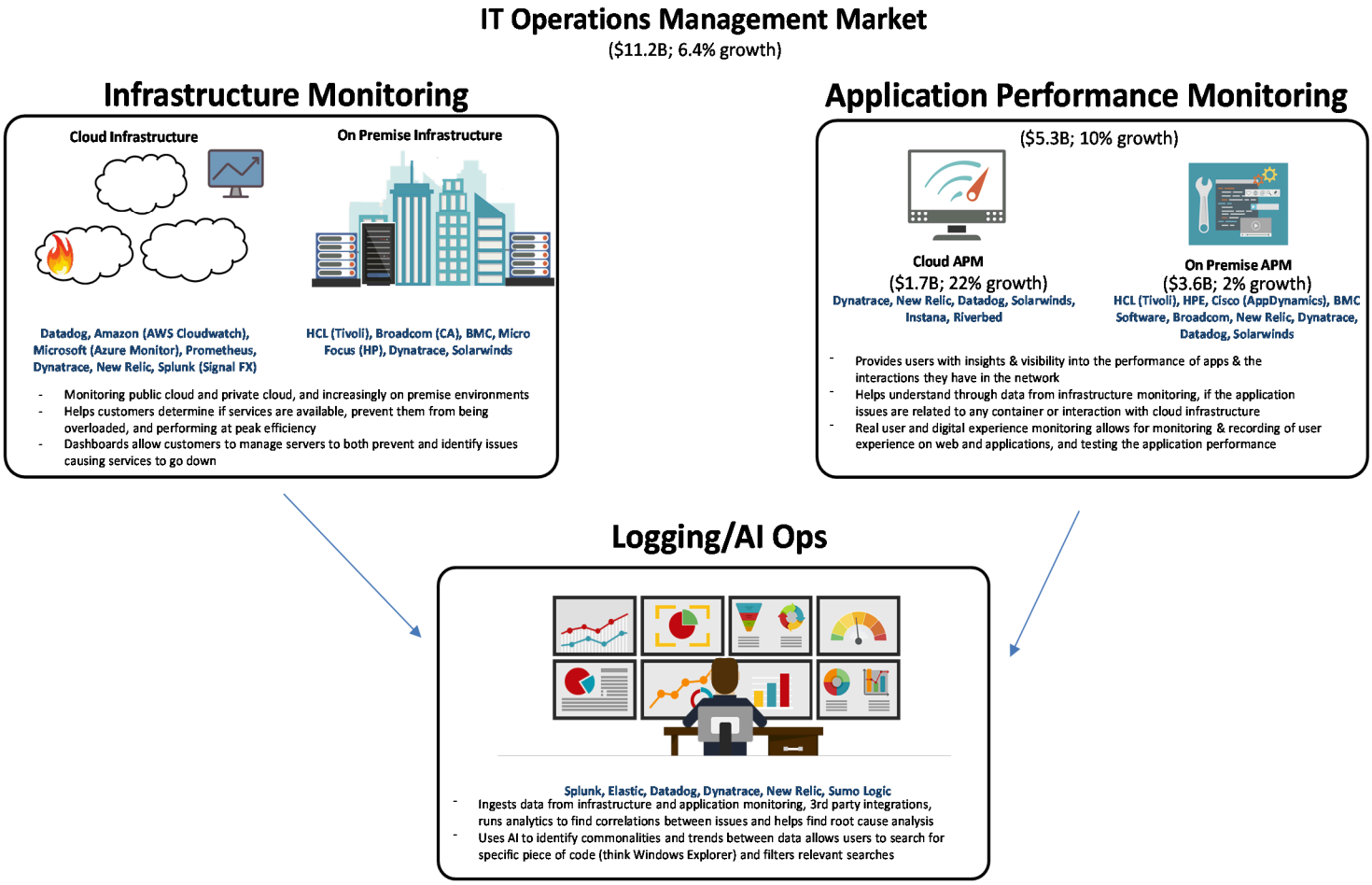
Figure 38: Monitoring Landscape



Source: J.P. Morgan Research, IDC, Gartner.

Market Share Shifts in the IT Monitoring Market

There are a few key trends that are driving share shift changes in both APM and the Infrastructure/AI Ops/Logging markets.

1) First is the share loss from legacy on-premise players (IBM and BMC in APM, CA and Micro Focus (HPE) in Infrastructure) as customers look for cloud native solutions to monitor the increasing number of workloads in the cloud.

2) The second major trend is established leaders in the APM market like Cisco (AppDynamics) and New Relic growing below market growth rates as newer technologies like that of Dynatrace gain market share. New Relic went through a product and sales transition and is now changing the pricing of the platform in an attempt to capture develop mind share in what we view as a move to compete down market with vendors like Datadog.

3) The last key trend is the idea of monitoring vendors having all three pillars of monitoring and branching out from their core competency to drive platform expansion and growth. An example of this is Datadog, which has

grown from just offering infrastructure, to APM, logging, synthetics, and RUM. While most enterprises use a best-of-breed approach as vendors in the space all specialize in different segments, we believe that over time we could see 25% of the market converge to a single vendor approach and believe DDOG, DT, NEWR, and SPLK (in that order) are the best positioned to capture that opportunity.

Table 28: Market Share Analysis on APM, AIOPS & Infrastructure Monitoring

APM Market Share Analysis

	2016	2017	2018	2019
Cisco (AppDynamics)	6.47%	9.25%	11.46%	12.42%
New Relic	8.42%	9.77%	11.38%	11.87%
Dynatrace	14.45%	14.09%	10.07%	10.98%
Splunk	4.80%	5.47%	6.02%	6.92%
Broadcom Ltd		0.00%	1.49%	5.51%
IBM	8.07%	7.07%	5.94%	5.02%
Micro Focus International	0.00%	1.74%	3.59%	2.91%
Microsoft	2.72%	2.60%	2.84%	2.81%
Riverbed	4.74%	3.83%	2.98%	2.58%
Quest Software	0.48%	2.30%	2.54%	2.48%
Datadog			1.29%	2.13%
Fujitsu	0.99%	0.91%	1.80%	1.53%
BMC	1.88%	1.71%	1.45%	1.34%
SolarWinds	0.56%	0.65%	0.63%	1.28%
Hitachi	1.51%	1.41%	1.51%	1.26%
Oracle	1.76%	1.60%	1.58%	1.21%
HPE	4.89%	1.95%		
CA Technologies	7.56%	6.69%	4.48%	0.00%
Total Market Size	**2,874.9**	**3,273.5**	**3,699.4**	**4,266.0**

AI Ops, ITIM and Other Monitoring Market Share Analysis

	2016	2017	2018	2019
Splunk	9.31%	12.54%	14.03%	16.52%
IBM	21.85%	18.74%	15.64%	13.21%
Microsoft	8.46%	7.82%	8.52%	8.40%
SolarWinds	5.39%	5.74%	5.64%	5.55%
Datadog	1.56%	2.14%	2.99%	4.89%
Dell EMC	3.92%	4.56%	4.58%	4.19%
Micro Focus International	2.08%	2.07%	4.99%	4.02%
VMware	2.71%	3.17%	3.40%	3.85%
BMC	4.73%	4.18%	3.79%	3.44%
Sumo Logic	1.51%	1.72%	2.07%	2.25%
Science Logic	1.23%	1.60%	1.61%	1.63%
LogicMonitor	0.45%	0.99%	1.41%	1.52%
Quest Software	0.25%	1.17%	1.30%	1.28%
New Relic	0.00%	0.22%	0.35%	1.01%
Oracle	0.43%	0.40%	0.40%	0.31%
ServiceNow	0.07%	0.10%	0.10%	0.13%
CA Technologies	4.34%	3.66%	1.62%	0.00%
HPE	5.94%	2.52%		
Total Market Size	**3,991.6**	**4,602.1**	**5,029.7**	**5,567.5**

Source: J.P. Morgan Research, Gartner Enterprise Infrastructure Software Market Shares. Note: Market Shares comprise only of APM, and AI Ops/ITIM/Other Monitoring. DT underwent subscription transition therefore market share after 2016 shows decline.

Competitive landscape: who competes with whom?

As mentioned above, New Relic, which was once regarded as the leader in the APM market, has seen its growth dip to 14% below other players like DDOG 61%, DT 30%, ESTC 44%. The company was the last of the players to introduce logging and infrastructure and has seen its market share erode from both DT and DDOG. Our analysis of the 922 reviews on Gartner Peer Insights indicate that NEWR APM customers that considered DT have dropped in the last twelve months, while AWS has seen more than 1/3 of NEWR customers also consider their solutions. NEWR recently shifted its pricing model and go-to-market towards selling an entire platform to developers in what we believe is a move down market. This is pushing NEWR more towards competition with DDOG as well as cloud provider solutions that are not often relied upon in large enterprises.

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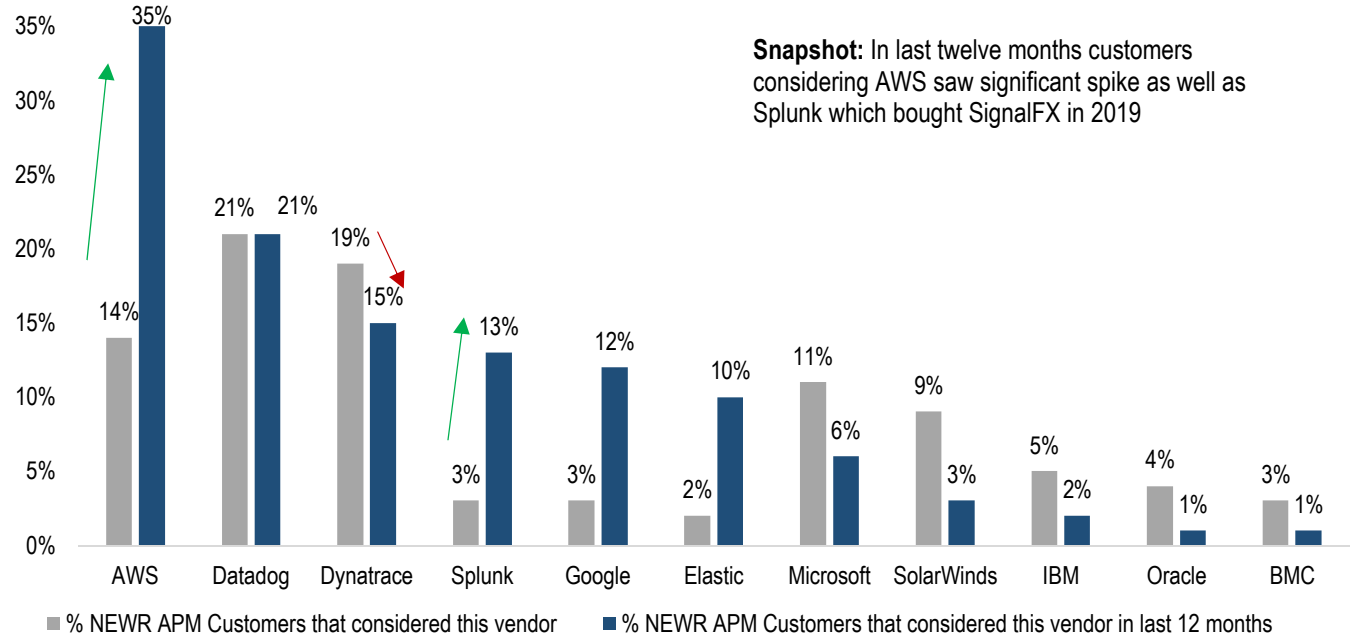
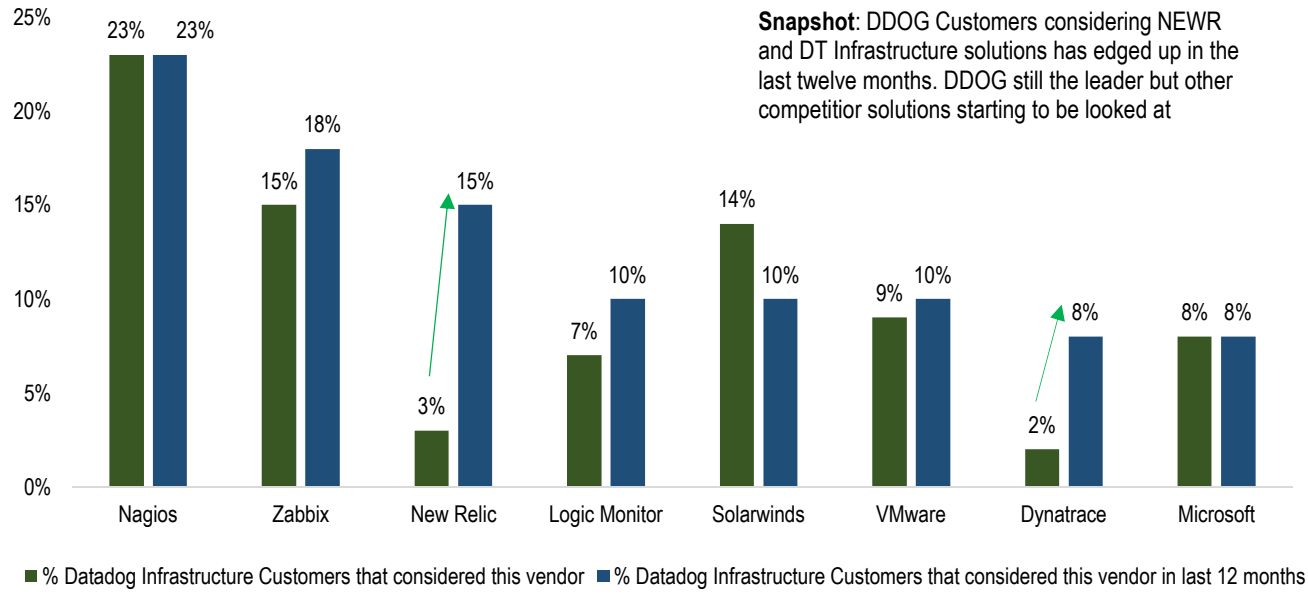
Figure 39: NEWR Competition Shifting Away from DT and More towards DDOG



Source: J.P. Morgan Research, Gartner Peer Insights. New Relic review sample size is 922 in total, 211 in last twelve months.

DDOG is the clear leader in the infrastructure monitoring market, and we estimate that the majority of revenue is coming from IT infrastructure monitoring. Our analysis of Gartner Peer Insights 184 DDOG Infrastructure Monitoring reviews shows that DDOG customers primarily consider open source solutions like Nagios and Zabix, shown in Figure 40. We note that DDOG customers considering NEWR and DT infrastructure solutions increased in the last twelve months, something we view as a natural evolution as those vendors' infrastructure monitoring solutions mature. However, this does not indicate, in our view, that DDOG is increasingly going head to head with vendors like DT or that it is losing deals to its other public monitoring players, rather an indication of customer awareness.

Figure 40: DDOG Infrastructure Competitors Comprised of Open Source and APM Centric Vendors



Source: J.P. Morgan Research, Gartner Peer Insights. Datadog review sample size is 184 in total, 29 in last twelve months.

Comparing pricing across vendors is like comparing apples to oranges

The monitoring space has seen vendors try to use price as a way to disrupt the market. The logging market was changed when DDOG came in with separate pricing for ingestion and indexing addressing a complaint frequently heard from Splunk customers that it was too expensive. We believe this is leading to increased traction for DDOG's logging solution and led Splunk change its pricing model in response.

More recently, we have seen NEWR attempt to disrupt the market with similar pricing changes. The company has been growing below the market growth rate of other public vendors (DDOG 61%, DT 20%, ESTC 44%), and in 1Q20, in an attempt to revive growth and customer expansion, it announced a bold change in pricing from host based to user/usage based. NEWR believes the main reason for the low adoption of monitoring has been additional cost to instrument additional hosts. That has left the second or third tier important applications unmonitored. With the rise of public cloud, there have been customers rationalizing their observability spend, and that is even more pronounced in the current environment, as we saw with the results out of Datadog. In addition, NEWR is now packaging the entire New Relic One Platform compared to previous pricing for different pillars (APM, Infrastructure, etc.) in a way to try more platform adoption. While this approach may end up helping the company renew its mindshare within developers, we believe it will take several quarters before growth starts to improve.

Pricing varies widely among different providers, both from a packaging perspective and target customer segment. This is seen in Table 29, which compares pricing among vendors and shows some vendors that have publically available platform/bundle pricing compared to others that continue to have a segment pricing and best-of-breed go-to-market strategy.

Table 29: Pricing Across Monitoring Vendors

Segment Pricing	New Relic	Solarwinds	Datadog	Dynatrace	Splunk
APM			$31 p/host/month		-Standard $55 p/host/year -Enterprise $85 p/host/year
Infrastructure		$9.99 per host per month -Sold in packs of 10 hosts, 100 containers (i.e. 1 pack of infrastructure would be $99.99 per month)	-Free $0 -Pro $15 p/host/month -Enterprise $23 p/host/month	$21 per 8GB host per month (includes AIOPS, Digital Business Analytics)	-Standard $15 p/host/month -Enterprise $25 p/host/month
Logging			-Ingestion $0.10 p/GB/month -Indexing $1.27 p/million log event/month	No specific logging pricing	-Splunk Data Stream processor -Splunk Cloud custom pricing -Splunk Enterprise $150 p/ingested gb/month
Full Platform	-Standard plan $99 per user per month (includes APM, Infrastructure monitoring, Digital experience monitoring, Logs, Serverless monitoring, and more) -Pro and Enterprise pricing available upon request - Free ingestion up to 100GB/month, after $0.25 p/GB	-$24.99 per host per month (Includes Infrastructure and APM) -Sold in packs of 10 hosts, 100 containers (i.e. 1 pack of infrastructure would be $249.99 per month)		$69 per 8GB host per month (includes APM, Infrastructure, AIOps, Digital business analytics)	

Source: J.P. Morgan Research and estimates, Company Websites as of 11/30/2020. Note Splunk prices shown are Host based, Usage based pricing also available.

Understanding the DevOps World

For more on DevOps see the following reports:

V111: Understanding the DevOps World - Digital Transformations

JFrog Initiation – A Leap Ahead in Software Deployment

When companies talk about digital transformations, in many cases that means using software applications to automate more business processes. But most of those applications are not available from a vendor and have to be built (developed) in house. Today, the modern approach to application development is done through the DevOps (developer operations) process, which can be confusing to investors. In the Figure below, we show what spans the application development, deployment, monitoring, and IT alerting segments.

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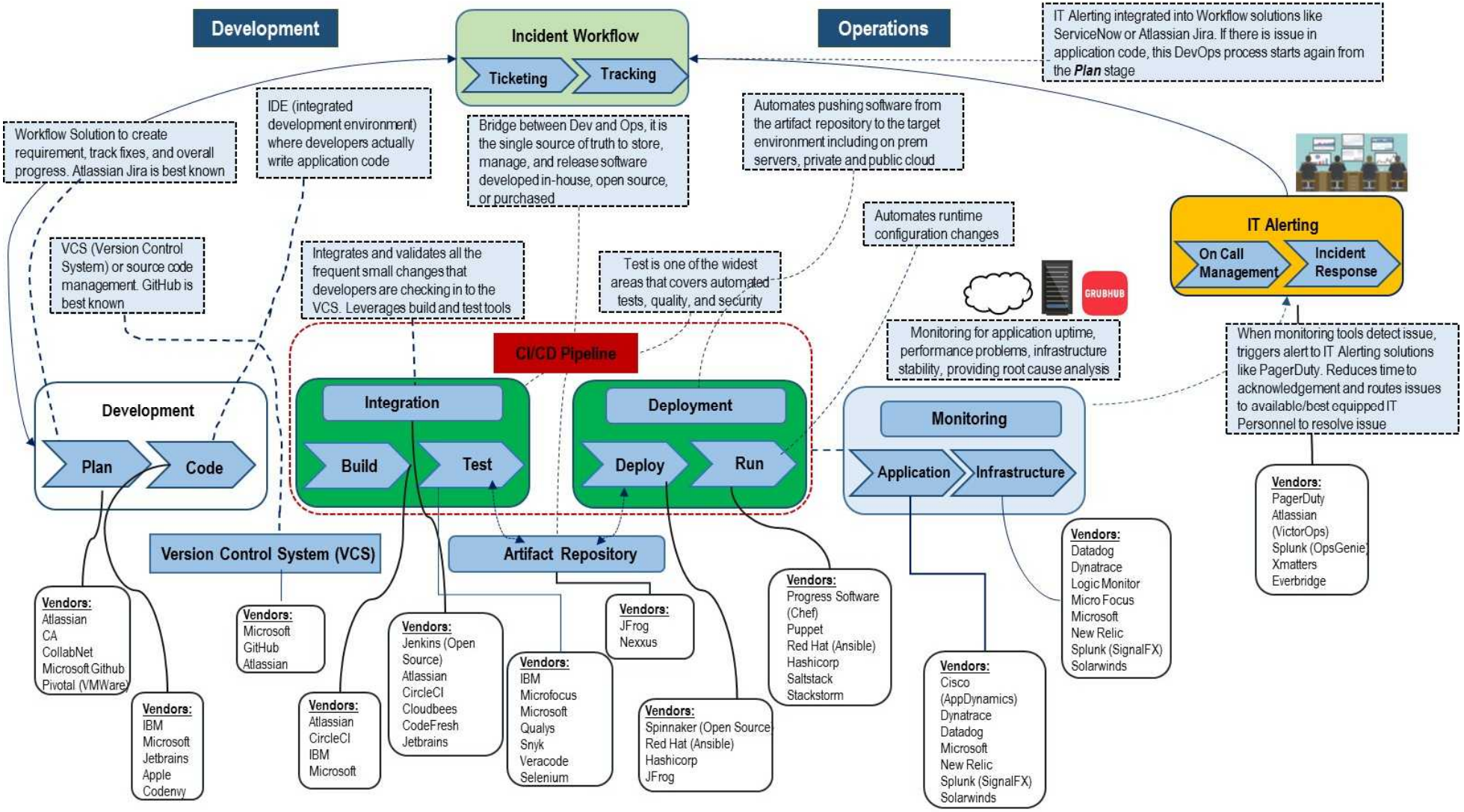
Figure 41: The Basics of DevOps



Source: J.P. Morgan Research

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Bottom-up build of total DevOps TAM points to +$110B

Given how many steps there are in the DevOps and software deployment process, we thought it would helpful to try to illustrate the addressable market size for the entire DevOps process. There are 50 million users on Github, which we are using as a proxy for the number of potential future developers in the world in the "Plan" through "Testing" phase. The artifact and monitoring total spending numbers are based on our JFrog bottom build above and our bottom-up for Datadog. The result of the analysis is total potential spend for the entire DevOps process of over $110B. To put this into context, Salesforce.com (CRM/OW/Mark Murphy), which is regarded as the premier large-cap software asset, sees its TAM reaching ~$168B by 2023. We realize this analysis is limited in nature given volume pricing discounts, but we think it can help investors understand the costs at each step of the DevOps process and show that this space is attractive.

Table 30: Bottom-Up Build on Total DevOps TAM Points to +$100B

	Plan	Code	VCS	CI/CD	Testing/Security	Artifact Repository	Monitor	
# units	40,000,000	40,000,000	40,000,000	40,000,000	40,000,000	2,250,000	467,849	
Vendor	Atlassian	Jetbrains	Github	CircleCI	snyk	JFrog	Datadog	
Plan	Jira + Access	IntelliJ IDEA Ultimate	Enterprise	Selhosted	Open Source + Pro	Enterprise	ARR Per Customer Segment	
Annual Price	$ 91.2	$ 299.0	$ 252.0	$ 420.0	$ 479.8	$ 7,000.0	$ 76,551.5	**Total Potential Spend**
Total Cost	**$ 3,648,000,000**	**$ 11,960,000,000**	**$ 10,080,000,000**	**$ 16,800,000,000**	**$ 19,190,400,000**	**$ 15,750,000,000**	**$ 35,814,540,000**	**$ 113,242,940,000**

Source: J.P. Morgan estimates, company websites. Note: Orange refers to the number of developers in the world, Green refers to the number of servers, and Blue refers to the number of companies. Annual price is based on list pricing as of 9/30/2020 and assumes no discount. Monitoring TAM based on bottom up build for Datadog, Artifact Repository based on build from JFrog.

IT Alerting and Mass Notification – Starting to Converge

There are two distinct markets we see within the Alerting landscape. The first is IT Alerting, which is used to communicate with internal IT workers inside the DevOps process and that is provided by players like PagerDuty. The other market is what is commonly referred to as Population Alerting or Mass Notification, which is used to communicate with workers, students, residents, and other population groups in situations of potential crisis (hurricanes, protests, terrorist attacks, etc.). Table 31 below shows the differences in addressable users, pricing dynamics, and competitors.

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Table 31: Differences Between IT Alerting and Mass Emergency Alerting

	IT Alerting	Mass Emergency Alerting
Description	Reduces time to acknowledgement and resolution of IT incidents by routing issues to available/best equipped IT Personnel	Notifies workers, residents, students, within geographic range of an indentified incident (natural disaster, terrorist attack, etc)
Addressable Users	-Developers -IT Operations and cybersecurity Operations -IT and Customer Support	-State/Country Residents -Educational Institutions -Enterprise Workforce
Pricing	~$200-300 Per User	-$0.20 per resident for State/Country Deals -$25 per Enterprise employee -$1.30 per Education employee/student
Total Addressable Market	~$20-$30B	~$5B (Population Alerting) ~$26B (Critical Event Management)
Partners	-(ITSM) Workflow Vendors -Monitoring Vendors -Cybersecurity Vendors	-Telecom Providers
Vendors	-PagerDuty -Atlassian (VictorOps) -Splunk (OpsGenie) -Xmatters -Everbridge -Datadog	-Everbridge -Blackberry (Athoc) -Xmatters -Honeywell -Motorola -Cisco

Source: J.P. Morgan Research.

Mass Emergency Alerting vendors like EVBG also offer IT Alerting solutions, and PD is seeing customers use their solutions in a different use case for crisis management for the entire workforce. Xmatters, a private company that raised $40M in 2018, is seeing success in the IT Alerting space with 650k paid IT users (disclosed Sept 2019) and also offers emergency/mass notification solutions for enterprises. The addressable market in each of these segments are large enough to prevent vendors from going head to head for now, but we are noticing more strategic moves in the space that could lead to eroding of the swim lanes. Lastly, Datadog recently introduced an incident management solution that is focused on data collection for incident response. While this is not directly competing with players like PD, we believe it further crowds the market in investors' minds.

EU population alerting mandate represents +$100M opportunity

EECC Article 110 – EU Public Warning System Mandate found here on page 148

In 2018 the EU made it mandatory for the 27 European Union (EU) member countries to have a mass population alerting system by June 2022 in what is referred to as EECC Article 110. This is driving the demand for solutions that vendors like Everbridge offer that use geographical-based location data to alert residents of incidents threatening the population, like natural disasters and terrorist attacks, all while protecting the end users' personally identifiable information (PII). Currently EVBG has 5 European countries that are using their solution for mass population alerting and that includes Iceland and Norway, which are not countries in the EU.

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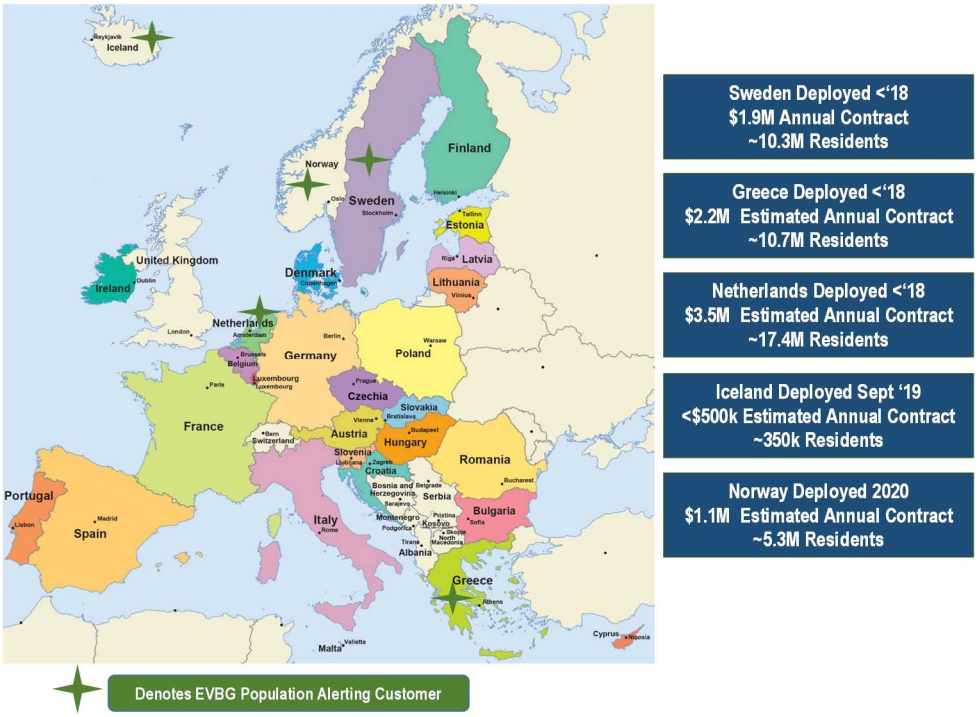
Figure 42: Map of Everbridge Mass Population Alerting Mandates in Europe



Source: J.P. Morgan Research, Europa.EU, GSA Advantage, Company Earnings Calls.

Contract Terms for Florida Statewide Population Alerting 2019 Contract with Everbridge, click here (pg 68)

Through our research we found a few references for contract sizes for mass population alerting. One of the EU countries that has already adopted EVBG is Sweden. EVBG has publically stated that Sweden's contract terms included a 7-year term worth $13M ($1.9M ACV) to deploy the solution across the 10M residents. In addition to the 11 countries with worldwide population deals, EVBG also has statewide deals in the US, including with Florida, NY, and California, which have similar pricing dynamics. In 2019 the company renewed its contract with the state of Florida, with public records showing a 5-year, $17.5M deal ($3.5M ACV), for a population of ~21.4M. Using the 18-23c per resident we have commonly found in contracts, that would imply ~$110M in potential opportunity for EVBG with the EU mandate. We acknowledge that countries like France, Germany, and Italy each account for +10% of EU's total population size and therefore could receive volume-based discounts. But the big picture is that the population alerting opportunity is much larger when incorporating other countries like the UK, statewide deals in the US, and other countries around the world, resulting in what Everbridge sees as a $4.8B worldwide opportunity.

Managed Service Providers – Helping SMBs with IT

The IT spend by SMBs reached $1.15T in 2020, according to Gartner estimates, and that is seen to be growing at a 6% CAGR through 2024. When looking deeper, there is $420B of IT spend coming from companies with less than 100 employees, which we consider to be true small business companies. Digital transformations, shift to the cloud, and changes to security architectures are all driving increased spend by SMB for the technology needs. However, not every SMB has enough IT personnel budget, or expertise to best select the right vendors or solutions needed to keep a business running.

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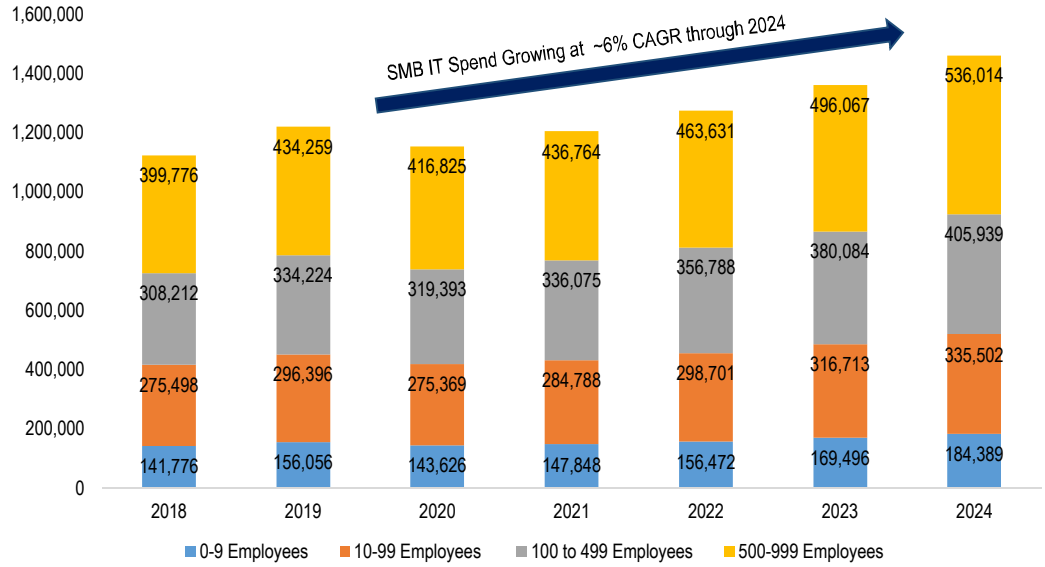
Figure 43: SMB IT Spending Forecasted to Reach Over Half a Trillion Dollars by 2024

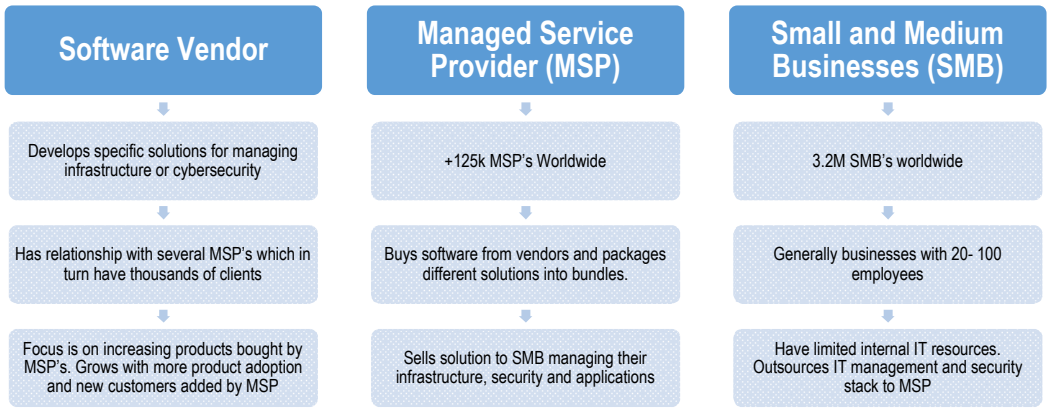


Source: Gartner Forecast: Small and Midsize Business IT Spending, Worldwide, 2018-2024, 3Q20 Update.

Understanding the MSP Software Business

According to SolarWinds, there are over 3.2 million small businesses with 20-99 employees in the world and 31.4 million businesses worldwide with <20 employees. These small businesses do not have the IT budget or internal personnel to manage the IT infrastructure, applications, security, or expertise in the technology tools needed to run a business. This is where MSPs, or Managed Service Providers, come into play, and it is estimated that there are over 125,000 MSPs worldwide (Datto S-1). By partnering and buying solutions from software vendors like Datto and SolarWinds, MSPs help remotely deliver solutions to SMBs that manage their infrastructure, devices, and applications in an affordable way. According to an IDC survey in 2018, 51% of SMBs in the United States were using MSP Services, and increasingly small businesses are relying on MSPs for their technology needs. MSPs are able to reach a large amount of SMBs seen in SolarWinds' disclosure that the +6,000 MSPs added in TTM (Q319) serve ~144,000 SMBs.

Figure 44: Understanding How the MSP Business Flows



Source: J.P. Morgan Research.

MSPs provide several different types of technology services

SMB IT needs range from phone services to infrastructure to security, and, as a result, there is a broad range of services that MSPs can provide. Figure 45 outlines the different types of services MSPs provide. Some MSPs are focused on specific verticals like finance, legal, or healthcare, while other MSPs are specialized in a specific set of technology solutions. That specialization also flows up the software vendor level, as we discuss below.

Figure 45: Different Types of Services MSPs Provide

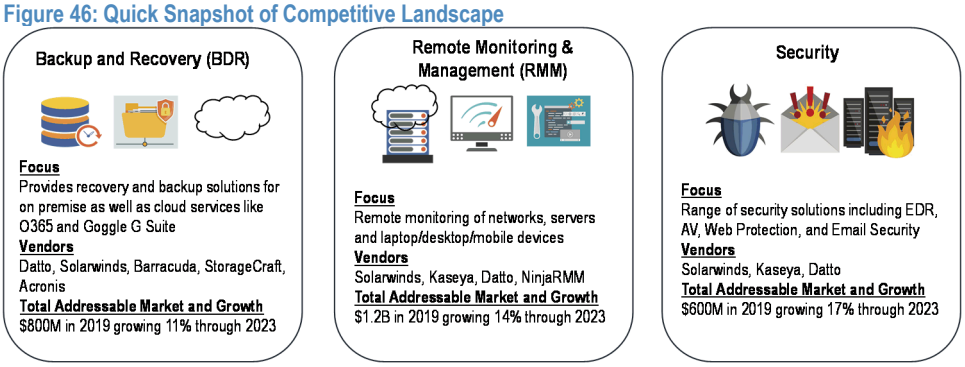
MANAGED NETWORKS & INFRASTRUCTURE
• These services include managed IP VPNs, which are widely used for secure, high-performance and cost-effective networking. Also, managed hosting and storage services falls into this category. These services eliminate the cost of owning and running a data center — the MSP will provide that back-end under an SLA. Likewise, managed LAN and WAN services also help to reduce total cost of ownership (TCO).
MANAGED SECURITY SERVICES
• This type of managed service provides a broad range of solutions from patch management to antivirus, malware and other remote security updates
MANAGED COMMUNICATIONS SERVICES
• This managed service merges data, voice, and video services on the same IP network. It also can include a managed contact center that combines traditional call center features with intelligent IP call routing and integrates e-mail, phone, Web, instant messaging, fax, and other human or automated forms of customer contact
MANAGED WIRELESS & MOBILE COMPUTING SERVICES
• Like managed hosting and storage, this service enables wireless capabilities without the capital expenditure and implementation
MANAGED PRINT SERVICES
• Often grouped just outside the larger framework of managed services, managed print enables remote monitoring, updating and management of an organization's document management infrastructure.
MANAGED SUPPORT SERVICES
• This service handles traditional help desk responsibilities, including trouble ticketing for IT problems among employees and resolution mechanisms.
BUSINESS INTELLIGENCE/DATA ANALYTICS SERVICES
• Increasingly MSPs are capturing and analyzing data that reveal trends and patterns that clients can act upon to further their business goals. Case in point: Trending information on peak Internet usage times around e-commerce. If an MSP can provide a timeline of peaks and valleys in traffic on a quarterly basis, customers can make adjustments to their marketing, sales staffing, supply chain and inventory plans.
MANAGED CLOUD INFRASTRUCTURE SERVICES
• With managed cloud, the MSP's or cloud provider's engineers manage the customers' computing, storage, networks and operating systems. It also may include managing the tools and application stacks (e.g. databases, ecommerce platforms and DevOps tools) that run on top of that infrastructure. Often customers can choose which functions to manage in-house and which to outsource to the service provider. In some cases where there are multiple cloud providers, the MSP fulfills to role of "cloud orchestrator."
MANAGED SOFTWARE AS A SERVICE
• Software-as-a-service (SaaS) delivery is inherently managed. The provider hosts and delivers the application to the customer and makes sure that it is constantly updated and improved. In some cases the MSP is the SaaS provider and in others it resells the services and assists with integrations to other on-premises and cloud applications.

Source: CompTia Buying Guide for Managed Services. Table Text unaltered, reformatted for report purposes.

Broad competitive landscape with different focus

Our focus here is on the two main public software vendors that have business models around software for IT MSPs (ex-Cloud MSPs) – Datto (~$523M MRQ ARR, +17,000 MSPs), which came public in late 2020, and SolarWinds, which plans to spin off its MSP business (~$300M revenue FY20E, +26,000 MSPs FY19) in 2021. Competition is not just limited to SolarWinds and Datto but also several other private vendors that specialize in different areas of MSP software solutions. Datto's business is tilted towards the backup and recovery software for MSPs, while SolarWinds has a bigger focus on remote monitoring/management and security. We acknowledge these are not all the services provided by MSP vendors, which also provide cloud managed services, help desk management (SWI), and networking focused vendors like Cisco Meraki, Aruba that provide routers and other edge equipment for SMBs. In addition, other pure play vendors in cybersecurity, for example, can also sell to MSPs, but their business is not designed around that customer base. Vendors in the space can continue growing with MSPs in number of devices those MSPs manage, but also in additional products used by MSPs to managed customers IT.

Figure 46: Quick Snapshot of Competitive Landscape



Source: J.P. Morgan Research, SolarWinds Altman Vilandrie & Company study.

Communications – Trends Should Continue in 2021

The communications portion of our coverage comprises UCaaS (Unified Communications as a Service), including CCaaS (Contact Center as a Service) and CPaaS (Communications Platform as a Service), along with BSS (Billing Support Systems), and OSS (Operational Support Systems). COVID-19 accelerated adoption of UCaaS and CCaaS as companies scrambled to quickly shift to a work-from-home/anywhere structure. But looking at 2021, we do not see things slowing down, even with the potential for a vaccine opening up the economy and potentially supporting more return to office. The reason is that companies now realize that they require the flexibility to support more flexible work arrangements moving forward. In addition, the emergence of 5G will likely create demand for BSS and OSS solutions.

The figure below shows the performance of our Communications coverage group relative to our overall coverage and the S&P 500, as of 11/30/2020.

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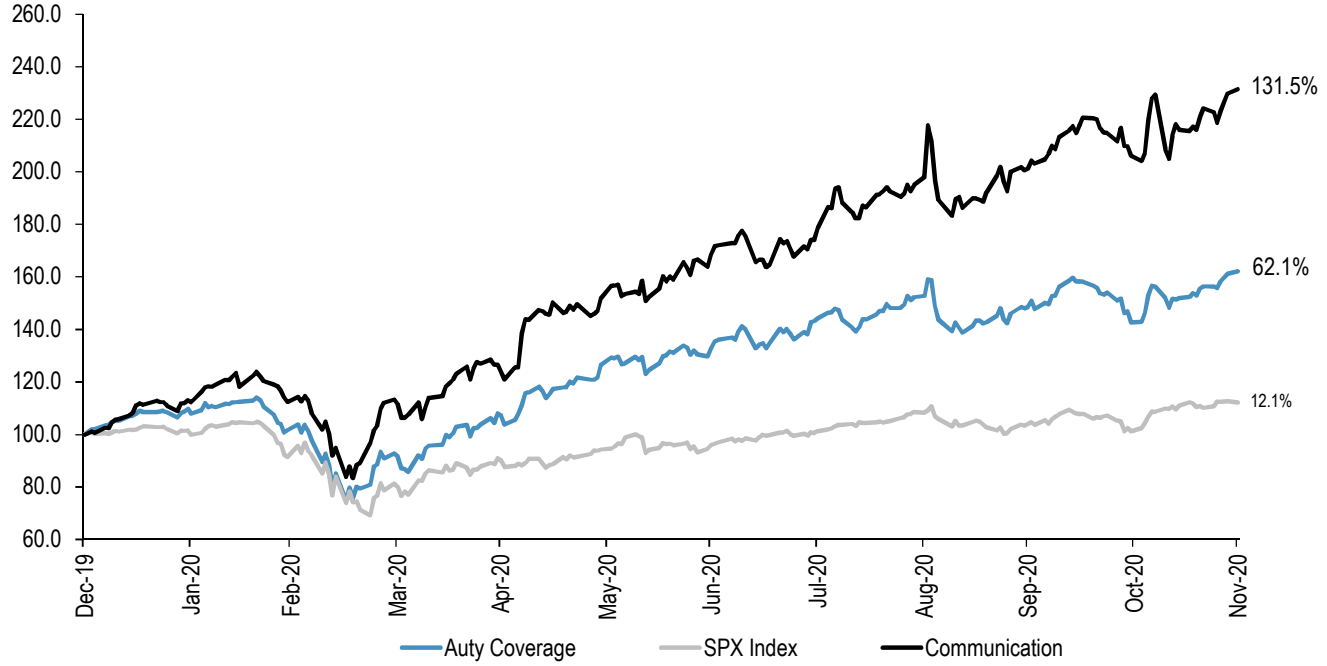
Figure 47: Communications Performance Relative to S&P 500.



Source: J.P. Morgan Research, Bloomberg Finance L.P. as of 11/30/2020.

UCaaS Enables Integrated and Streamlined Workflow

UCaaS (Unified Communications as a Service) is a cloud delivery platform that offers communications services and a variety of productivity and collaboration tools such as video conferencing, screen-sharing, and team/task management capabilities. Over the past few years, corporations have started recognizing that cloud solutions are technologically superior to the traditional on-premise systems, as they offer proficient voice quality, add-on functionalities, flexibility, and cost savings. We believe the combination of these factors makes UCaaS the obvious choice moving forward for businesses. Leading cloud players in this space like RingCentral are benefitting the most from this transition, while legacy vendors including Avaya and Cisco are simultaneously struggling to fend off the market share losses to these emerging vendors in both UCaaS and CCaaS (Contact Center as a Service).

~$41B market shifting to cloud across telephony, messaging, and conferencing

Gartner estimates that the worldwide Unified Communications market, comprising of the telephony and messaging, conferencing, and group videoconferencing subcomponents shown in Table 32, below, stands at ~$41B in 2020. This means that as a whole, UCaaS vendors are currently targeting a ~$41B market that could ultimately shift towards cloud. Gartner expects the market to grow to ~$47.3B by 2023, at a ~5% CAGR, with telephony and messaging growing the fastest. The benefits of adopting cloud infrastructure are multifold in terms of functionality and, as a whole, cloud infrastructure allows organizations to eliminate the need to have a server to be physically present in the office along with its associated costs. We dive into more of the advantages of cloud UC systems below.

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Table 32: Unified Communications $41B TAM Growing at 5% CAGR into 2023

Worldwide Unified Communications and Collaboration	2020	2021	2022	2023	CAGR 2020-2023
Total Telephony and Messaging	**32,362**	**34,564**	**36,613**	**38,202**	**5.7%**
Premises-Based Telephony and Messaging	4,931	4,893	4,981	4,808	-0.8%
Telephony Product Support Services	10,542	10,127	9,692	9,212	-4.4%
Cloud-Based Telephony and Messaging	16,888	19,545	21,940	24,182	12.7%
Total Conferencing	**5,288**	**5,474**	**5,816**	**6,170**	**5.3%**
Premises-Based Conferencing	185	179	173	161	-4.4%
Conferencing Product Support Services	151	151	147	140	-2.3%
Cloud-Based Conferencing	4,953	5,144	5,496	5,868	5.8%
Total Group Videoconferencing Systems and Premises-Based Video Infrastructure	**3,117**	**3,187**	**3,046**	**2,887**	**-2.5%**
Group Videoconferencing Systems	1,591	1,703	1,623	1,526	-1.4%
Group Video Product Support Services	1,017	1,006	989	969	-1.6%
Premises-Based Video Infrastructure	220	210	189	173	-7.6%
Video Infrastructure Product Support Services	289	269	245	219	-8.8%
Total	**40,767**	**43,226**	**45,475**	**47,260**	**5.0%**
Growth %	0.0%	6.0%	5.2%	3.9%	

Source: Gartner, September 2020.

Disadvantages of legacy on-premise systems include complexity and cost

PBX (Private Branch Exchange) systems are designed to provide internal connections within the business as well as connections with the outside world. Some enterprises prefer these traditional systems, especially when there is skepticism surrounding security and control while uploading the data on cloud. However, on-premise systems are increasingly becoming technologically inflexible and outdated, as many support only voice on desktop phones and are limited in terms of innovation. Additionally, since hardware-based systems generally require a PBX server to be physically present in the office premises, installation can be time-consuming and expensive. Adding to the costliness is the need for regular maintenance and support by administrators who are specifically trained to operate and maintain on-premise UC systems. RingCentral points to a two-year cost savings of $91,779 when adopting RingCentral Office for 100 users instead of an on-premise PBX system. A snapshot of this comparison is provided in Table 33, below.

Table 33: RNG Estimates $91,779 in Cost Savings by Adopting Cloud over On-Premise PBX

100 User Phone System Comparison	RingCentral Office	Average Traditional On-Premise PBX System
Up-front costs		
On-premise hardware; PBX software licenses	$0	$7,895; $20,000
One-time phone cost	$9,900	$15,000
Setup and implementation; integrations with Box, GoogleDocs, Dropbox, Outlook	FREE	$5,000; additional charges may apply
Monthly costs		
All inclusive pricing with business class features	$2,499	Not available
Unlimited calling; unlimited Internet fax; local numbers for each user; toll-free numbers and minutes; feature and functionality upgrades; 24/7 customer support; audio conferencing	FREE	$800; $1,000; $200; $300; $240; $1,000; $500
Business SMS; system management optimization	FREE	Not available
Telephone Service	N/A	$700
Ongoing system management and configuration; service contract	Designed for easy self-management; no contracts required	Requires IT or outsourced support; contracts required and early termination fees
Total Costs		
Total Monthly Cost	$2,499	$4,740
Total Cost in Year 1 (*includes phones*)	$39,888	$104,775
Total Cost in Year 2	$29,988	$56,880
Total Cost Over 2 Years	$69,876	$161,655
Savings with RingCentral Office	**$91,779 (58% cost savings over 2 years)**	

Source: RingCentral website.

Advantages of cloud include minimal hardware and technological enhancement

A shift from on-premise to cloud communication supports lower capex, installation costs, easy scalability, and integration with other cloud-based applications. For UCaaS, the endpoint hardware for the user depends upon the services that are needed. For example, for basic requirements like telephony, conferencing, and screen sharing, a headset with built-in microphone and a PC are sufficient. Cloud-based solutions can be delivered through two different types of architectures: 1) multi-tenant, in which all customers share a common software instance, and 2) multi-instance, in which each customer receives its own software instance and billing is done on a per seat basis. Communication over the cloud also brings technological advantages, as cloud-based systems offer business analytics, reporting, IVR, and robust integrations that are generally difficult to implement with on-premise systems.

UCaaS Vendors Target On-Premise Installed Base of 400M+

To better understand the opportunity for UCaaS vendors to displace traditional on-premise PBX systems, we think it is important to evaluate just how many on-premise users exist in the marketplace today. The shift to the cloud is evidenced by high subscriber churn for companies like Avaya and Cisco, and Gartner's estimates for the declining on-premise installed base support the idea that this trend is here to stay. Its forecast for telephony alone is shown below in Table 34, pointing to ~340M premises-based telephony users in 2020, expected to decline at a 7.7% CAGR through 2023. Cloud-based telephony is simultaneously growing, standing at ~105M current users and forecasted to increase at a 16.7% CAGR into 2023. Estimates for rapid growth of the cloud telephony installed base means that cloud-based telephony users should grow from ~24% of the current total installed base to ~38% by 2023.

We note that the forecast below only includes estimates for on-premise telephony users, and does not include on-premise user count for additional areas like messaging, conferencing, and videoconferencing. Synergy Research Group, a research firm that focuses solely on emerging IT and cloud infrastructure, estimates that the global UC installed base stands at 400M+ users. This means that leading UCaaS vendors like RingCentral have the opportunity to migrate over 400M on-premise users to the cloud.

Table 34: Declining On-Premise Telephony and Conferencing Installed Base

Telephony Installed Base, Worldwide (in thousands)	2020E	2021E	2022E	2023E	CAGR 2020-2023E
Premises-Based Telephony	340,421	315,641	291,879	268,107	**-7.7%**
Growth %	-6.0%	-7.3%	-7.5%	-8.1%	
Cloud-Based Telephony	104,977	127,181	147,461	167,003	**16.7%**
Growth %	15.7%	21.2%	15.9%	13.3%	
Total Telephony	**445,398**	**442,822**	**439,340**	**435,110**	**-0.8%**
Growth %	**-1.7%**	**-0.6%**	**-0.8%**	**-1.0%**	
Premises-Based Telephony Percentage of Total Installed Base	76.4%	71.3%	66.4%	61.6%	
Cloud-Based Telephony Percentage of Total Installed Base	23.6%	28.7%	33.6%	38.4%	

Source: Gartner, September 2020.

RNG has preferential access to nearly half of the 400M+ on-premise base

In late 2019, RingCentral forged a strategic partnership with Avaya that made RNG the exclusive UCaaS provider for Avaya's 100M installed customer base. Throughout calendar year 2020, RingCentral announced similar partnerships with Atos, Alcatel-Lucent Enterprise, and Vodafone Business that added 110M installed users to this base. With preferential access to over 210M on-premise customers, RingCentral has a clear pathway to compete for nearly half of the total on-premise PBX market, and we believe this opportunity could serve to accelerate the company's topline revenue growth for years to come.

Targeted Base for UCaaS Is Moving Up-Market

Looking at the UCaaS market, we see three distinct segments of potential customers. SMB and mid-market companies are those that have fewer than 1,000 employees and actually started as the origin of where vendors looked to penetrate the market. The second segment includes companies with 1,000 to 5,000 employees and represents some of the fastest growth in the industry, as these companies have become comfortable with the idea that the solutions will meet the needs of their employees. The final area is the large enterprise segment where companies have over 5,000 employees. We have begun to see companies in this range adopt UCaaS technology, including Hyatt, Delta, Uber, and others, which we believe demonstrates that this technology is ready for primetime regardless of the size of the company.

UCaaS makes a compelling case for adoption by SMBs

Lower deployment costs, especially in the absence of a dedicated IT department, is a considerable advantage. SMBs might lack funds to set up a dedicated on-premise communication system and the subscription costs are also spread across a lower base of employees. Apart from that, they benefit from services like Interactive Voice Response (IVR) that give a more professional impression for the company, and the ability to selectively deploy and pay for requisite services.

Strategically, the most important segment is mid-sized enterprises

While mid-sized enterprises also benefit from many of the cloud features that we mentioned for SMBs, they are much more important for UCaaS vendors since they provide plenty of upselling opportunities. We observe vendors like RingCentral going in with the "land and expand" mindset whereby they are able to sell a variety of add-ons after proving their performance with the basic products.

Large enterprises slower in implementing UCaaS may opt for hybrid model

Many larger enterprises already have working systems in place, customized as per their requirements. Many of the UCaaS players do not have the scale to service them either at this point in time. They also require an efficient communication mechanism for their global workforce, a portion of which may be based out of areas not yet serviced by the cloud industry. Having said that, we are now seeing increasing rates of adoption, as companies like 8x8 and RingCentral are starting to win some major contracts in this segment. They are aided by the cloud infrastructure companies in general displacing incumbents in other verticals like CRM, WFM, sales and HR, as the cloud ecosystem allows effective integration between applications.

To minimize the costs of immediately shifting thousands of employees to the cloud, and in some cases hundreds of thousands, some large enterprises may initially opt for a hybrid model that combines cloud services with on-premise hardware. Companies like Cisco, Microsoft, and Unify tout the advantages of hybrid collaboration, including the ability to spread out the cost of transitioning to the cloud over time. While these hybrid solutions may be very effective in helping large enterprises make their transition to the cloud initially, we believe they are ultimately a temporary measure and will eventually fall behind full-cloud solutions.

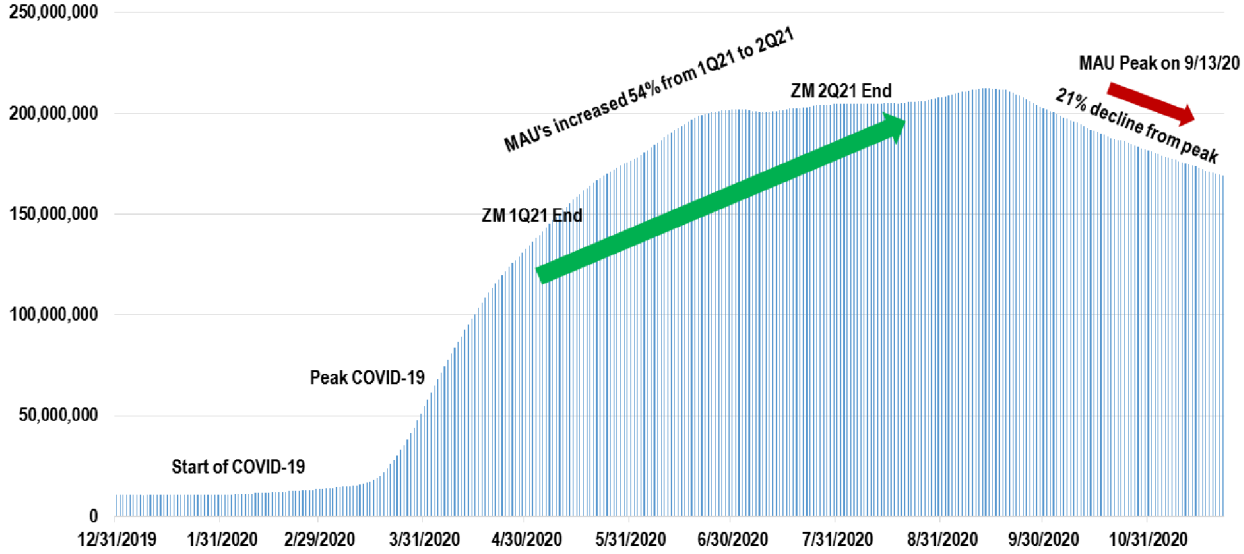
ZM Remains Dominant Video Market Share Leader

Since March, we have published several analyses of Zoom's user and market share data gathered from Apptopia. Each iteration of this note has reflected ZM's dominant market share amid COVID-19, with ZM usage accounting for 50% of daily active users (DAUs) as of July 24th and 48% as of October 9th. Though the number of monthly active users (MAUs) has decreased by roughly 43M since the peak in mid-September (as of Nov. 22nd), ZM's market share of DAUs remains steady at 47%.

Continued decline in MAUs as portions of the world economy begin to reopen

According to our analysis of Apptopia data, Zoom's MAUs peaked at ~212.6M on September 13th, and as of November 22nd MAUs had declined to ~169.4M, representing a loss of roughly 43M users over that period. This compares to 132.7M MAUs at the end of ZM's 1Q21 and 204.8M at the end of ZM's 2Q21. The decline in usage could have resulted from the reopening of certain economies around the world, including corporate workers returning to the office and students returning to school classrooms. Additionally, since revenue from customers with <10 employees increased to 38% of overall revenue in 3Q21, the decline in usage could indicate that some of that customer base is beginning to churn off (~50% annual churn in that segment). Figure 48 graphically shows how MAUs have trended throughout the pandemic, including the most recent 21% decline since the mid-September peak.

Figure 48: Monthly Active Zoom Users Decline 21% since Peak in Mid-September

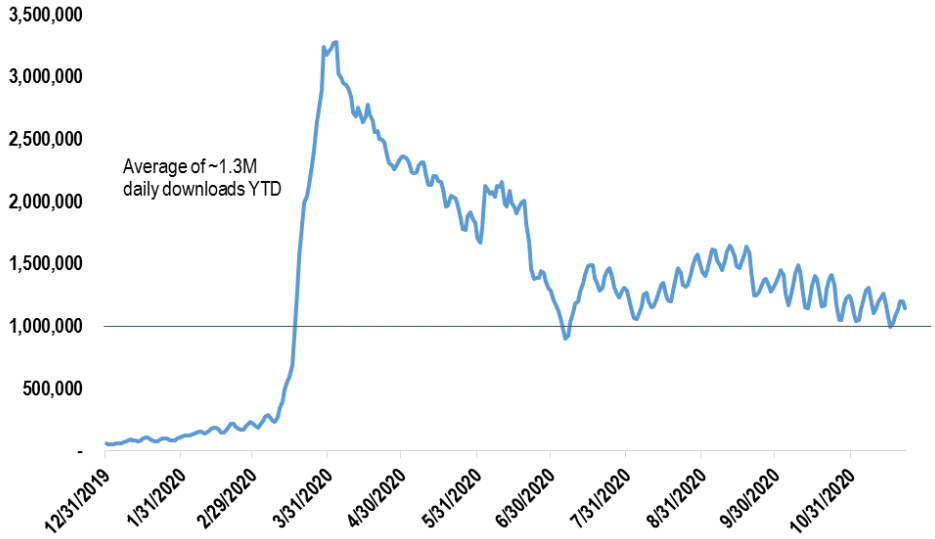


Source: Apptopia Data as of November 22, 2020.

Daily downloads of Zoom application continue pace above 1M+ per day

Despite the decline in monthly active users since September, daily downloads of the Zoom application have recently remained steady. After declining off of the all-time highs seen in March and April, daily downloads of Zoom Cloud Meetings have steadied at a pace of over 1M per day. Our analysis indicates that the year-to-date average of daily downloads, as of November 22nd, was 1.3M downloads per day.

Figure 49: Daily downloads of Zoom Cloud Meetings remain above 1M+ per day



Source: Apptopia data as of November 22, 2020.

ZM maintains leadership with 37% share of downloads and 47% share of DAUs

To put these metrics into context, we evaluate how usage of Zoom Cloud Meetings has stacked up against comparable applications in recent months. Apptopia data since August 1st shows that Zoom continues to lead in share of downloads across the

universe of video conferencing and collaboration apps, accounting for 37.2% of cumulative downloads, with the next closest applications being Google Meet at 28.1% and Microsoft Teams at 15.2%.

Zoom has continued its leadership in market share of daily active users across these videoconferencing and collaboration applications as well, making up 47.0% of total DAUs. This represents just a 0.6% decline since our last analysis on October 9th, with the only application showing an increase during that time being Microsoft Teams, whose usage ticked up by 1.6%. Market share breakdowns for total DAUs since our first analysis in March can be seen below in Table 35, in addition to the percentage change in market share over that time period.

Table 35: Zoom Maintains ~47% Share of Total Daily Active Users

	% of Total DAUs March 22nd	% of Total DAUs July 24th	Market Share Gain (Loss)	% of Total DAUs October 9th	Market Share Gain (Loss)	% of Total DAUs November 22nd	Market Share Gain (Loss)
Zoom Cloud Meetings	39.2%	50.8%	11.7%	47.6%	-3.2%	47.0%	-0.6%
Google Meet	8.1%	20.9%	12.9%	25.1%	4.2%	23.8%	-1.3%
Microsoft Teams	15.3%	10.4%	-4.9%	12.8%	2.5%	14.5%	1.6%
Skype for iPhone/Android	21.8%	8.0%	-13.8%	5.6%	-2.4%	5.6%	0.0%
Cisco Webex Meetings	4.6%	5.3%	0.8%	5.0%	-0.3%	5.0%	0.0%
Skype for Business	4.2%	1.3%	-3.0%	0.9%	-0.4%	0.9%	0.0%
GoToMeeting	1.4%	1.0%	-0.4%	0.8%	-0.2%	0.9%	0.1%
GoToWebinar	1.3%	0.9%	-0.4%	0.8%	-0.2%	0.8%	0.0%
Slack	3.6%	0.9%	-2.7%	1.0%	0.0%	1.1%	0.1%
BlueJeans	0.5%	0.4%	-0.1%	0.3%	-0.1%	0.3%	0.0%
% Change in Total DAUs	**100.0%**		**230.5%**		**9.5%**		**-12.9%**

Source: Apptopia data as of November 22, 2020.

CPaaS Market Growing at 34% CAGR into 2023

A burgeoning platform within communications that we believe deserves recognition is Communications Platform as a Service (CPaaS). CPaaS is a cloud-based platform that allows developers to implement real-time communications features without having to build backend infrastructure and interfaces. The platform typically includes pre-built applications and application programming interfaces (APIs). APIs allow applications to access the data or features of another operating system, application, or service without having to exit the main application upon which the API is built. Being able to access the APIs of partners enables a more streamlined process of communication by making communications more agile, fluid, and integrated.

The CPaaS market is the fastest growing subset within communications, growing at a compounded annual growth rate of ~34% into 2023. As estimated by IDC, the total market opportunity for CPaaS, which includes voice, data, and video stands at $5.6B in 2020 and is expected to grow to ~$13.4B by 2023. As seen below in Table 36, the fastest growing sub-components of this market include data (SMS/notifications) growing at a 39% CAGR and voice at a 33% CAGR.

Table 36: CPaaS Market Growing at ~34% CAGR into 2023

	2020	2023	CAGR 2020-2023
Worldwide CPaaS Revenue			
Voice	2,387.50	5,616.50	33.0%
Data (SMS/Notifications)	1,909.50	5,127.90	39.0%
Video	905.9	1,959.60	29.3%
Other (Security, Flow Builder, etc.)	401.9	694.5	20.0%
Total	**5,604.80**	**13,398.50**	**33.7%**

Source: IDC CPaaS Market Data, May 2020.

Increasing pressure for enterprises to customize with APIs

In the digital transformation to the cloud, enterprises are increasingly expected to keep up with start-ups by being able to quickly innovate and customize their platforms with tools such as communications APIs. There are currently ~900,000 developers worldwide using APIs and more than 300 system integrators, consultants, and service providers in the partner network. Most vendors in the market therefore recognize that flexibility is key in offering CPaaS solutions to their customers. For example, Vonage's CPaaS platform operates as a self-service model, where customers begin with a free trial and can pay for additional usage based on their specific business needs.

Push notifications offer much higher value to vendors than traditional SMS

In the notifications market, vendors began with SMS as the primary communication medium. Since then, we have seen a growing amount of over-the-top messaging through the use of Google Chat, Apple iMessage, WhatsApp, and other mediums. These two messaging types offer different value to CPaaS vendors; whereas routing of traditional SMS generates very low margins in the 20-30% range, over-the-top data messaging offers much higher margins of 50-60%. Vonage began drawing a clearer distinction between its low-margin SMS revenue and high-margin IP-delivered messaging revenue when its high-value APIs underwent rapid acceleration during COVID-19. The company's high-value APIs grew 143% in the third quarter of 2020, with particularly high uptake of programmable video, and revenue from these APIs now accounts for more than 20% of total API platform revenue. If Vonage's API revenue continues to shift away from low-margin SMS, we could see a significant lift in the ~49% of business service revenue that comes from APIs.

Cloud Contact Center Growing 18% into 2023

Companies in virtually every industry require a group of people to interact with customers, partners, and other parties. They are typically set up in what are called contact (call) centers, where the primary interaction is done over the phone. Contact Center vendors provide the communication capability for both inbound and outbound calls, along with email, instant messaging (chat), and social network interaction. Much of these services are also seeing the same kind of disruption as the UCaaS space, where legacy on-premise contact center technology is being replaced by cloud-based alternatives. Contact center as a service (CCaaS) technology offers a flexible replacement, as it removes the need for companies to maintain physical infrastructure, enables integrations with other cloud services, and lowers capex spend.

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Morphing competitive landscape due to consolidation and cloud disruption

In the CCaaS space, the traditional contact center solution providers offering on-premise solutions were led by Cisco, Avaya, and Aspect Software. Then, a new generation of born-in-the-cloud vendors led by Five9 began to disrupt the low end of the market. Newer on-premise vendors like InContact (acquired by Nice) saw the trend developing and jumped on it by developing their own cloud-based systems. Additional cloud providers then emerged, including NewVoiceMedia (acquired by Vonage) and Amazon. This consolidation has put the market in a phase where we are seeing the cloud vendors like Five9 and Nice's InContact growing at much faster rates, demonstrating that they are taking market share from traditional vendors. Similar to the UCaaS market, very high end is the last to move, and we are still waiting for some of the biggest contact centers to start moving to the cloud.

Cloud contact center growing at 18.2% CAGR to reach $5.8B by 2023

IDC breaks down its estimates for the contact center market into on-premise and CCaaS forecasts. While the cloud contact center category includes multi-tenanted database products owned by companies like Five9 and Nice, the on-premise category includes legacy on-premise products in addition to cloud-deployed instances of contact center licenses when the license that is being deployed to the cloud is on-premise. Table 37 shows the on-premise category declining at a (7.7)% CAGR into 2023, driven by pure on-premise applications being replaced by public cloud alternatives like Five9 as well as on-premise legacy licenses being replaced by new subscription cloud-deployable licenses. These modern cloud-deployable licenses still qualify as on-premise, but they are designed for ongoing automatic updates rather than massive updates every 3-5 years. On the flipside of the on-premise decline, the market for cloud contact center currently stands at $3.5B and is expected to grow at an 18.2% CAGR to reach ~$5.8B by 2023.

Table 37: Declining On-Premise as Public Cloud Grows at 18.2% CAGR

	2020	2023	CAGR 2020-2023
On premises/other	5,888.00	4,635.60	-7.7%
Cloud	3,509.10	5,798.80	18.2%
Total	**9,397.10**	**10,434.40**	**3.6%**

Source: IDC Data, June 2020.

Partnerships vs. consolidation in achieving fully integrated UC and CC stack

Now more than ever, communications consumers are prioritizing the ability to access both UCaaS and CCaaS capabilities from the same vendor, in an integrated and all-in-one communications stack. Though some end users are still willing to adopt the solutions separately, we believe that integration is a growing trend in the marketplace and, over time, most companies will want to offer multiple collaboration capabilities. For many companies, the path to get there has been diverse – while some have chosen to build their own proprietary product, others have chosen to forge partnerships with existing best-in-class providers, and others have chosen to outright purchase the communications asset.

A brief summary table of this activity across select vendors is shown in Table 38, below. While RingCentral has chosen to partner with InContact to provide contact center functionality and Five9 has chosen to partner with Zoom Phone for UC, companies like Vonage and 8x8 have chosen to acquire multiple companies

throughout the years to build out these capabilities and go-to-market with an all-in-one communications stack. RingCentral's partnership with InContact should eventually dissipate, as the company has indicated that it is currently in the process of building out its own proprietary CCaaS solution.

Table 38: While Some Choose to Partner, Others Choose Consolidation/Ownership

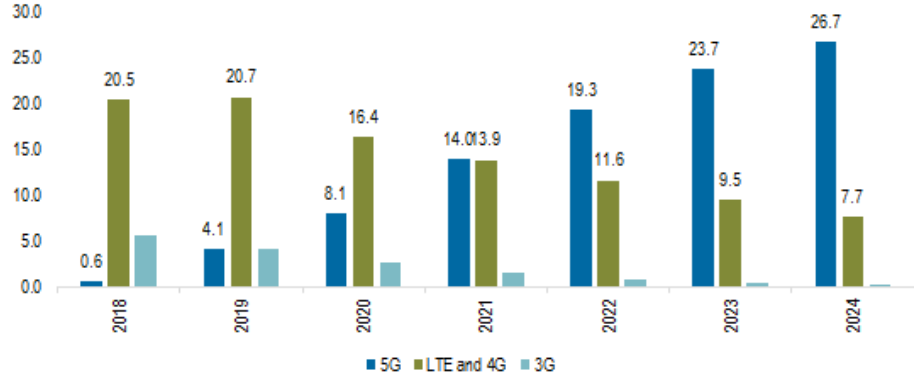
	Partnership	Consolidation/Ownership
RingCentral	InContact for CCaaS capabilities	In process of building out proprietary CCaaS product
Five9	Zoom Phone for UCaaS capabilities	N/A
Vonage	N/A	Acquisition of NewVoiceMedia for CCaaS (2018); acquisitions of Vocalocity (2013), Telesphere (2014), iCore Networks (2015), Simple Signal (2015), etc. for UCaaS capabilities
8x8	N/A	Acquisition of Contactual (2011), DXI (2015) for CCaaS; Acquisition of Voicenet (2013), Quality Software (2015), etc. for UCaaS capabilities

Source: J.P. Morgan Research.

BSS/OSS Software Spend Following 5G Infrastructure growth

5G network infrastructure is still in its infancy with 2020 being the first year that Gartner expects spend on 5G to surpass that of 3G—a pretty surprising fact. The ramp of 5G spending is expected to be in line with previous generation ramps but is forecast to get to a larger scale than previous generations, with Gartner forecasting 5G infrastructure spend to top LTE's $20.6B peak in 2019 by 2023.

Figure 50: 5G Infrastructure Set to Surpass LTE, at $14B, in 2021



Source: Gartner, $B

Below we compare the growth in 5G network spending in Figure 50 to what we believe is a good proxy for the timeline in the last generation, LTE, from Gartner's forecast in 2011. The growth rates through the years are similar, with a slight nod to LTE, but the scale of 5G can clearly be seen in Figure 51. We opted for 2011 and 2020 as T-0 for the comparison as it was the year after the $1B threshold had been crossed which we see as a clear indication of scale.

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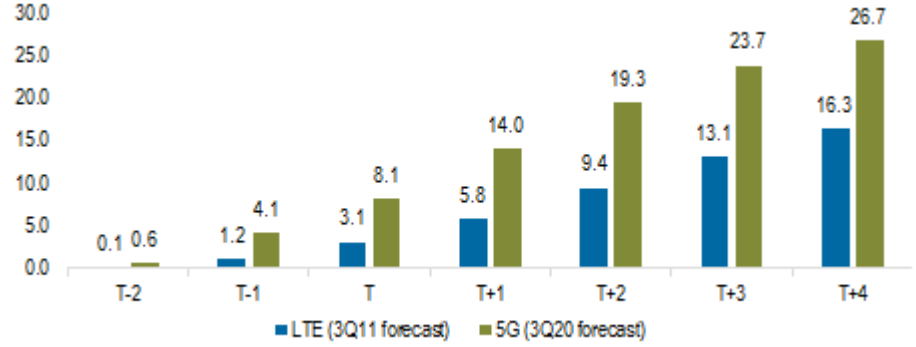
Figure 51: 5G Scale Even More Optimistic than Early LTE Forecasts

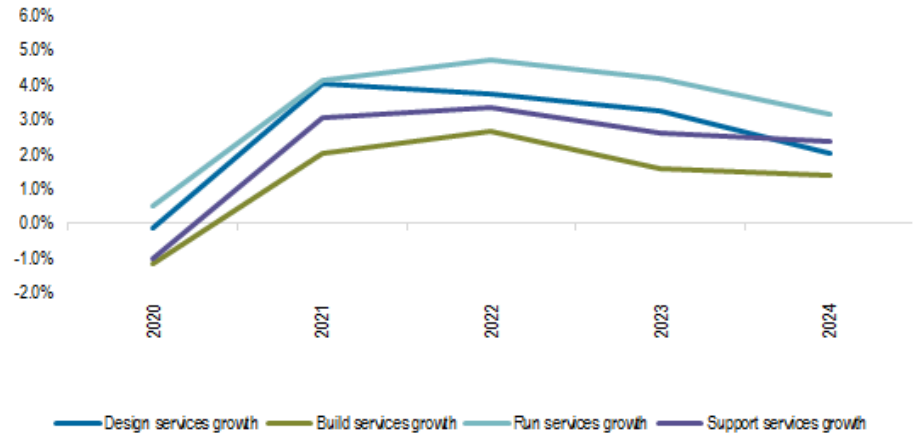


Source: Gartner, $B

Software and services forecast a better indication of demand for Amdocs

The ~35% CAGR in 5G network spend is encouraging, but for Amdocs the tailwinds created by 5G are more limited. As 5G engagements pick up, there are legacy network projects and service contracts that will be ramped down in a similar way that LTE and 3G infrastructure spending falls off as 5G spending picks up. Communication service provider (CSP) software is split, broadly, into business support and operation support systems, or BSS and OSS. For Amdocs, BSS is the much larger of the two, but during times of large scale network deployments it is an important competitive attribute to have both. In the early days of the network generation rollout planning and design will lead to spending in other areas, and in Figure 52, we see that the peak in design services growth is expected to be in 2021, with the peaks in build, run and support services all expected to peak in the following year.

Figure 52: Design Services Growth Forecasted to Peak in 2021 with the Rest to Follow



Source: Gartner

DOX's product portfolio positions the company well to sustainably grow in the low- to mid-single digits

The overall growth rate for CSP software services is estimated to be in the low-single digits throughout the forecast period, and the same is true for CSP software growth. Buried in these forecasts, however, is a continuum of spending related to the 5G rollout, which Amdocs should be able to ride like a series of cresting waves

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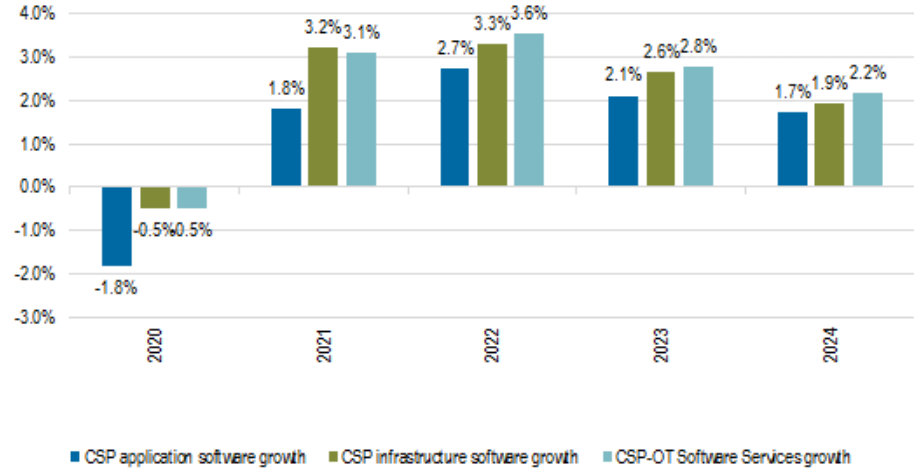
throughout the next 3 to 5 years. First is the design and planning phase, which we already see peaking in 2021; then will come the OSS services that come with any new network, where activation, provisioning and other administrative services are required for new subscribers and failure and performance monitoring and optimization software and services are required once the network is up and running. On the BSS side, new services will need to have rating and charging capabilities prior to launch (hello, Openet) followed by the potential for a long tail of new use-cases for the 5G network, which could multiply either the number of subscribers or services each subscriber actually pays for, which plays right into Amdocs' historical strength. Our takeaway from the growth rates in Figure 53 is not that mid-single-digit growth is eye-popping. Our takeaway is that each vector of DOX's business has a stable and/or improving outlook in the coming years and that with a broadened portfolio the company stands to capitalize on an elongated cycle.

Figure 53: Stable and improving outlook for CSP software and services growth



Source: Gartner.

Pricing and Revenue Management Markets Likely Stunted in Near Term

The market for sales force productivity, which we believe is the best proxy for revenue management and price optimization software, is expected to take a step back in terms of growth relative to the pre-pandemic estimates, according to IDC. Looking at the five-year period between 2019 and 2024, the total spend is now forecast to grow at a 6.6% CAGR compared to the year-ago projection, which called for 11.2% growth between 2018 and 2023. The downshift, which can be seen in Figure 54 below, is understandable given the global slowdown, but one thing to watch is that IDC is not forecasting a sharp bounce back in these applications but rather a gradual acceleration. Industry growth is now expected to get back to the double digits in 2024 at 10.3% compared to the previous year's expectation for stable growth above 11% for most of the forecast period.

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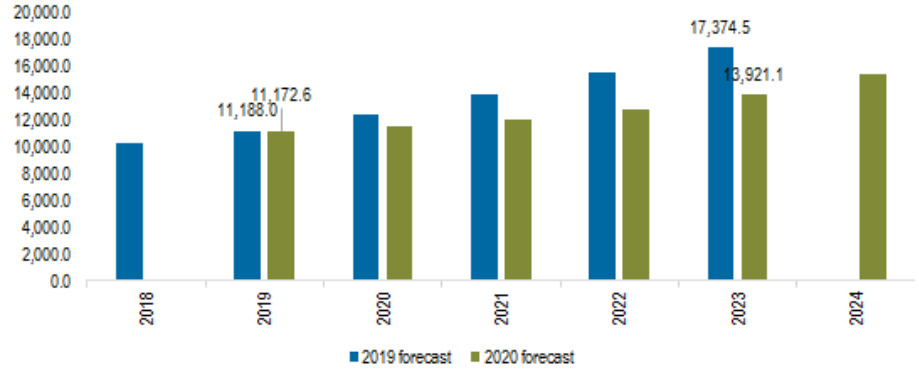
Figure 54: Sales Productivity Software Market Now Expected to Be $13.9B in 2030, Down from $17.4B

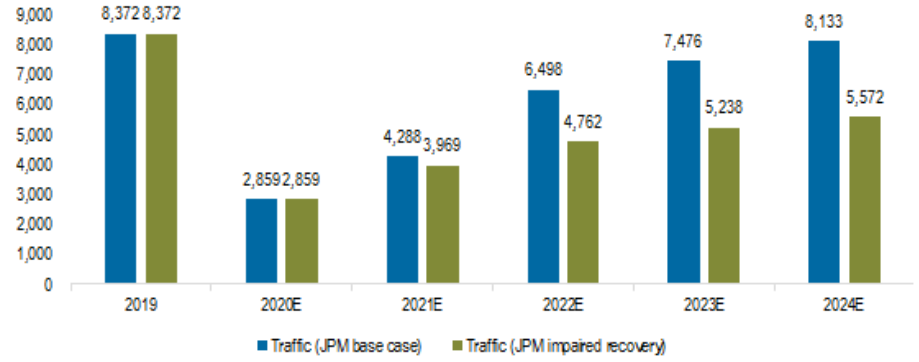


Source: IDC Data – 2019H2 Software Forecast Tracker, IDC Data – 2020H1 Software Forecast Tracker

J.P. Morgan Looking for Flight Traffic to Grow 50% in 2021

While the above industry data is something we are monitoring heading into 2021, the pandemic really shed light on the vertical nature of the PROS business and its 40%+ exposure to the travel and airlines industry. Airline traffic is expected to fall by about two-thirds in 2020 based on the industry metric revenue passenger kilometers (RPKs); nothing surprising here. However, what we think could be a bit of an overhang for PROS for a number of years is the out-year estimates. The international air transport association (IATA) is calling for a ~50% snapback in air traffic in 2021, according to their 2021outlook published in November, down from a 75% recovery in their previous outlook. This is in line with views from J.P. Morgan aerospace analysts (Seifman, Perry), who are also looking for 50% recovery in 2021 as of their October update. The picture beyond 2021 is for continued recovery in traffic and capacity, but even by 2024 the base case does not yet forecast pre-COVID air traffic.

Figure 55: J.P. Morgan base case calls for 4 years of recovery in flight traffic



Source: J.P. Morgan estimates. Units are RPKs

Bullish scenarios still point to ~4 years to "normalcy" for PROS customers

The IATA forecast from July is slightly more bullish in the short run compared to our J.P. Morgan analysts' view. But neither IATA nor J.P. Morgan expects pre-pandemic levels to be reached through 2024. The tough part for PRO is that this extended downturn in airline traffic and revenue will have an even longer lasting impact on its revenue from the segment due to the structure of the company's contracts. The subscription revenue model has a nice way of smoothing out income

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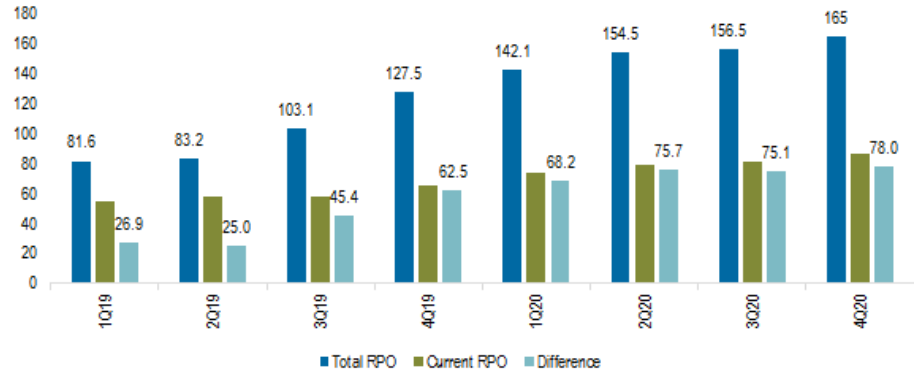
statement performance, but this benefit cuts both ways, as a recovery will not be fully reflected in revenue growth just as revenue from the segment did not fall by ~90% in FY20. Many airline customers sign 5+ year contracts as well, so PROS will be renewing long-term contracts for the next few years with customers that likely are not back to pre-pandemic levels and who will be looking for pricing concessions and adjustments around the edges, but more importantly the principal metric upon which PROS looks to price its contracts—revenue—will likely be below the mark in the previous contract. To their credit, PROS has been flexible with customers, allowing them to negotiate new contract terms during the crisis, and in the long run we see this as the right thing to do, but it now appears that even when these modified contracts come up for renewal, the airline customers will not yet be to full strength. Now we are talking about the renewal cycle in 2025 to 2030 as the next period of "normalcy."

RPO and Bookings the Numbers to Watch for ModelN

With MODN transitioning its business from on-premise to the cloud, there are a number of moving pieces on the income statement that may not tell the entire story, including maintenance revenue declines and a subscription revenue build that takes time to layer in. This is why we have focused on remaining performance obligation (RPO) and bookings rather than revenue. These non-revenue metrics have us somewhat on alert as we enter ModelN's fiscal and calendar 2021.

Figure 56: Non-current RPO flattened in 2020



Source: Company reports.

Ramped deal structures decoupled from the numbers

Looking at Figure 56, above, we see that both total RPO and non-current RPO saw only modest incremental builds in the last 9 months of the company's FY20 compared to the preceding periods. This means that new bookings are only filling the top of the funnel enough to offset the amount of revenue that is coming out of the bottom. This fact, on its own, is not a cause for concern, in our view. However, in the context of what is happening with ModelN, where ramped deal structures are pushing more of the contract value into future periods, it is something to watch for. A year ago we were very comfortable with subscription and other revenue growth coming in at just 7.0%, because we could look to the large build in RPO and bookings as validating management's continued confidence in the underlying health of the business – and indeed subscription revenue accelerated in FY20. Today, we are coming off a fourth quarter where ramped deals are increasingly part of the overall pie, and based on the numbers in Figure 57, it appears the total contract values are smaller in scope. Bookings can be a volatile metric, so the raw gyrations quarter to quarter may not be the best way to view the business, but even on a rolling

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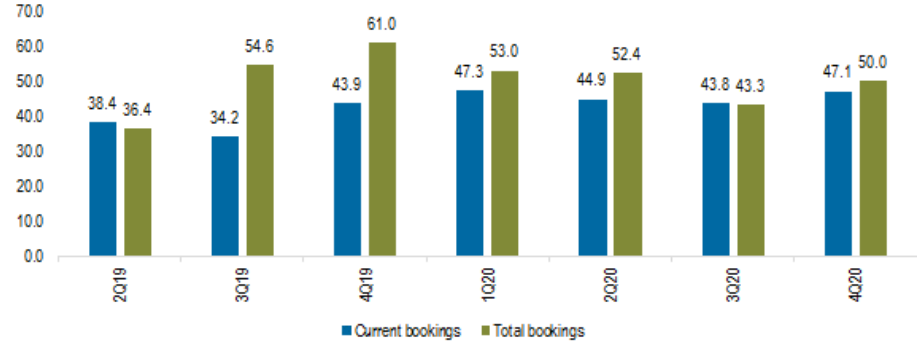
4-quarter basis, total bookings have declined over 5% sequentially each of the last two quarter.

Figure 57: Calculated Bookings Peaked in 2H19



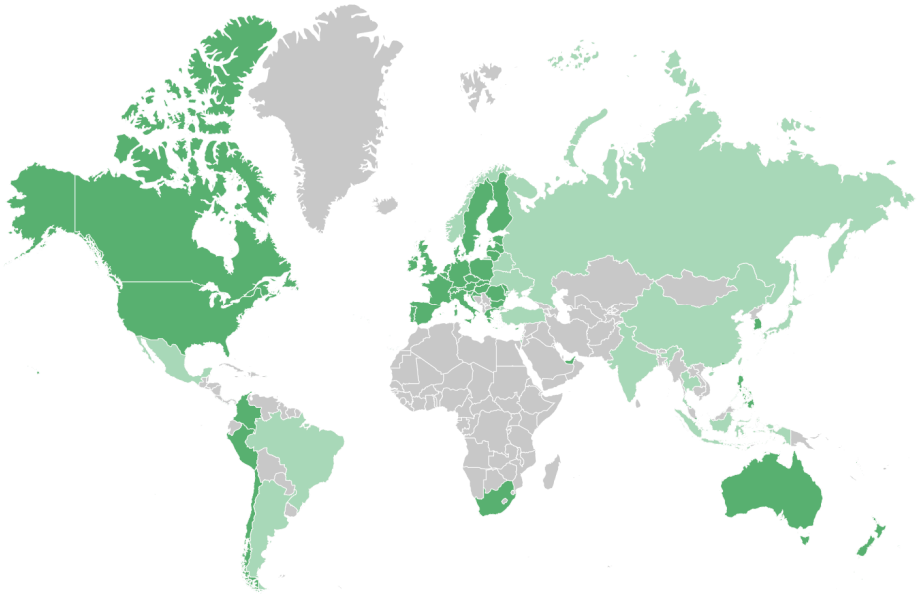
Source: Company reports.

E-Signature – Much More than a Work-from-Home Trend

June 2020 marked the 20-year anniversary of the Electronic Signature in Global and National Commerce (ESIGN) Act being passed in the U.S., establishing the validity of electronic signatures by declaring that they have the same legal status as traditional wet ink signatures. The space has seen continuous innovation since then, and organizations across the world have adopted the use of electronic signatures to transform the way they do business. However, the opportunity for digital transformation in this area remains under-penetrated. Results from an IDC survey published in May of this year showed that only one-third of responders (35%) had implemented digital authorization via electronic signature technology, and although adoption has likely ticked up amid COVID-19, we believe that significant opportunity remains for vendors like DocuSign to penetrate the opportunity going forward. IDC estimates that worldwide eSignature software revenue currently stands at ~$1.7B, growing at a 22.3% CAGR to reach ~$3B by 2023.

The map below shows the areas of the world where laws regarding eSignature have been enacted. Since there are differences between the legality and enforceability of electronic signatures versus digital signatures, it is important to note that the regions shaded in darker green on the map are the countries where eSignatures are equal to handwritten signatures under the law. Included in this group are the United States, Canada, the European Union, Switzerland, Hong Kong, South Korea, South Africa, Australia, and the others that are colored in dark green.

Figure 58: World Map of eSignature Legality



Source: PandaDoc eSignature Legality Guide.

Agreement Cloud Capabilities Extend Beyond eSignature

Now more than ever, eSignature software is applicable to a wide array of agreement workflows, including sales contracts, employment offers, privacy policies, and customer/partner onboarding. Since businesses are likely to adopt this software as part of a broader strategy to digitize, automate, and transform their content workflows, eSignature providers can differentiate themselves by offering technology that manages the entire contract lifecycle. DocuSign is capitalizing on that strategy with its Agreement Cloud, which was launched in March 2019 following both organic and inorganic product investments by the company. The Agreement Cloud is an all-encompassing platform that covers every stage of the agreement process, both before and after signature, including document preparation and contract generation, connections to other software, and APIs. DocuSign leveraged its 2018 acquisition of SpringCM to build out the contract lifecycle management (CLM) solutions of the Agreement Cloud, such as agreement collaboration and workflow management.

Agreement Cloud adds use cases and skews toward large enterprises

The stand-alone eSignature market has targeted small, medium, and large enterprises. Any company looking to transact efficiently is a potential prospect for eSignature, whether that business is a single entrepreneur or a Fortune 100 company. With the broadening of the platform beyond just eSignature, to the all-encompassing Agreement Cloud platform, DocuSign is better positioned to target the higher-end market. While a lone real estate agent who works for a small business may only need eSignature capabilities, a larger enterprise will likely demand a more robust product like Agreement Cloud to digitize its entire document lifecycle.

Market research conducted by Gartner in late 2018 supports the idea that DOCU's Agreement Cloud would be better suited to the upmarket, indicating that 61% of contract life cycle management purchases have come from companies with $1B+ in annual revenue. This compares with DocuSign's current customer mix of less than 1% of total customers spending over $300K annually, a proxy for large enterprise

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customers. The Agreement Cloud has also brought to light more back office use cases for items like internal interactions, purchase orders, IT, and offer letters to employees.

Data Points to Continued Market Share Gains for DOCU

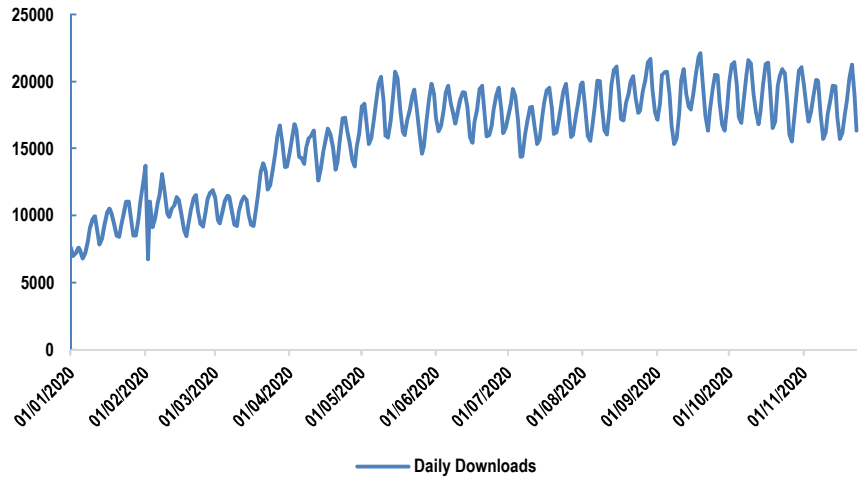
There is no question that the COVID-19 environment has accelerated demand for DocuSign's eSignature and Agreement Cloud offerings. As businesses shifted their employees to work from home, they were no longer able to execute in-person agreement processes and were increasingly prompted to adopt eSignature technology. DocuSign added 73,000 new customers in their 3Q21, bringing their customer total to nearly 822,000 worldwide. The company indicated that total customer additions in the first three quarters of FY21 have nearly tripled the additions over that same period in FY20. Uptake also extended beyond new customers, as demand increased from existing customers to expand across new use cases, departments, and borders. This increased customer adoption translated into top- and bottom-line results in 3Q21, with billings growing 63.5% year over year and revenue growing 53.5% to $382.9M.

Daily downloads continue to increase despite global economic reopenings

In an attempt to contextualize DocuSign's recent strength in usage and customer adoption, we look at usage trends for other eSignature providers based on Apptopia data. First, however, we look at daily download data for the DocuSign application, shown in Figure 59, below. Whereas mobile downloads of Zoom Cloud Meetings peaked during the height of the pandemic and then began to taper off as certain global economies reopened, DocuSign's daily downloads have not seen a similar decline in recent months, and instead continue to increase. We note that the spikes shown in Figure 59 relate to weekend declines in downloads and the fact that the majority of downloads occur during the workweek. Overall, DocuSign has seen an average of ~17,892 daily downloads since April 1, 2020.

Though Apptopia's data only tracks application data and does not reflect web traffic for the product, the platform's past data has proven to be highly correlated with DocuSign's reported web and mobile revenue.

Figure 59: Average Daily Downloads of DocuSign Continue to Increase



Source: Apptopia data as of November 25th, 2020.

Daily and monthly mobile usage data shows DocuSign far ahead of Adobe Sign

To better understand whether other vendors in the eSignature market are experiencing similar trends, we evaluated Apptopia data for the daily active users (DAUs) and monthly active users (MAUs) of DocuSign's top competitors, including Adobe (Adobe Sign), HelloSign, and SignNow. Though there are several other vendors that offer eSignature technology, we find that investors mainly compare DocuSign to Adobe Sign, as these two providers serve the high end of the market, where certification and security are very important. The 'scribble sign' companies at the very low end of the market are not directly comparable to DocuSign, because it has been shown that these do not hold up in court.

As seen in Table 39, DocuSign has captured roughly 73-75% share of total DAUs and 70-73% share of MAUs across competitor applications since March. This compares to just 1-3% and 2-6% share for Adobe, respectively, indicating that Adobe Sign is seeing significantly less mobile usage than DocuSign. The vendor that has captured the most share behind DocuSign since March is SignNow, an eSignature platform owned by airSlate that recently became the first eSignature solution to be launched on the AWS Marketplace.

Table 39: DocuSign Leads Market Share of DAUs and MAUs by Significant Margin

Market Share % of Total DAUs	March	April	May	June	July	August	September	October	November
Adobe Sign – Form Filler (App)	1.3%	2.1%	2.8%	2.7%	2.6%	3.1%	3.4%	3.3%	3.1%
DocuSign - Upload & Sign Docs (App)	**74.3%**	**73.5%**	**73.4%**	**73.5%**	**73.5%**	**73.5%**	**73.9%**	**74.2%**	**74.6%**
SignNow: Sign & Fill PDF Docs (App)	24.0%	24.0%	23.2%	23.4%	23.6%	23.3%	22.7%	22.4%	22.3%
E-signature app - Zoho Sign (App)	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
HelloSign (App)	0.4%	0.4%	0.5%	0.4%	0.3%	N/A	N/A	N/A	N/A
Market Share % of Total MAUs									
Adobe Sign – Form Filler (App)	2.7%	3.1%	4.5%	4.8%	5.1%	5.6%	6.1%	6.1%	5.5%
DocuSign - Upload & Sign Docs (App)	**73.2%**	**72.5%**	**70.9%**	**71.0%**	**70.9%**	**71.3%**	**71.5%**	**71.7%**	**72.8%**
SignNow: Sign & Fill PDF Docs (App)	23.0%	23.2%	23.2%	23.2%	23.1%	23.0%	22.3%	22.1%	21.7%
E-signature app - Zoho Sign (App)	0.1%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
HelloSign (App)	1.0%	1.0%	1.3%	0.8%	0.8%	N/A	N/A	N/A	N/A

Source: Apptopia data as of November 25th, 2020.

Growth in eSignature usage opens up room for increased competition

Despite the fact that Apptopia data points to significantly lower market share for Adobe Sign, this portion of Adobe's Document Cloud has seen tremendous growth since the onset of COVID-19. The company is currently seeking FedRAMP moderate certification, which would enable Adobe Sign for non-publicly available data, opening up additional verticals like healthcare, education, and federal. Though we believe DocuSign will continue its market leadership in the space going forward, the surge in demand for eSignature, coupled with additional vendors gaining FedRAMP certification, could open up room for increased competition going forward.

Accelerated adoption and usage of eSignature likely to persist after COVID-19

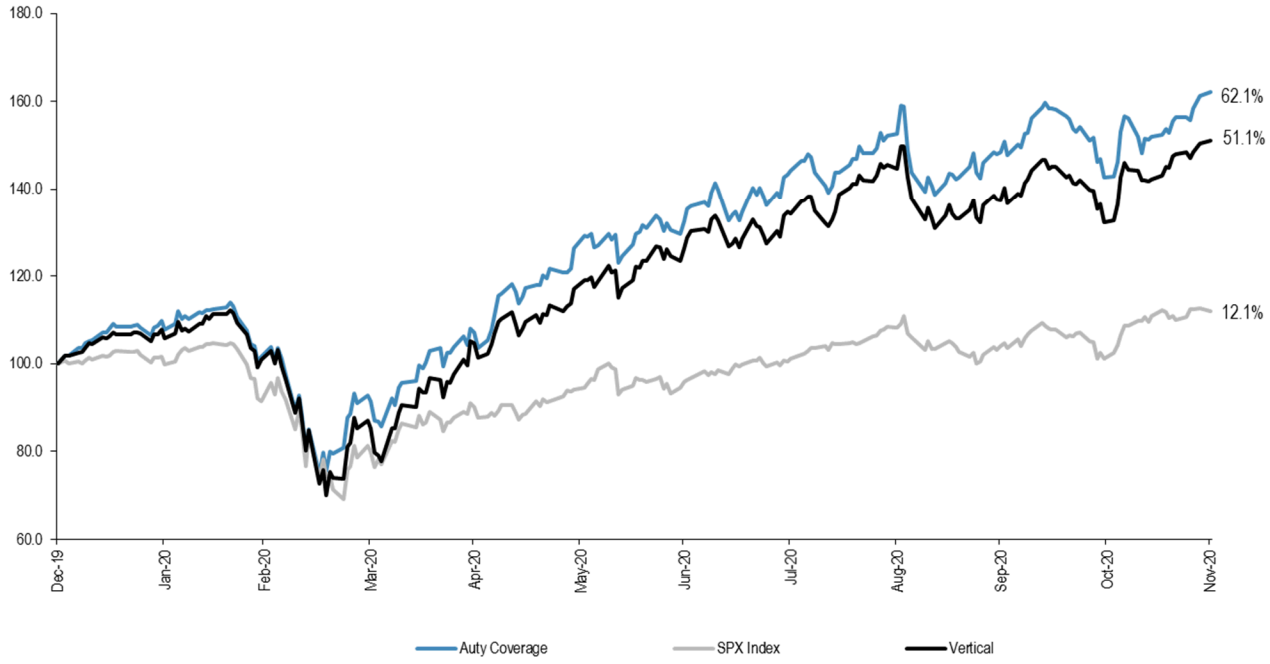
Not only has DocuSign captured a disproportionate amount of mobile usage share over competitor applications since March, but its percentage share has continued to increase in recent months. After the company's share of DAUs and MAUs ticked down slightly in the May-July timeframe and bottomed at 73.4% and 70.9%, respectively, this share has been progressively increasing since August. This data,

along with the recent daily download increases, suggest that accelerated digitization of agreement processes is likely to extend beyond the COVID-19 pandemic. Unlike other areas of a company's workflow that may return to legacy solutions once there is a widespread return to the office, companies are unlikely to reverse content workflow overhauls that included adoption of eSignature technology.

Vertical Applications

The figure below shows the performance of our vertical applications coverage relative to our overall coverage and the S&P 500, indicating that the segment has underperformed our overall coverage at 51.1% as of 11/30/2020.

Figure 60: Vertical Applications Performance Relative to the S&P 500.



Source: J.P. Morgan Research, Bloomberg as of 11/30/2020.

Design

The design segment of our coverage is the most cyclically sensitive, and we have been cautious in our ratings throughout 2020. But we are encouraged by the potential for recent vaccine trial efficacy results to lead to a more open and expanding global economy beginning in the second quarter of 2021, in line with our J.P. Morgan economic Outlook. On the back of that view, we are turning positive on a broader section of our design coverage to go along with the positive views maintained on the EDA portion of the design segment. For simplicity, we divide the design segment into MCAD (mechanical computer-aided design including simulation) and EDA (electronic design analysis).

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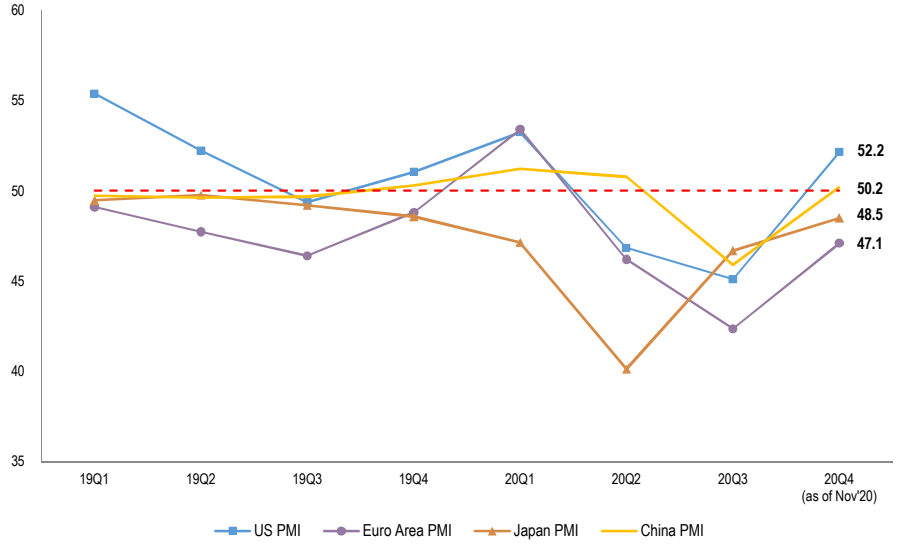
MCAD –Turning Positive on Improved Outlook for Economy

MCAD returns trailed our EDA coverage in 2020, as concerns around manufacturing and autos weighed on the space. Heading into 2021, we believe a continued economic recovery and the likelihood of increased infrastructure spending from the Biden administration will reaccelerate investor demand for these names.

US PMI data reflects expansion, while the rest of the world remains in contractionary territory

PMI data from October and November show the US rebounding from third quarter troughs, while data from Europe and Japan show continued contraction in manufacturing activity, albeit at a less severe level than in previous quarters. As stricter lockdowns in other areas of the world have reduced manufacturing activity, we view a vaccine as the primary catalyst for global PMI growth in 2021.

Figure 61: Global PMI Data 2019-2020



Source: Bloomberg Finance L.P.

JPM expects US unemployment to decline through 2021 to 5.6%

The unemployment rate dropped to 6.9% in October, well below the 14.7% peak in March bust still nearly twice as high as February levels. Nonfarm payrolls grew 638k in October, following September gains of 672k as economic activity continues to resume. J.P. Morgan US chief economist Michael Feroli expects the employment rate to continue to fall throughout 2021 to 5.6% in the fourth quarter, assuming broad vaccine availability in the second half of the year and an additional $1T of support from the federal government.

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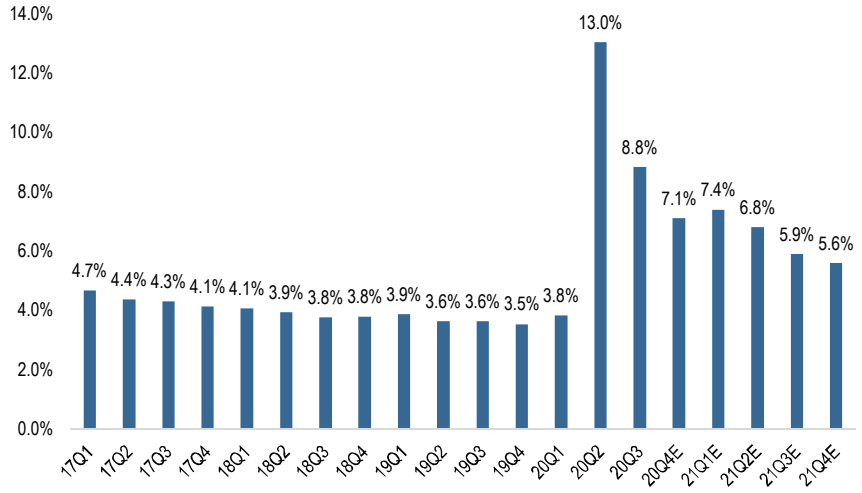
Figure 62: US Unemployment Rate Recovering Steadily

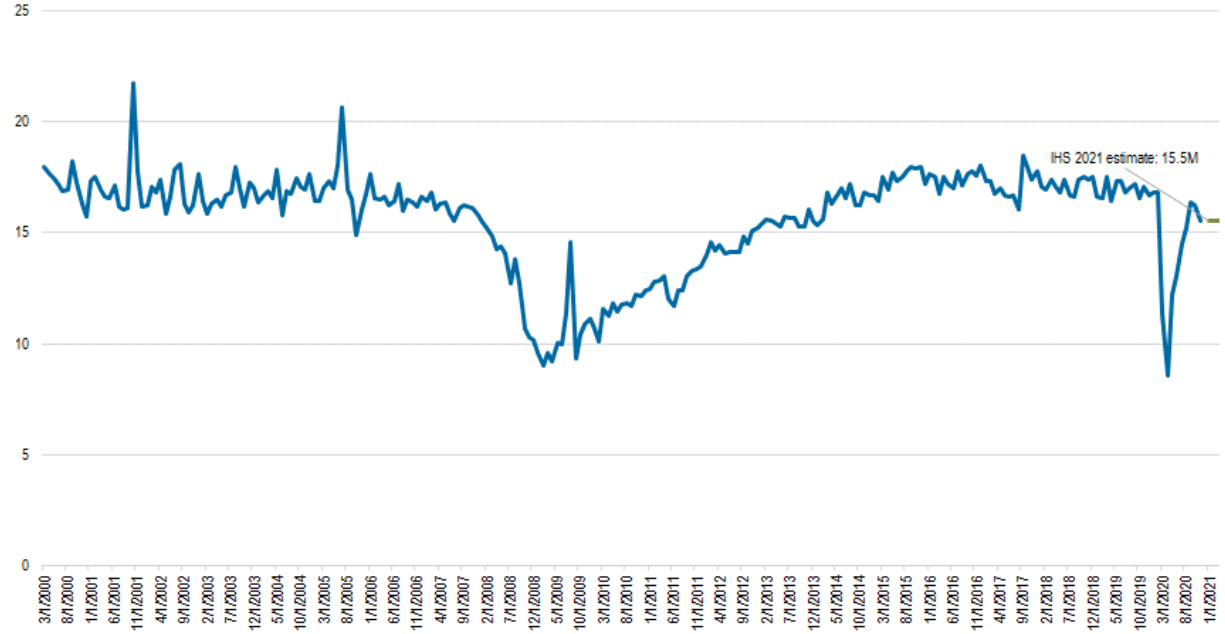


Source: J.P. Morgan estimates, Bloomberg Finance L.P.

Automotive and Aerospace Production Set for a Rebound

US automotive sales have bounced back in the last three months with seasonally-adjusted annual rates of 16.34M, 16.21M and 15.5M cars in September, October and November, which were down 4.9%, 2.1% and 9.0%, respectively, year on year. These are not stellar results but represent the best three-month period since the pandemic began. IHS Automotive expects 8.8% growth in SAAR in 2021 compared to 2020 at a rate of 15.5M vehicles, which we see as achievable given sales in the last three months have topped or equaled that mark.

Figure 63: US Auto SAAR back to ~16M level

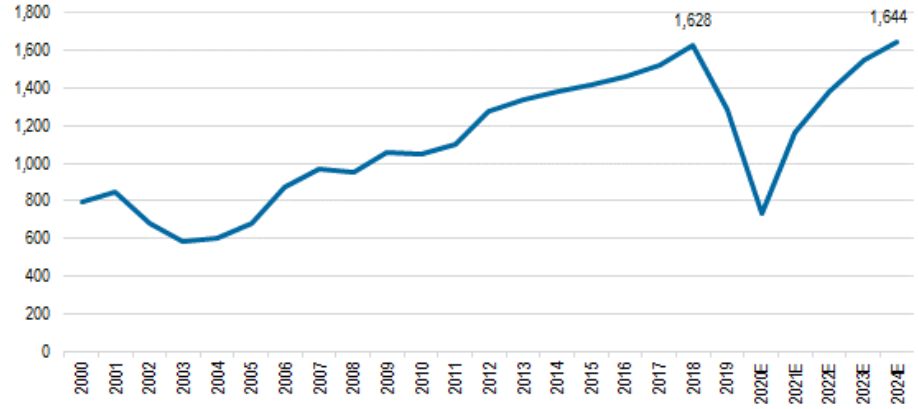


Source: Bloomberg Finance L.P., HIS

J.P. Morgan Aerospace analysts forecasting 58% bounce-back in commercial deliveries

Commercial aircraft deliveries have also been hit hard during the pandemic, with deliveries expected to be less than half of the 2018 cycle peak. J.P. Morgan aerospace analysts (Seifman, Perry) expect commercial aircraft deliveries to grow 58.4% in 2021 compared to 2020 and another 18.9% in 2022. This would put aircraft deliveries back above the 2019 marker by 2022, but it may take another couple years to get back above 1,600 on an annual basis. This should underpin strong demand for both design and simulation software from both the manufacturers and suppliers in aerospace.

Figure 64: Commercial Aircraft Deliveries Expected to get back above 1,600 by 2024



Source: Company reports and J.P. Morgan estimates.

COVID-19 Stimulus Presents Opportunity for Infrastructure Spending and Construction Management

U.S. infrastructure spending has steadily declined over the last six decades, but COVID-19 stimulus could turn it back up

In 1958, infrastructure spend represented 3.1% of GDP, while in 2017 it represented just 2.3%, following decades of fairly steady decline (see Figure 65). Looking at the data, we found no significant bifurcation between red and blue administrations to indicate that one party typically spends more on infrastructure. However, the most recent jump in infrastructure spend as a percent of GPD was in 2009, with the American Recovery and Reinvestment Act mirroring the New Deal's efforts to create jobs and rejuvenate the economy through heightened infrastructure spending. We think it is likely that Pres. elect Biden, who helped pass the Recovery Act in 2009 and who has been a large proponent of infrastructure spending, will include public spending on infrastructure as a prominent component of any COVID-19 stimulus bill. Although it is likely that a split congress will bring ample negotiations over the terms of any proposed package, we believe bipartisan interest in job creation will prevent infrastructure spending from fully landing on the chopping block.

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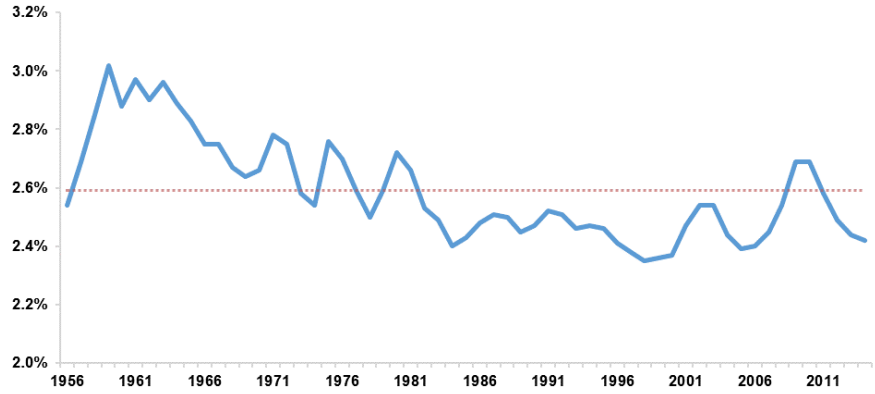
Figure 65: Infrastructure Spending as a Percent of GDP 1954-2014

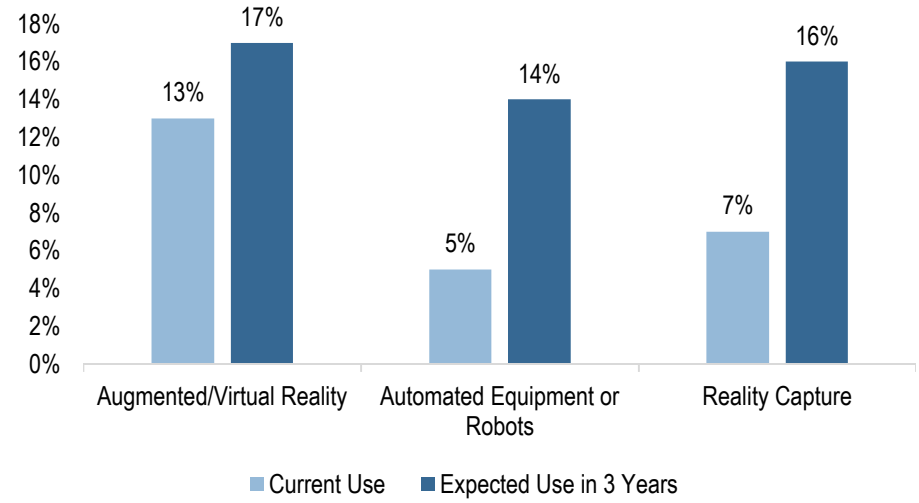


Source: U.S. Bureau of Economic Analysis.

Underpenetrated construction industry presents large opportunity for MCAD vendors

According to McKinsey analysts, the construction industry is one of the world's least digitized markets, with many contractors still relying on pen and paper to plan and budget projects. The typical construction project involves multiple independent contractors and suppliers who have their own ways of doing things and little incentive to adjust for an individual project. Additionally, construction projects vary greatly, making it difficult to standardize processes. Strict budgets leave little wiggle room for R&D spend, yet the lack of digitization often leads to over-budget projects and delayed timelines. A study by the U.S. Chamber of Commerce in 2018 found that while the industry is currently underpenetrated, most contractors are expecting to increase their technology investments within the next three years. We expect adoption among larger firms to come first, as more integrated in-house teams will make the transition easier. Still, the same study found that 26% of companies have no plans to invest in any new technology within the next three years, showing the industry has not fully embraced the benefits of digitization just yet.

Figure 66: 2018 Survey Shows Growth Opportunity within Construction



Source: U.S. Chamber of Commerce, USG Corporation.

Construction software brings together all key constituents in a $12.7B TAM

The construction software segment got its start by attempting to improve communications between the jobsite and architects but has evolved to cover all elements of project management, including bringing together general contractors, subcontractors, and owner/operators to help automate all aspects of the construction process, starting with bid preparation/submission to finance to safety and all the way to placing buildings into operation with BIM (building information management) systems. The ability to monitor progress and communicate changes is driving greater efficiency across the construction process. We expect the total addressable market for this part of design to reach $12.7B in 2025.

Aspen trails rest of coverage as volatility in the oil markets spooks investors

With the pandemic halting commercial and industrial travel, the already struggling oil markets took a turn for the worse in the spring with oil prices declining steeply into negative territory. As Aspen primarily services companies in the oil and gas industries, investor concerns over the state of the company's end markets has kept returns muted, gaining just 6.5% this year compared to our broader design coverage returns of 32.4%. To understand how big of an impact temporary disruption in the oil markets typically has on Aspen's core business, namely annual customer spend (ACS), we looked at a few factors: the relationship between oil prices and major energy companies' capex spend and the relationship between this capex spend and Aspen's ACS.

Energy capex is stickier than revenue

While revenue is highly correlated to changes in oil prices, capex is typically a bit sticker. This makes sense to us intuitively; companies are not going to easily overhaul their capital spending projects even if revenue is a bit lower in the quarter. Additionally, while revenue is affected in real time as oil prices move, there is generally a 1-quarter lag for any major oil movements to flow through to capex spend. We looked at data from the top 30 most capital intensive energy companies and found that from 2012-2020, oil prices had an 89% correlation to revenue and a 67% correlation to capex. We also looked at changes in ACS to measure any impact capex has had on bookings and found that roughly 13% of ACS change is due to changes in capex, which is significant, in our opinion.

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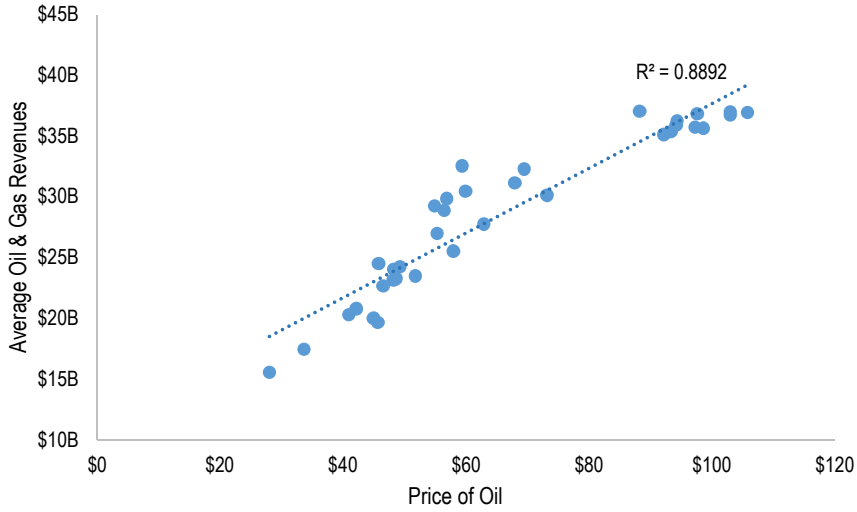
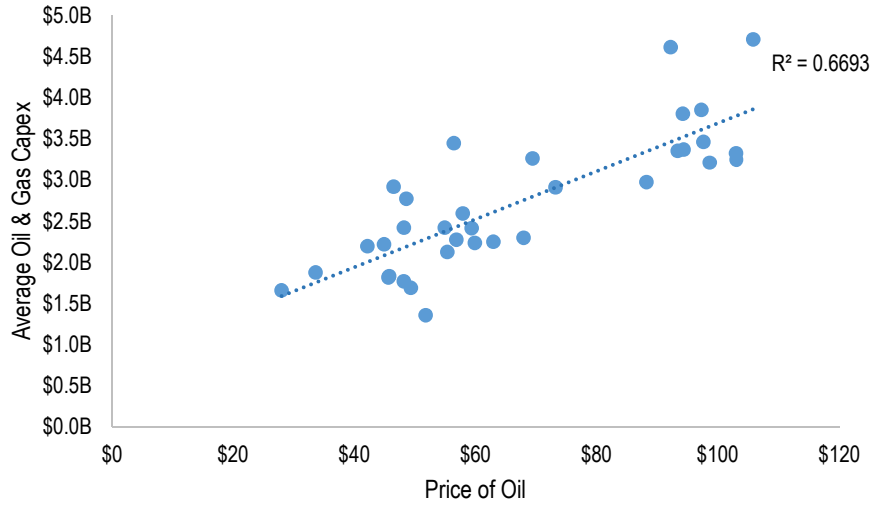
Figure 67: Oil Prices vs Oil & Gas Revenues



Source: J.P. Morgan estimates, Company data.

Figure 68: Oil Prices vs Oil & Gas Capex Spending



Source: J.P. Morgan estimates, Company data.

Although capex tends to hold up fairly well during short-term volatility in the oil markets, investors appear to link Aspen's stock more closely to oil in times of distress. We compared Aspen's stock price to oil prices over the last 8 years and found that while the overall correlation was minimal, it jumped nearly 30x during times when oil fell below $50. However, we believe short-term oil volatility could bring longer-term benefits to Aspen as energy companies invest more heavily in software to drive product efficiency. J.P. Morgan E&P analyst Arun Jayaram expects higher maintenance activity in 2H21, with a focus on operational efficiency through simulation software, in line with our expectations.

Figure 69: Overall Correlation Between Changes in Price of Oil vs Changes in AZPN Price Is Minimal

Regression Statistics	
Multiple R	0.059060054
R Square	0.00348809
Adjusted R Square	0.003042223
Standard Error	1.606672948
Observations	2237

	Coefficients	*Standard Error*	*t Stat*
Intercept	0.051511496	0.033973126	1.516242463
Change in Price of Oil	0.04747628	0.016974044	2.796992845

Source: Bloomberg Finance L.P.

Figure 70: Correlation Is Much Higher When Oil Is Below $50

Regression Statistics	
Multiple R	0.298970076
R Square	0.089383107
Adjusted R Square	0.084407058
Standard Error	3.624176362
Observations	185

	Coefficients	*Standard Error*	*t Stat*
Intercept	0.116618022	0.266458742	0.437658831
Change in Price of Oil	0.657663225	0.155173709	4.238238728

Source: J.P. Morgan estimates, Bloomberg Finance L.P.

Digital Twin Is in Its Early Stages but Growing Rapidly

In its most basic sense, a digital twin is quite self-explanatory: it is a digital replica of a physical asset, system, or process, used to create efficiencies in a business environment. However, to what extent a physical asset is replicated and the use cases to which a digital twin can be applied are where we begin to see diverging definitions and standards. Rather than a concrete set of solutions, we view digital twin as more of a concept that is constantly evolving. Below we examine a broad timeline of digital twin adoption and the current growth opportunities that affect our coverage.

Background on digital twin

In some ways, digital twin adoption started decades ago in the industrial and manufacturing industries as OEMs instrumented equipment with sensors that would send information from out in the field back to engineering teams. In these cases, companies could receive digital information about a physical asset to detect system or product failures in much shorter periods of time than could be achieved with periodic maintenance checks.

The use of physics-based models transformed digital twins from tools that could detect existing issues into ones that could apply predictive analytics to catch errors before they even occurred. Within these use-cases, organizational needs determine which solutions a customer will purchase and at what price point. In many cases, data only needs to be received periodically once a month, or even once a quarter, where in other areas such as process manufacturing and augmented reality, real-time data processing is a must.

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IoT Adoption and Expansion into New Industries Should Drive Growth

Digital twins are enabling the rapidly growing IoT market

Like the digital twin, IoT is a rather broad concept with use cases that span from wearables to autonomous driving vehicles and require capabilities that stretch beyond the predictive maintenance or failure prevention that we have seen in the early phases of IoT applications. While the idea of IoT has been discussed for many years, we expect to see actual implementation tick up through the advancement of artificial intelligence, increased cloud adoption, and improved mobile connectivity through 5G to facilitate experiences like augmented reality. Some of the more advanced use-cases, such as self-driving cars, require real-time data processing and highly accurate foresight into any errors or disruption. The main barriers in this space are cost and compatibility; customers are looking for attractive price points to implement the technologies into smaller assets and often require integration with multiple vendors' solutions.

Modern digital twin adoption is now expanding beyond the manufacturing industry

Unsurprisingly, modern digital twin adoption is fairly concentrated within the manufacturing industry, with an estimated 70% of manufacturers employing digital twins by 2022. As mentioned above, the early implementation of sensors into manufacturing equipment has made the transition to predictive analytics much faster than for other industries. Still, vendors are also focusing on other verticals to capture increased demand. As of last year, just 6% of enterprises overall have employed digital twins into their business functions, but 38% are engaged in one- to three-year planning stages for implementation. One of the more prominent verticals outside of manufacturing is the healthcare industry, where engineers at medical devices and pharmaceutical companies are using simulation software to develop, test, and repair equipment and medication.

Largest barrier to vertical expansion is lack of engineering knowledge

The customer base for digital twins is expanding to non-engineer designers, operations departments, and healthcare professionals as use cases broaden beyond manufacturing. For example, a hospital may not only use digital twin technology for equipment maintenance but also within its surgical team to analyze a digital heart before surgery. While expansion into other verticals provides promising growth opportunities, the lack of coding experience among non-engineers is one of the largest barriers to digital twin adoption in these areas. Furthermore, vendors that have operated exclusively in the industrial and manufacturing industries may find it difficult to prove their expertise in other verticals.

We believe the best positioned companies are those that offer a wide breadth of solutions and embrace an open ecosystem

With growth opportunities stretching in multiple directions, vendors face somewhat of a juxtaposition between the demand for more technically advanced software and the need for easier-to-understand platforms. To navigate this complicated environment, vendors must be willing to engage in partnerships with other players and develop a wide set of solutions to meet varying needs.

Partnerships are a key theme in digital twin expansion

In November, we hosted a Digital Twin Conference, where we sat down with the CEOs of some of our design names to discuss current trends and growth prospects

within the digital twin market. One theme stood out above the rest: digital twin adoption relies on an open ecosystem. Partnerships between PTC, Ansys, and Rockwell as well as Aspen and Emerson expand go-to-market abilities and the capabilities of the products. Sharing industry expertise allows for a broader customer base, and the additional data brought in from multiple platforms enhances the feedback loop for customers as well.

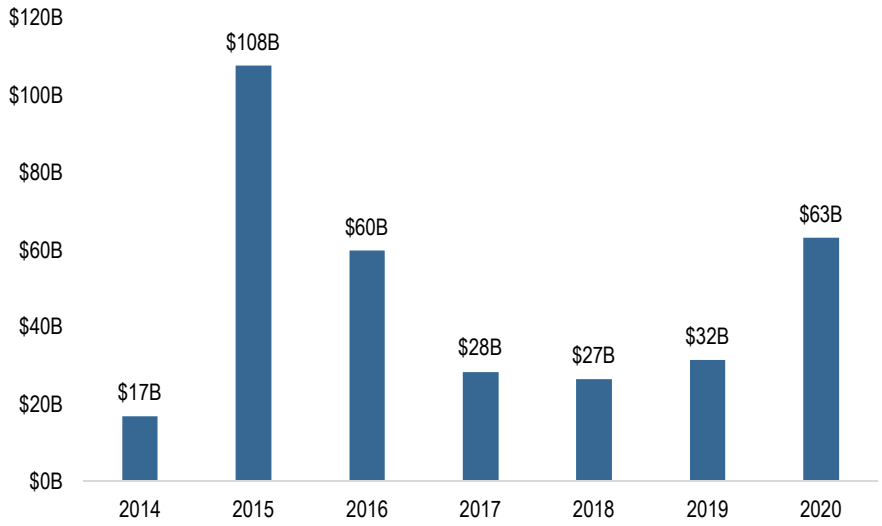
EDA Set for Another Strong Year in 2021

Electronic design automation (EDA) was one of the rare spots within the design software space that actually saw tailwinds from the COVID-19 fallout. Consumer electronics, cloud infrastructure, mobile compute, gaming and other semiconductor and systems-related areas saw large spikes in demand. Increased demand means more attention is paid to chip time-to-market, all while maximizing power, performance and area. CDNS and SNPS each outperformed our coverage universe in 2020, and we see tailwinds into 2021 that keep this subsector an attractive one.

Second Largest Semi M&A Announcement Year in History

Although the COVID-19 pandemic halted M&A activity in the spring, two mega-deals in the back half of the year make 2020 the second highest year in history for M&A announcements in terms of dollar value (see Figure 71). As of September 2020, the total announced deal value for the year was $63.1B, second to only 2015, in which $107.1B of deal value was announced. Compared to 2015, however, which saw over 30 announcements, the first nine months of this year were much more concentrated with just a few key deals. NVIDIA's planned acquisition of Softbank's Arm for $40B and Analog Devices $21B announcement to purchase Maxim Integrated Products will account for over 95% of the total M&A dollar value this year, if approved. With the majority of deal value in 2020 limited to just a few players, we see room for increased M&A activity in 2021 as the economy continues to reopen. The US-China trade war has also dampened some M&A activity over recent years, so any improvement in US-China relations could also spur additional deal volume.

Figure 71: M&A Activity at Highest Level Since 2015



Source: IC Insights 2020 McClean Report

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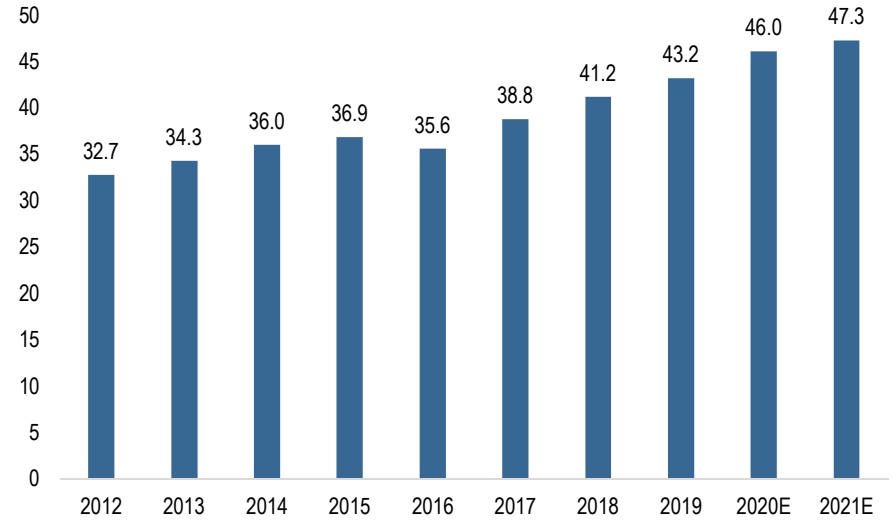
Forecasting Semi R&D to Grow by 3% in 2021

Based on our estimates, the Street and J.P. Morgan semiconductor analysts' views, we expect semiconductor R&D spend to increase by 3% in 2021 from 2020. We note that for the last two years, R&D growth has outpaced our expectations, increasing 4.8% and 6.6% in 2019 and 2020, above our estimates of 0.7% and 2%, respectively. We believe our 2021 projections have room for upside as well, especially if we see a swifter-than-expected economic recovery. Below, Figure 72 shows the historical and projected aggregate R&D spend of 20 of the top semiconductor names on which we based our estimates.

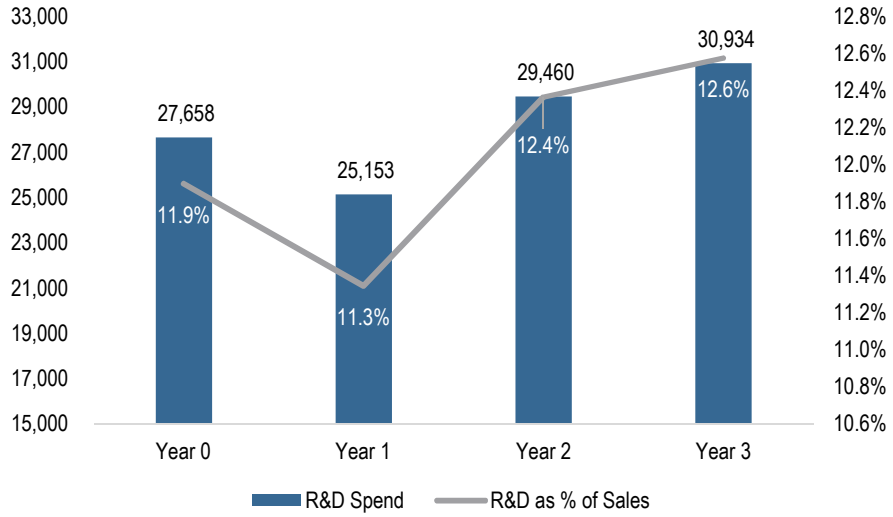
Figure 72: Semi R&D Spend 2012-2021 (in $B)



Source: J.P. Morgan estimates, Company data.

While increased consolidation in the semiconductor industry is a point of concern for some EDA investors, we believe the impacts on CDNS and SNPS revenue are muted, as R&D spend has been historically unaffected by industry consolidation. We looked at major semiconductor M&A activity between 2015-2017 and found that, on average, R&D spend as a percent of sales actually grew in the 2-3 years following an acquisition. Figure 73 shows the aggregate R&D spend of 20 semiconductor companies that made major acquisitions between 2015 and 2017. Year 0 represents the combined R&D spend of the target and acquirer in the year prior to the deal. Years 1-3 represent the R&D spend of the acquirer in the three years following the deal.

Figure 73: R&D Spend Has Historically Grown in the Years Following an Acquisition (in $M)



Source: J.P. Morgan estimates, Company data.

While consolidation provides cost synergies, we expect these savings to generally come out of COGS and SG&A before trickling through to R&D in the longer term. Furthermore, any impact on EDA names is likely offset by an overall increase in product development as well as a higher focus on EDA by semiconductor names.

EDA Spend Outpacing Overall R&D Spend

Over the last several years, we have seen EDA spend outpace overall R&D spend, growing 4.8% in 2019 compared to overall R&D growth of 4.8%. Following the large sweep of consolidation in 2015-2016, EDA actually gained share in the R&D market, with EDA spend increasing 9.2% in 2016 despite a 3.2% decline in R&D, further offsetting any headwinds of cost synergies to EDA names. We see an opportunity for further EDA market share expansion if heightened M&A activity continues through 2021.

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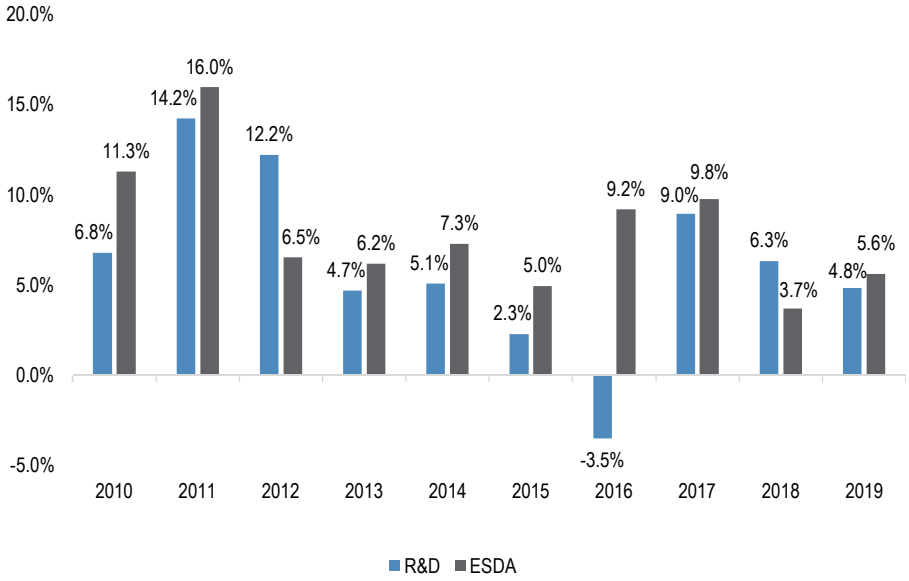
Figure 74: EDA growth vs R&D growth 2010-2019

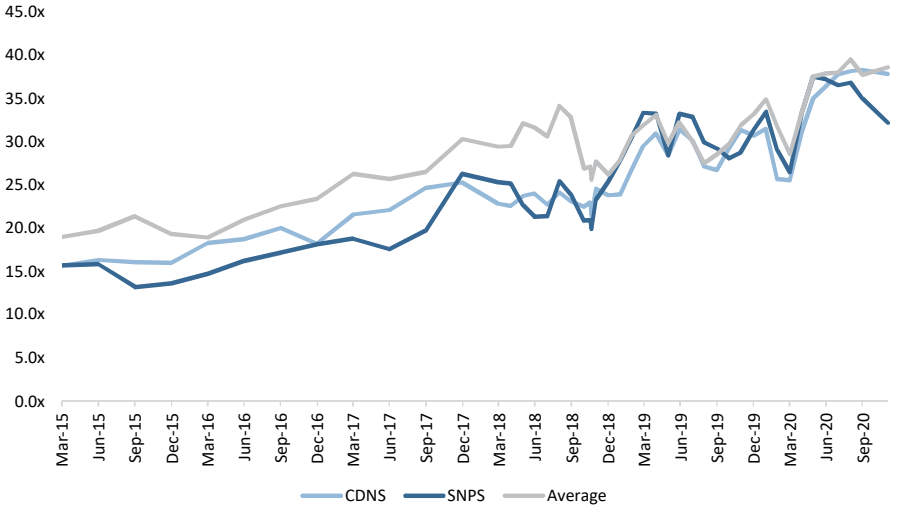


Source: J.P. Morgan estimates, Company data.

EDA Valuation at All-Time Highs

While our EDA names have historically traded at a discount to the design average, the spread has tightened over the last year, with CNDS surpassing the industry average during the height of the pandemic. COVID-19 has accelerated digital transformations across industries, and EDA names like CDNS and SNPS offered additional protection from the more cyclical end markets that our MCAD names serve. While we believe a COVID-19 vaccine will not reverse the software adoption seen in 2020, recent market stabilization has caused CDNS and SNPS to come off their July highs, making valuations a bit more attractive.

Figure 75: EDA EV/FCFF Multiples Have Come Off July Peaks but Are Still at All-Time Highs



Source: Bloomberg Finance L.P.

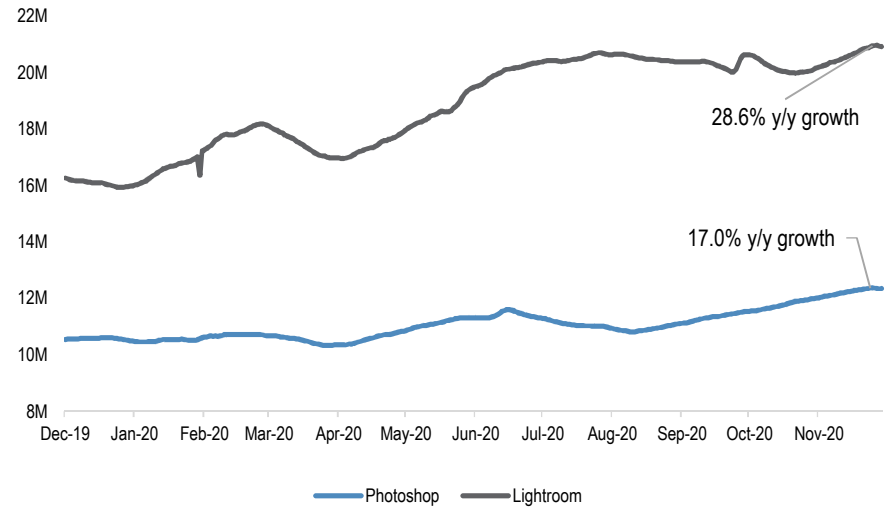
Content Creation and Digital Marketing

Yet again we find a sector of our coverage that benefited from the pull-forward of digital transformations and the demand for digital content. Adobe's content creation powerhouse saw impressive user growth, even from its most established applications, and the digital marketing channel continues to be the fastest growing segment of the market. These trends have staying power, and we would expect 2021 to bring more strong demand.

Creative Cloud Benefits from Digital Acceleration

The average person is now becoming a creator through digital formats like social media, a trend we believe is only accelerating with the current virtual environment. Over the last year, daily active users (DAU) on Photoshop and Lightroom have grown by 17% and 29%, respectively, as seen in Figure 76, below. This growth is also reflected in Adobe's Creative Cloud ARR, which grew 20.8% YoY in 3Q20.

Figure 76: Photoshop and Lightroom Daily Active Users



Source: Apptopia

Adobe expands mobile offerings to capture growth

We believe Adobe is well-positioned to take advantage of the current environment with its latest release of iPad offerings in October as well as strength in Adobe Acrobat. The company updated its Photoshop platform, initially released last November, and rolled out Adobe Illustrator on the iPad for the first time. Below is a brief timeline on Adobe's iPad offerings since 2014.

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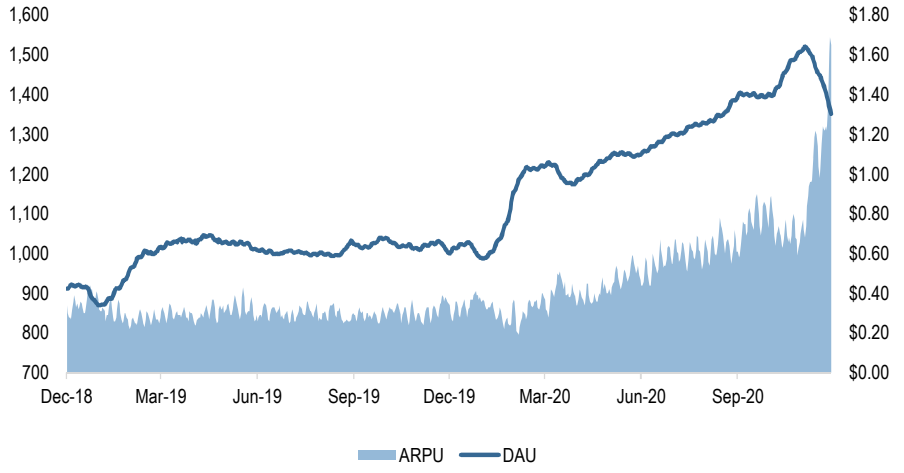
Figure 77: Timeline of Adobe iPad Rollouts 2014-2020

Apr-14	Lightroom mobile 1.0	Adobe adds Lightroom to the iPad, with an iPhone release one month later
Oct-15	Lightroom mobile 2.0	Lightroom is available for free without a Creative Cloud subscription as part of Adobe's new strategy to hook customers on free apps and then upsell to
Nov-19	Photoshop for the iPad 1.0	Adobe launches its first version of Photoshop on the iPad
Oct-20	Photoshop for the iPad 2.0	Version 2.0 brings several upgrades including livestream capabilities and image resizing
Oct-20	Illustrator for the iPad	Illustrator is available for download on the iPad for iPasOS 13.4 or later
Oct-20	Lightroom mobile 6.0	Latest version of Lightroom for the iPad with new capabilities including color grading and watermarks

Source: Company data.

Experiencing even faster growth than Adobe's creative cloud apps is Adobe Acrobat, with mobile usage jumping dramatically this year (see Figure 78).

Figure 78: Adobe Acrobat DAU and ARPU accelerate in 2020



Source: Apptopia, J.P. Morgan estimates.

Investor Focus Lies on Digital Marketing and Advertising

With stability in Creative Cloud, investors are focusing on Adobe's Digital Experience segment, which has experienced some weakness from SMB customers throughout the pandemic. We believe further economic recovery and increased usage of Acrobat, Scan, and Sign will boost the segment in 2021, although we expect slower growth through 2024 than we saw in the last several years.

Advertising applications expected to lead the growth in Experience Cloud

IDC expects the Digital Experience industry to experience a slowdown over the next few years, growing at a CAGR of 10.1% through 2024, compared to a CAGR of 15.6% from 2015 to 2019. Within the industry, Advertising Applications are expected to lead the growth through 2024 at a CAGR of 13.0%, much lower than last year's projected 2019-2023 CAGR of 19.1%. We note that these figures were produced in June 2020, and we see room for upside given our more optimistic outlook in the back end of the year, coupled with digital acceleration as a result of COVID-19.

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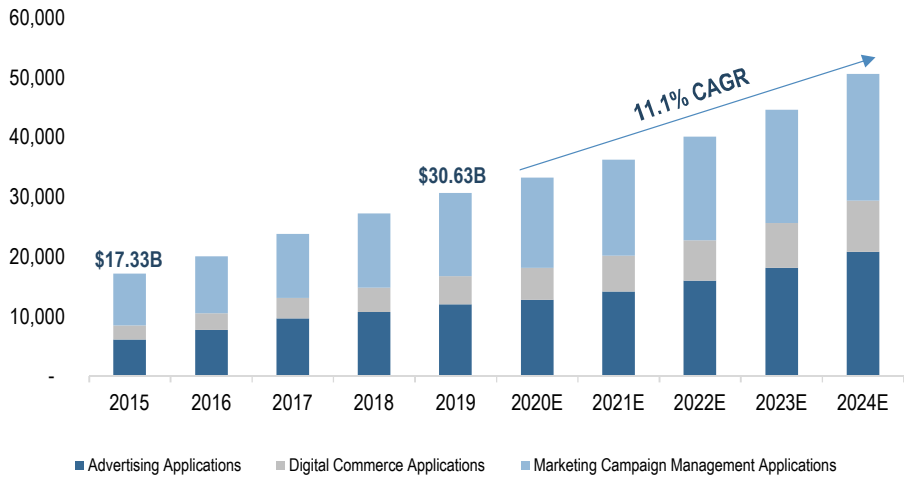
Figure 79: Digital Experience Market Expected to Reach Nearly $51B by 2024



Source: 2020 data: IDC Data – 2020H1 Software Forecast Tracker

Figure 80: Advertising Applications Should Lead Growth at a CAGR of 13%

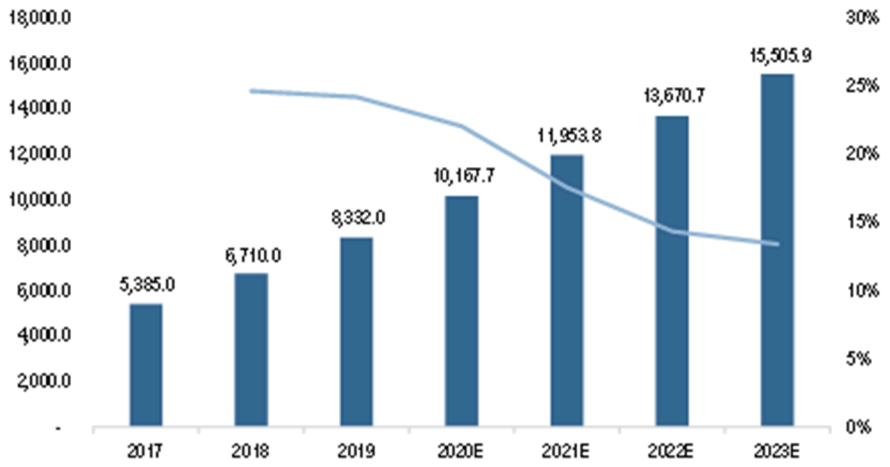
	CAGR 2015-2020*	CAGR 2021-2024
Advertising Applications	15.9%	13.9%
Digital Commerce Applications	18.0%	12.1%
Marketing Campaign Management Applications	11.6%	9.7%

Source: 2020 data: IDC Data – 2020H1 Software Forecast Tracker. *2020 values are still partially actual and estimated.

Adobe Expected to Outpace Industry Growth for Digital Experience

As a market leader, we expect Adobe's Digital Experience segment to outpace the broader industry, especially with recovery in the SMB space (see Figure 81). Digital Media ARR has come in above our estimates for both the second and third quarters this year, showing resiliency despite some end market difficulty.

Figure 81: Adobe Digital Experience Expected to Slow but Outpace the Broader Industry at a 15.1% CAGR Through 2023



Source: J.P. Morgan estimates, Company data.

Fintech – Business Environment Rebounding into 2021

Our fintech universe stretches across a number of end-markets, including small business tax and accounting services (INTU and AVLR), regional banks and credit unions (QTWO) and into the investment management market (SSNC). Below we focus on the strong rebound seen in business creation and bank health through 2020, which we believe is a positive sign for our cyclically exposed fintech names.

Small Business Trends Showing Some Good Signs, but Vaccine Timing Is the Linchpin

We were starting to see some cracks in the small business outlook as we entered 2020 that gave us some pause, even before the pandemic took hold. Based on NFIB surveys, small business optimism was still good but off the highs, and hiring plans were also less optimistic than they had been in prior years. The pandemic, obviously, cut the legs out from under the economy, so there is no surprise in the cratering of many of the indexes we track, but the surprising point to us is how well things have bounced back in the second half of 2020. Things could reverse, depending on the timing and efficacy of the vaccines, but to this point expectations seem positive and underpin our expectation that small business activity should be constructive in 2021.

New business application spike in 2H20 a good sign for future formation

New business applications jumped 82% in the October 2020 quarter to a seasonally adjusted 1.57M applications. Of these, 537K were considered high propensity applications, which means they have characteristics indicative with future formation—corporations, indication of hiring, industry codes like retail/restaurants/healthcare, etc. These were both the highest marks since 2004 and represent a good sign for business starts.

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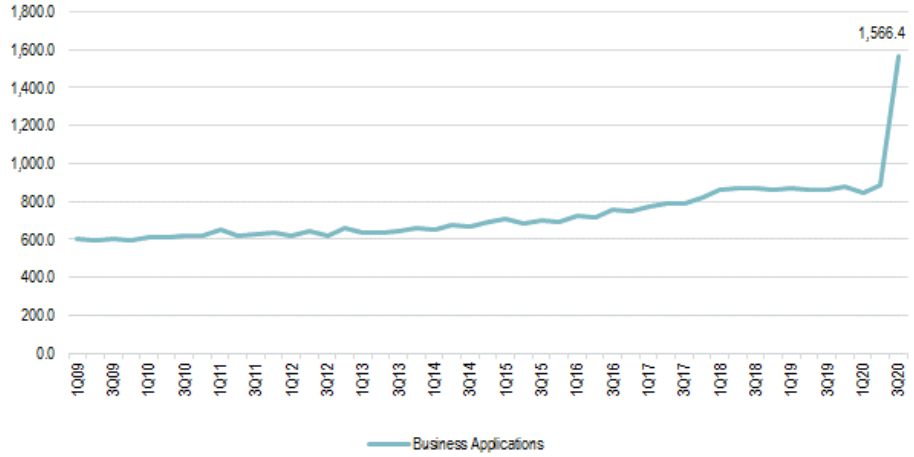
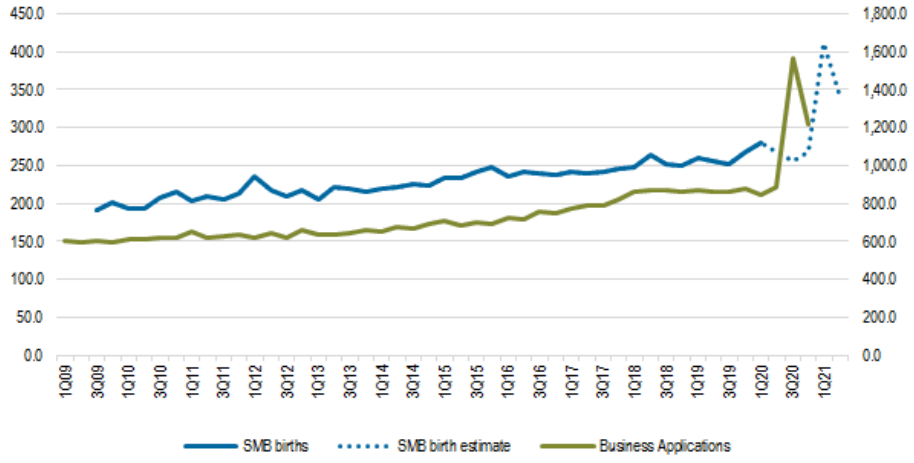
Figure 82: Business Applications Jumped to Over 1.5M in 3Q20



Source: Census and BLS

Fourth quarter applications are also off to a very strong start, with non-seasonally adjusted applications up 38.3% over the first 7 weeks of 4Q19. Extrapolating this growth to the entire quarter would produce another 1.2M applications for the fourth quarter of the year. Using a 2-quarter lag, we are able to estimate that the first quarter of 2021 could see over 400 business starts, if the previous relationship holds, which would be the best quarter if business starts in the entire data set.

Figure 83: Applications Strongly Tied to Formation 6 Months Later



Source: BLS and Census

Financing index shows Intuit's lending strategy is a good one

The number of small businesses that have found the borrowing environment easier versus more difficult has been chronically bad. The small business credit conditions index is a simple measure of the percent of respondents that found access to credit "easier" minus the percent who found it "harder"; by this simple measure, the NFIB survey respondents have not once sided on "easier" in the 16+ years of the survey – not even in the months after the credit crunch created by the global financial crisis. As we see in Figure 84, below, the best reading this survey has produced is -1%, but the good news is that these have clustered within the last couple years. The fact that credit availability, while still reading negative, is trending in the right direction bodes

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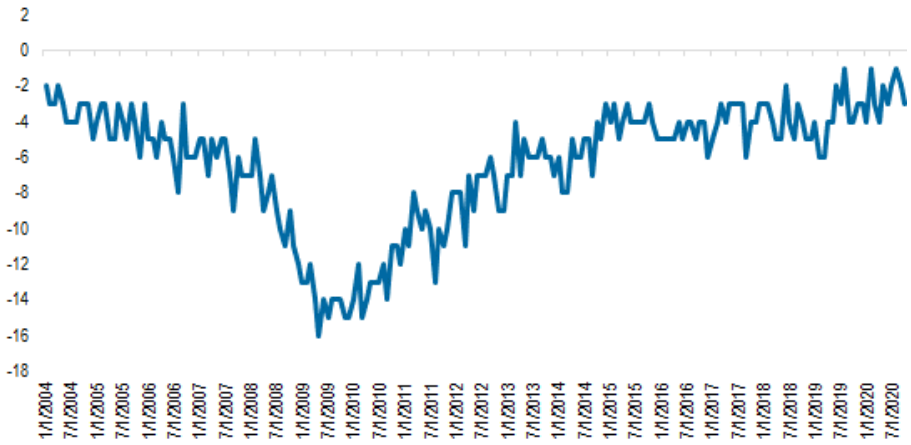
well for Intuit's small business lending program and could be a logical extension for the services that Credit Karma provides. Credit Karma has a strong brand in consumer credit, and by extending these capabilities into Intuit's Quickbooks base, the company could solve a large and chronic problem.

Figure 84: Ease of Credit a Chronic Problem for SMBs

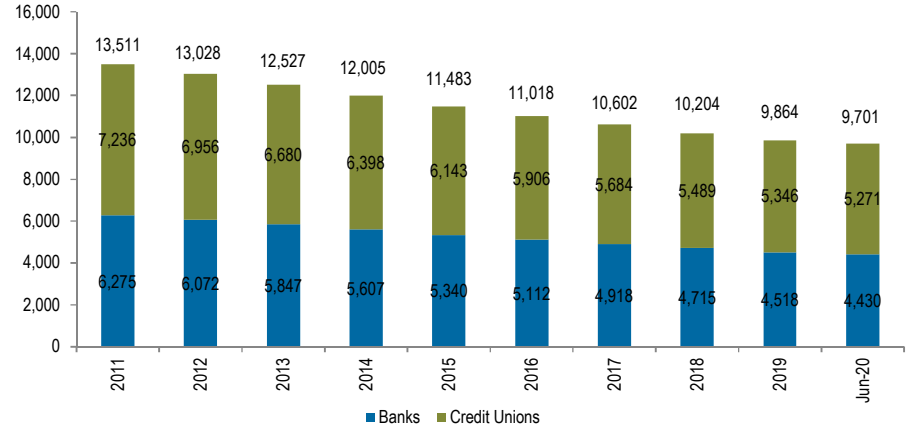


Source: NFIB index

Bank Deposits Spike in 1H20, a Good Sign for QTWO

The count of commercial banks and credit unions continues to fall, although the rate has slowed in recent years. The fact that the combined entity count was down 3.3% in 2019 and another 1.7% through June of 2020 does not signal any warning signs to us in terms of the health of the vertical – it is simply a consolidation wave that has persisted for many years. The FDIC has not shown year-on-year growth in commercial banks in any year since 2000, despite growth in domestic deposits. Deposits through the first half of 2020 jumped 17.4% compared to balances at the end of 2019, likely due to the influx from COVID-related stimulus.

Figure 85: Bank and credit union declines slowing



Source: FDIC, CUNA.org

Stimulus rollout could aid account openings for small and regional banks

Just as we saw an increase in tax returns in 2020, there could be a similar spike in terms of the number of bank accounts opened by people who may have previously

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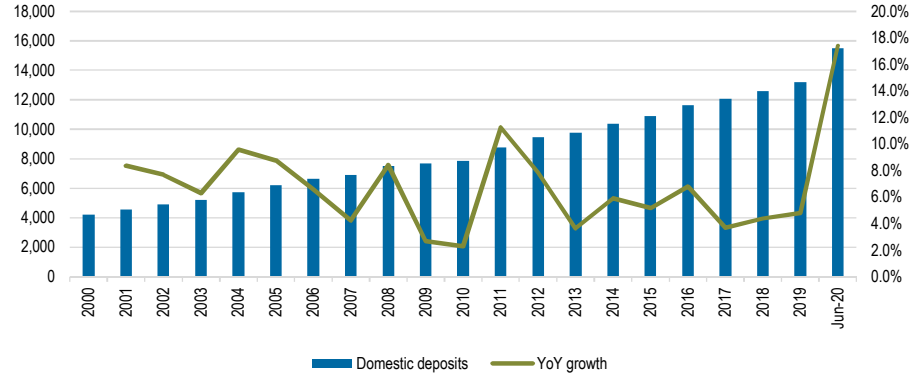
been unbanked due to the stimulus rollout. To put the potential impact into perspective, Intuit estimated that there were approximately 7-8M returns filed in 2020 that otherwise would not have been filed without the stimulus push. While we do not know the amount of accounts held at FDIC institutions, we do believe part of the 17.4% jump in total deposits is due to an increase in accounts and balance per account.

Figure 86: Deposits up over 17% in first 6 months of 2020 on the back of stimulus

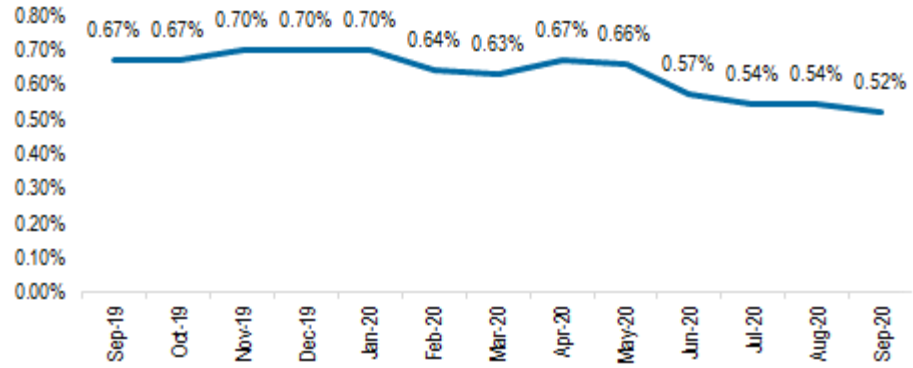


Source: FDIC

Credit Union delinquency improving through the year

In a somewhat surprising trend, overall credit union loan delinquency rates have fallen as we have moved through 2020. There was an initial bump in April and May, but since then delinquency rates have trended down. This could be due to stimulus and the re-opening of the economy, but interestingly another trend is the relative share of loans has accrued toward first mortgages while loans for new cars, home equity and second mortgages have been share donors in the loan portfolio, which points to some preference for safety during the downturn. Credit Unions tend to be more localized, so we view their demand for software and modernization projects as pretty durable looking into 2021.

Figure 87: Credit Union Loan Delinquency Rates Falling Through 2H20



Source: CUNA.org

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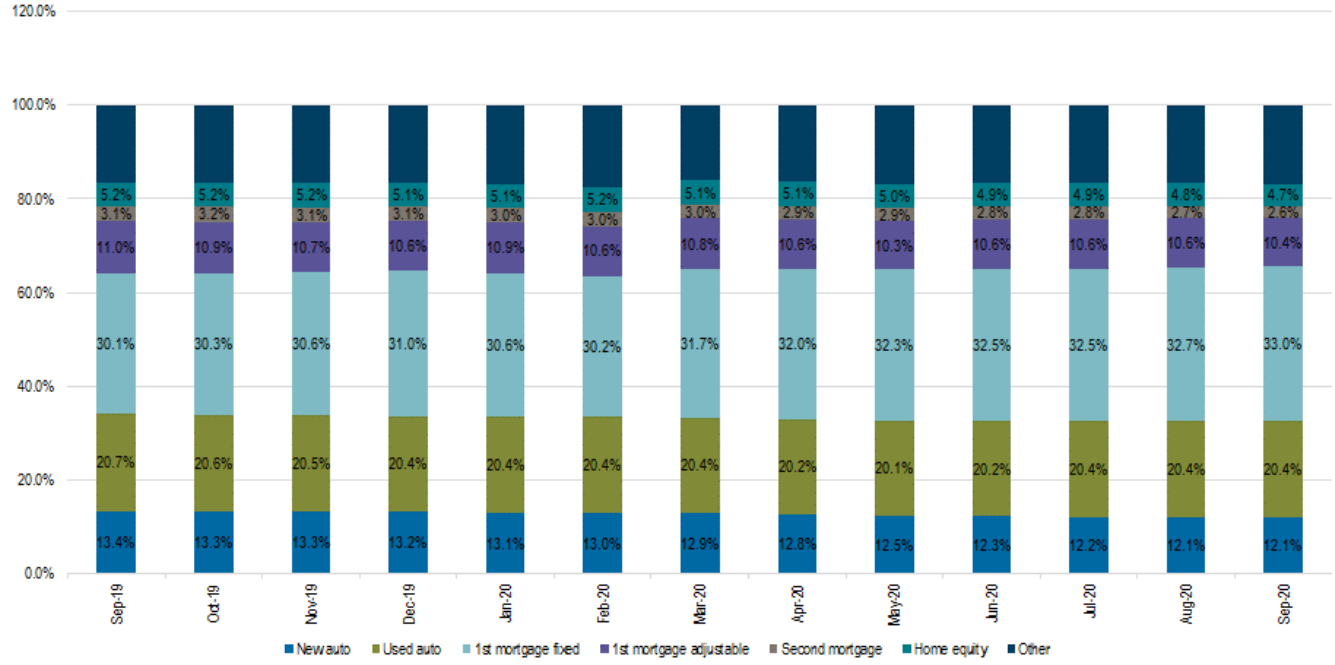
Figure 88: First Mortgage Loans Trending Higher in Credit Union Portfolio Share



Source: CUNA.org

Bank Consolidation Took a Pause in Early 2020

FDIC insured mergers have risen steadily since the financial crisis, now over a decade ago. Most of the consolidation falls into commercial banks, where the segment has seen 200+ transactions in 6 of the last 7 years (196 mergers in 2017), according to the FDIC. There were just 87 FDIC mergers in the first half of 2020, down only 1 from the first half of 2019's mark of 88, but we do not believe this tells the entire story. Bloomberg's M&A tracker in North American banks shows the level of activity completely dried up in the first couple of quarters of the year. Activity has picked up recently, however, with pending transactions in North America totaling 21 at the end of 3Q20 compared to 14 in 3Q19.

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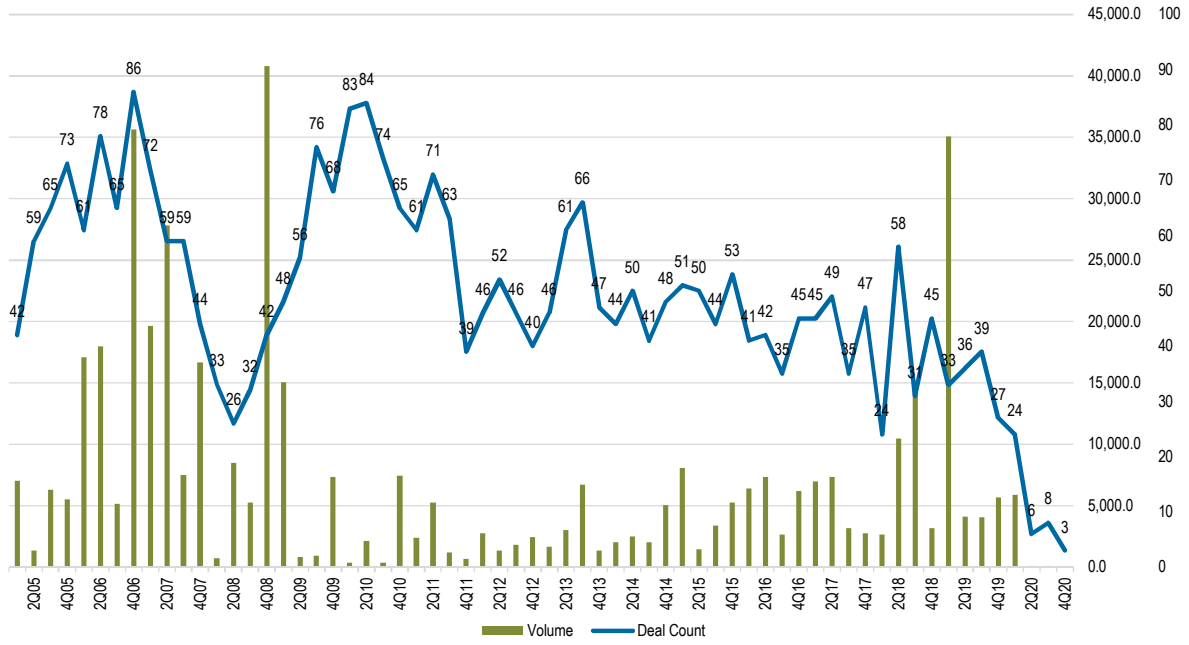
Figure 89: Bank M&A Came to a Halt in Early 2020

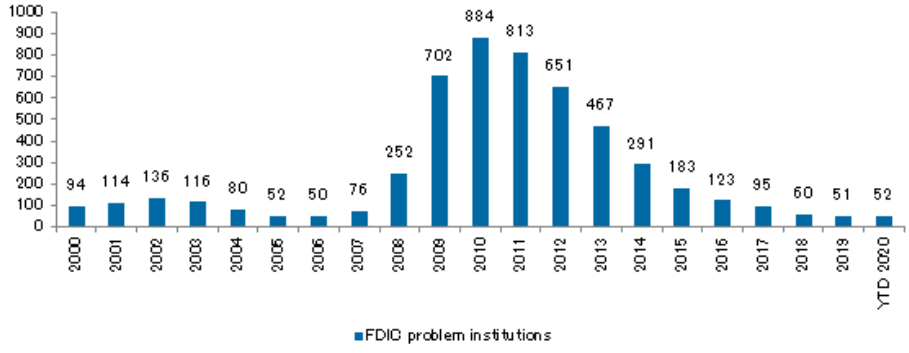


Source: Bloomberg Finance L.P.

Bank health remains stable, although on watch for 2021

The number of commercial banks that the FDIC considers problem institutions ended June 2020 at 52, up just 1 from the end of 2019 and actually down from the 56 such institutions at the end of June 2019. This is an initially encouraging data point, but if we look at Figure 90, the problem institution is a backward looking metric. Notice that the peak in problem institutions during the financial crisis was in 2010 and 2011, after the economy had started to recover. We would anticipate a similar trend from COVID-related weakness as we head into 2021 and 2022. Bank failures continue to be very low, with just 2 in the first half of the year.

Figure 90: FDIC Problem Institutions Remained Low in 1H20



Source: FDIC

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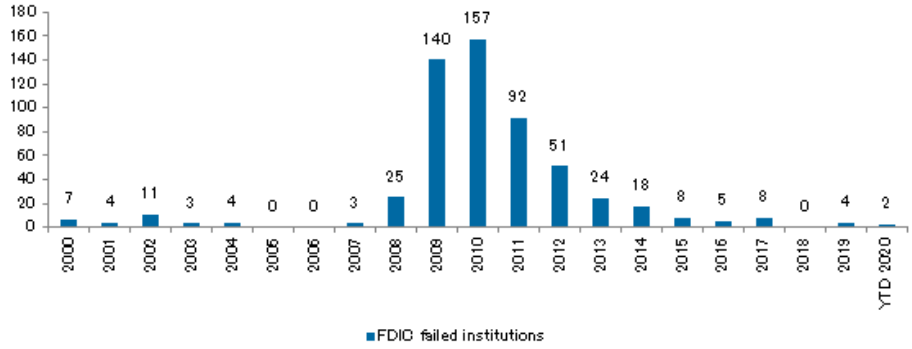
Figure 91: FDIC Failures Still in Single Digits

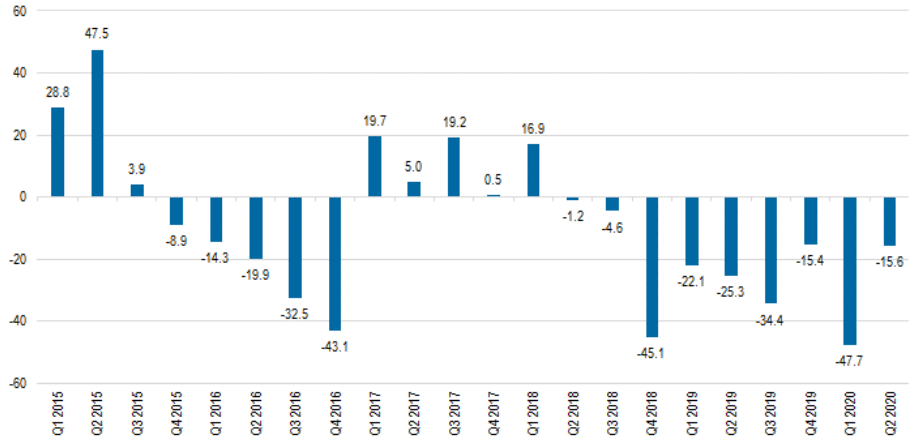


Source: FDIC

Hedge Fund Flows and Performance Stuck in the Mud

Performance across the industry has lagged the broad benchmark in 2020, and flows have not fared much better. Unless there is a significant reversal in both flows and performance in the final month of the year, 2020 will be another year of underperformance and outflows for hedge funds. The pandemic sell-off in the first quarter did trigger some accelerated outflows, with the Preqin flows index showing the worst net outflow in over five years, with $47.7B leaving the industry in 1Q20.

Figure 92: Hedge Fund Flows on 9-Quarter Outflow Streak



Source: Preqin

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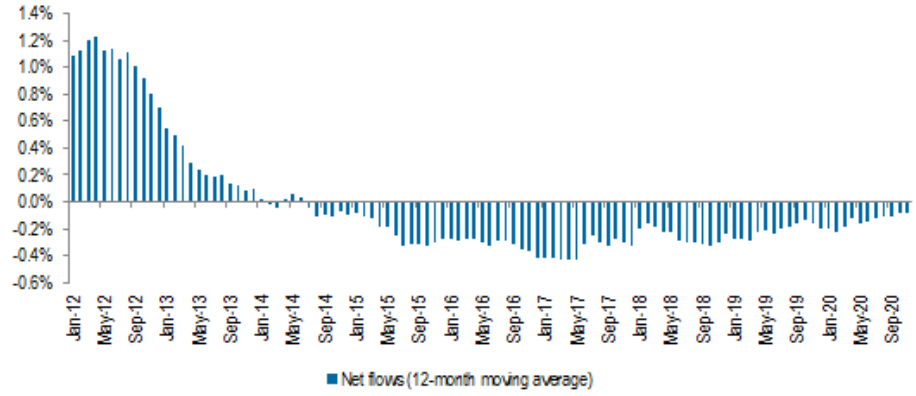
Figure 93: SSNC Also Showing Continued Net Outflows, but Narrowing



Source: SSNC Globe Op

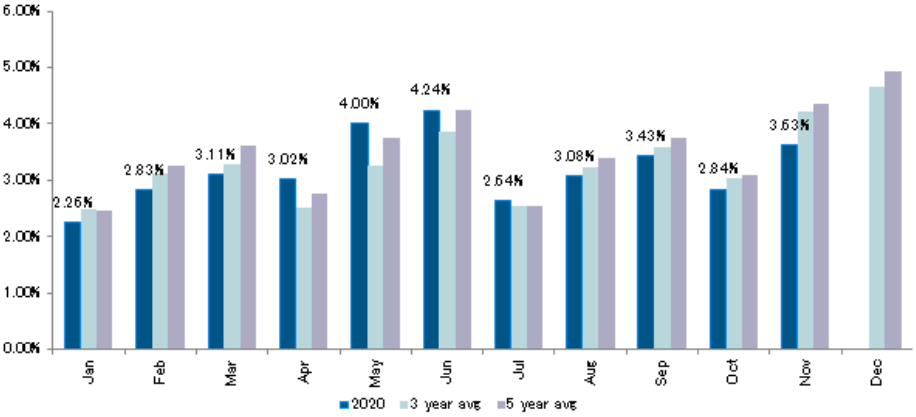
Equity strategies leading performance over the last year

In the twelve months ended 3Q20, hedge funds overall saw returns of 8.56%, according to Preqin, compared to the 12.98% price-only return for the S&P. Equity strategies have led all other over the last 12 months and also saw a strong bounce in the third quarter, returning 10.62% and 6.89% in those periods, respectively, compared to the 5.3% and 8.56% of the overall hedge fund market.

Redemptions have remained stable, a good sign for SSNC heading into 2021

Despite the performance and flows trends continuing against the industry, SSNC's forward redemption index remained fairly stable during the early part of 2020, which is a positive sign entering 2021. Forward redemptions did tick up in April and May relative to the 3-year and five-year averages ended 2019, but by less than 1% in both cases. Further, since July, redemptions have been below recent averages, and overall 2020 is on the lower boundary for redemptions going back to 2008. This should provide a stable foundation for funds to make investments in the coming year.

Figure 94: Redemptions Mostly Below Historical Averages Despite Spring Blip



Source: SSNC Globe Op

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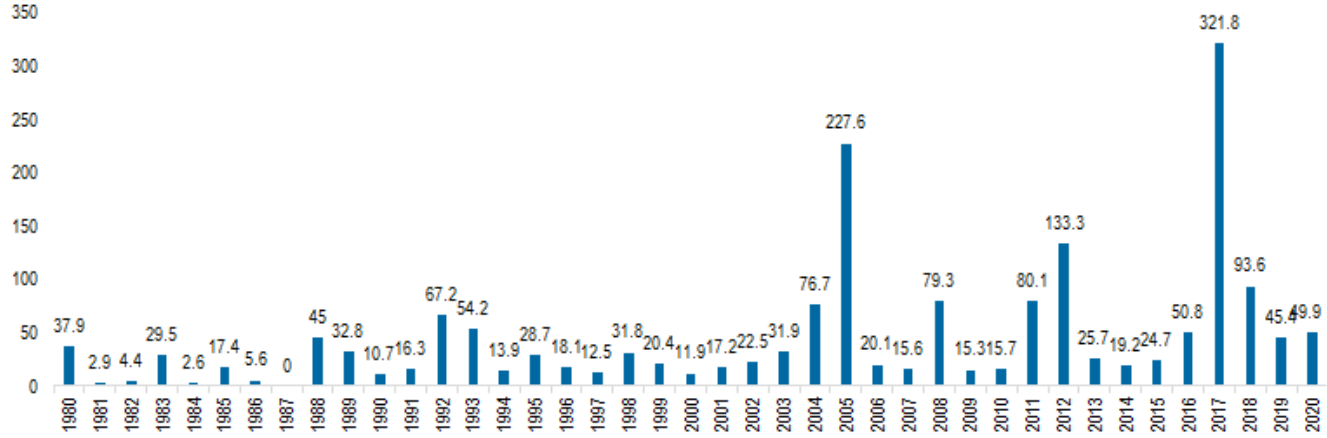
Insurance Software – Hardening Cycle Continues Investment Tailwind

The insurance market has enjoyed its most prolonged and sustained hardening cycle in over a decade, as premium pricing according to the CIAB survey accelerated to double digits in the first nine months of 2020. Looking out to 2021, we do not see much reason for major trend disruption, with catastrophes in 2020 tracking ahead of the last two years, and that should offset any savings passed on to the end-customers due to the reduction in mobility.

Catastrophe Costs Above 2019, Even Without Wildfire Damage Factored In

According to the National Oceanic and Atmospheric Association, the US has sustained 16 $1B+ events in 2020, adjusted for inflation, at a cost of $49.9B. This is a slight increase over the 2019 levels, but an important caveat is that the estimated damage from the fires in the Western US have not been contemplated.

Figure 95: Catastrophe Costs in 2020 in Line with Those of Previous Years, Excluding Wildfires, $B



Source: NOAA

Wildfire damage could top 2018 highs, but unlikely to rival hurricane costs

The wildfires that swept across California have largely not been included in the costs presented above. Looking at wildfire damage in previous years, however, we can get a sense for how large the costs may end up being. Table 40 provides the 3 largest wildfire damage years of the last 40 years. Assuming the damage in 2020 approaches or exceeds the previous records, 2020 appears to be headed for an above-average year from a catastrophe perspective, even if far below the peak years.

Table 40: 2018 Previous High for Wildfire Damage

Year	Wildfire damage ($B)
2018	24.7
2017	18.9
1991	6.4

Source: NOAA

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Looking at the data through the years, the total catastrophe costs see the biggest spikes in years with particularly destructive hurricanes. The three most expensive years since 1980 (2005, 2012 and 2017) are synonymous with Katrina, Sandy and Harvey, and looking at the three largest years for tropical cyclone costs, we see the scale of damage from hurricanes far exceeds that of wildfires.

Table 41: Hurricane Damage Traditionally the Largest Catastrophe Expense

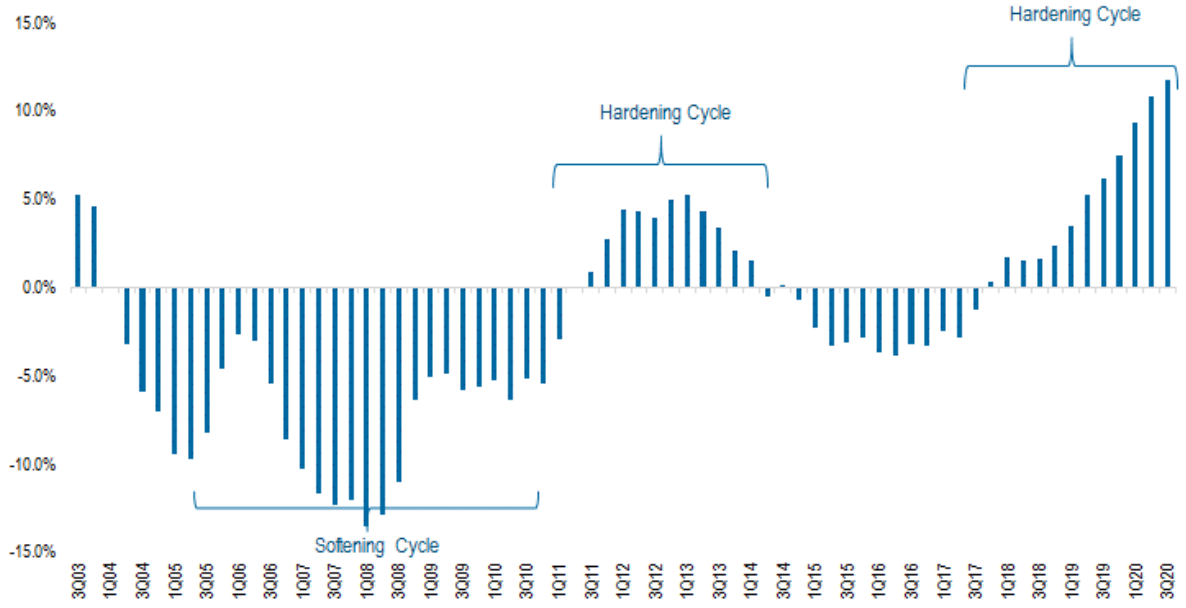
Year	Tropical cyclone damage ($B)
2017	278.3
2005	224.4
2012	78.0

Source: NOAA

Premium Pricing Accelerated Through the Pandemic

The third quarter of 2020 was the 12th consecutive quarter of pricing increases and also the highest reading in the 16-year data set at 11.7%. We have long viewed this vertical as one of the most attractive in software for the long-term customer relationships and amount of direct written premiums that are still on legacy systems and in need of an upgrade to the core. Adding the hardening cycle seen in Figure 96 to this secular underpinning portends very strong infrastructure and technology investment by insurers in the coming year.

Figure 96: P&C Premium Pricing into the Double Digits in 2020



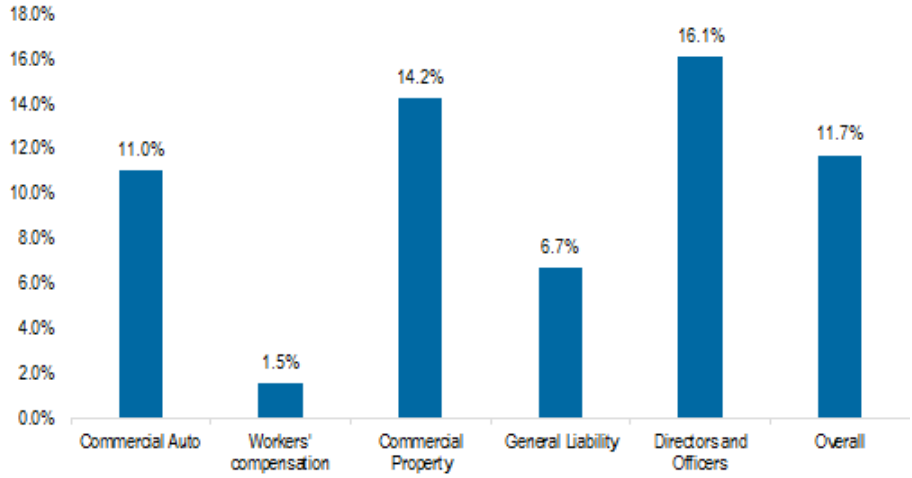
Source: CIAB survey

D&O and commercial property insurance lead the way in pricing

Looking at pricing by line of business, both commercial auto and property insurance were above 10% in the third quarter. The wildfires in the western US likely had an impact on property pricing, contributing to the 14.2% increase in average commercial property premiums. The auto pricing increase does surprise us a bit given the work-from-home wave would have led to lower traffic incidents, but the

pricing of premiums may also reflect the risk appetite of insurers during a period of uncertainty heading into winter months where the virus could force more shutdowns.

Figure 97: D&O, Property and Auto Premiums All Up Double Digits in 3Q20



Source: CIAB survey

This may be a little inside-baseball, but the directors and officers premium rise does not come as a surprise to us. Having been involved in a number of IPOs in recent years, we have been hearing from CFOs that D&O insurance premiums have been soaring and have far exceeded expectations as the companies move from the private to public markets. This was the second straight quarter of increases above 16% for D&O premiums after an 8.9% increase in the first quarter.

Healthcare / Life Sciences

The healthcare vertical for software is another sector that could have particular ramifications from the presidential election. The key will likely be the outcome of the Senate run-off elections in Georgia in terms of what could have been on the regulatory front, impacting the biggest customers for software vendors supporting this industry. On one hand, a Biden presidency is likely to be favorable for drug research through funding for areas like the NIH (National Institutes of Health), but on the other hand, the blue wave sweep of Georgia could put the government on a path for significant pharmaceutical drug price reform that could pressure the core customer base. This comes at a time where pharmaceutical sales rep headcount is already expected to decline 10% over the next year on the back of digital transformation.

Blue Wave and Major Healthcare Reform Looking Less Likely

Since Joe Biden has been declared the winner of the presidential election, the 2020 election's impact on the healthcare sector will largely come down to whether we see a blue wave or a blue sweep in the legislative branch of government. At this point, a blue wave would require the Democrats to gain a significant majority in the Senate, which hinges upon key run-off elections in Georgia that will take place in early January and an expanded majority in the U.S. House of Representatives. Based on

current standings for the House election, for which the Associated Press has just four votes left to call, Democrats have lost 9 seats but still hold a majority.

Lower likelihood for aggressive reform policies is positive for pharma and managed care specifically

Election ramifications on the healthcare space can be broken down into its smaller sub-sectors. For the pharmaceutical space, the main concern going into the election was a blue wave scenario where Democrats gained a significant majority in the Senate and an expanded majority in the House, which could have led to aggressive reform policies. Based on where we sit now, it seems as if this outcome is less likely, meaning that any meaningful drug price reform is difficult to envision. In the Managed Care space, J.P. Morgan analyst Gary Taylor sees a low probability that material healthcare reform could be passed with a narrow Democratic Senate. Additionally, he believes a public option for healthcare is largely unlikely, as providers will not choose to participate in a plan that threatens their commercial profitability and instead expects that Joe Biden will pursue more modest ACA fixes.

Biden presidency could be advantageous for Life Sciences due to NIH support

In the Life Sciences space, we view a Biden presidency as largely positive due to factors such as NIH funding and increased COVID-19 investment. The former Vice President champions the Cancer Moonshot program, which seeks advancements in cancer prevention, diagnosis, and treatment, and his strong support of the NIH suggests that there is no major risk to the core NIH budget. Additionally, Biden's COVID-19 taskforce has developed a package that calls for increased investment in testing, contact tracing, and PPE, including a $25B investment in vaccine manufacturing and distribution. Overall, J.P. Morgan Life Sciences Tools & Diagnostics analyst Tycho Peterson believes that these factors could serve to lift some of the diagnostic names in the space.

COVID-19 Accelerating Healthcare's Digital Transformation

The behavior of patients and healthcare providers has changed significantly since the onset of COVID-19, as the pandemic has forced the industry to rapidly innovate and adopt virtual models of care delivery. The environment has highlighted the critical nature of being able to deliver care outside of the four walls of a hospital, and we believe this trend is here to stay. Though the industry was experiencing some digital transformation prior to COVID-19, this move to virtual has accelerated rapidly in recent months. A Gartner study conducted in May showed that the percentage of patients engaging in virtual medical behaviors had increased dramatically across all surveyed categories since March, including 10% more patients ordering prescription medication online and 14% more patients meeting doctors virtually (see Figure 98). Since the survey was conducted just two months into the pandemic, there has likely been further acceleration since then.

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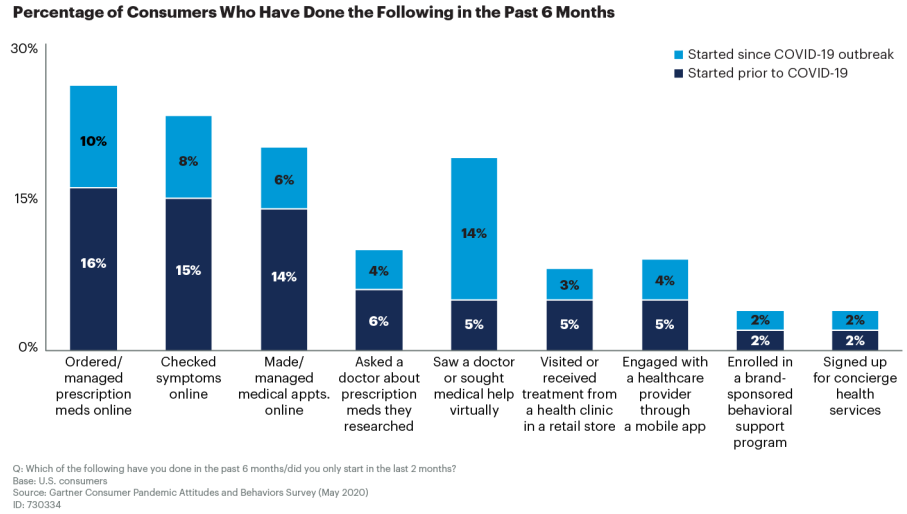
Figure 98: Rapid Increase in Patient Virtual Behaviors since COVID-19

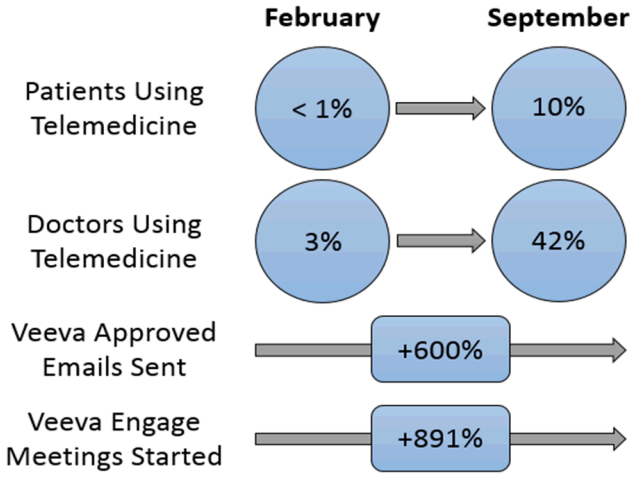


Source: Gartner "Predicts 2021: Healthcare Providers Must Accelerate Digital Transformation to Address Disruption" (Nov. 2020).

VEEV data shows higher usage of telemedicine and certain CRM applications

Patient data from Veeva's Crossix platform also points to accelerated usage of telemedicine for both patients and doctors, with patient usage increasing to 10% by September and doctor usage increasing to 42% (see Figure 99). Usage of two Veeva CRM applications that enable digitized medicine grew significantly, with Approved Emails up over 600% as of September and Engage Meetings up over 891%. This data suggests that Veeva is a critical player in moving the industry to digital.

Figure 99: Veeva Data Shows Large Increases in Telemedicine and Industry Shift to Digital



Source: Veeva Analyst Day 2020, Crossix patient data and Veeva Pulse data.

Growing role of artificial intelligence in the industry's digital transformation

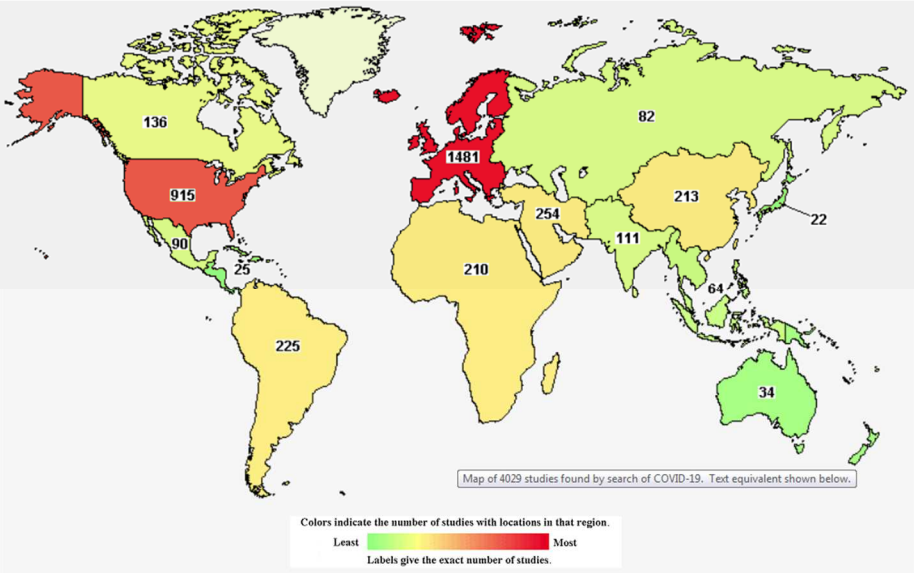
Accelerated digitization of the doctor-patient relationship and other areas of the healthcare industry are trends that we believe will persist after COVID-19 subsides. Gartner predicts that by 2022, 30% of outpatient encounters will be virtual and that these interactions will represent 15% of the industry's revenue. Doctors and healthcare providers will have to adjust their patient care models to meet this

demand, but it is also likely that organizations will increasingly rely on artificial intelligence. In fact, Gartner estimates that 30% of healthcare delivery organizations (HDOs) will deploy virtual health assistants for digital patient care by 2023, thereby displacing a certain percentage of the humans who are currently directing patients to the right level of care. These HDOs will use natural language processing (NLP), AI, and machine learning to deploy virtual health assistants that can replicate human-led triage encounters such as diagnosis conversations and clinical interviews.

Spotlight on COVID-19 Clinical Research: 4,029 Active Studies

The clinical trial landscape of 2020 has drastically differed from that of 2019 due to the emergence of COVID-19. Clinicaltrials.gov, the United States National Library of Medicine's official registry of clinical trials, points to the existence of 4,029 COVID-19 studies that are either vaccine-related or involve at least one drug intervention. As of November 26, 2020, the registry counts 359,013 active studies worldwide, meaning that COVID-19 studies have grown to ~1.12% of the total in 2020. Figure 100 shows the geographical dispersion of these studies, 915 of which have at least one location in the United States, and 1,481 of which have at least one location in Europe.

Figure 100: Geographical Dispersion of Active COVID-19 Studies



Source: Clinicaltrials.gov.

Federal funding of COVID-19 studies is an area to watch in new administration

Table 42, below, indicates that 143 of the 4,029 active COVID-19 studies are currently classified as vaccine-related, whereas 1,297 are drug-related. The remaining studies are either not classified or are mapped to standardized drug names automatically assigned by the National Library of Medicine. Of the 4,029 ongoing studies worldwide, 124 of them are federally funded by the United States. Since healthcare and clinical research are heavily regulated, the impact of a pending Biden administration on the industry will be a key area to watch over the next several years.

Table 42: COVID-19 Study Breakdown for U.S. and U.S. Federal Funding

	Total Studies	Vaccine Studies	Drug Studies
All COVID-19 Studies	4029	143	1297
At least one U.S. location	915	33	404
U.S. Federal Funding	124	11	37

Source: Clinicaltrials.gov.

Veeva Vault EDC enables deploying of COVID-19 studies in just 5-10 days

At the onset of COVID-19, Veeva quickly recognized that its customers needed a way to build and deploy COVID-19 trials in a matter of days rather than weeks. The urgency in the industry meant that trials could not be delayed by the typical months-long startup process. As a result, Veeva created a flexible casebook template for COVID-19 studies for Veeva Vault EDC, a module of Veeva Vault CDMS. This casebook includes pre-populated forms for testing and visits, study differential reports that identify and document any changes between studies, and real-time User Acceptance Testing (UAT) such that studies can be built and deployed in as little as 5-10 days.

New Development Cloud products should help VEEV meet clinical trial demand

Veeva's Analyst Day in late October featured several product additions to the Vault platform-based Development Cloud, including Veeva Stats and MyVeeva for Patients. Veeva Stats is a statistical programming environment built for programmers to help them execute clinical data management with high levels of configurability and should be available in late 2021. Two other product additions fall into the Veeva Clinical Network, namely SiteConnect to bring together the site and sponsor sides of the network, and MyVeeva for Patients to provide a one-stop-shop platform for patients to manage their clinical trial needs from initiation to completion. Management also provided an update on Vault CDMS, stating that they have 100+ trials in process for 40+ customers, 2 of which are top 20 pharmaceutical companies.

Drugs in R&D Pipeline Reach Nearly Double-Digit Growth

Growth of the healthcare R&D pipeline rapidly accelerated in 2020, with the total number of drugs in the R&D pipeline reaching 17,737, up 9.62% from 2019, meaning that there are 1,556 more drugs in development than in 2019. Nearly double-digit growth in 2020 compares to expansion of 5.99% in 2019 and just 2.66% in 2018. The total R&D pipeline counts all drugs in development by pharmaceutical companies, from those at the preclinical stage, to various stages of clinical testing and regulatory approval, to launched drugs still in development for additional indications or markets.

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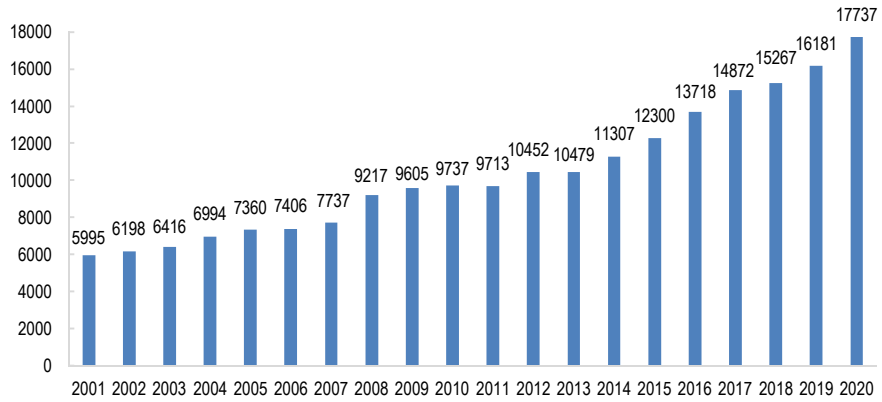
Figure 101: Total R&D Pipeline 2001-2020



Source: Pharma Intelligence, "Pharma R&D Annual Review 2020."

Strong early phase trial growth, but later-stage success rates are low

Pharma Intelligence data shows preclinical phase trials growing at 13.2%, more than doubling last year's 6.0% growth and representing a strong clip in new preclinical stage drug growth. The number of drugs in Phase I trials increased by an impressive 10.3%, over 300 basis points ahead of 2019 growth and triple the rate of 2018 growth. Though Phase III and pre-registration growth came in stronger than in prior years, these increases begin to taper off at the registered and launched phases. The 14.5% decline in registered drugs is significantly worse than the growth increases in this category for both 2019 and 2018, and launched drug growth slowed to just 4%. This trend is consistent with that of past years and continues to demonstrate the difficulty of getting clinical trials over the hump and into later-stage arenas.

Table 43: R&D Pipeline Growth by Phase

	2017	2018	2019	2020
Preclinical	**7,493**	**8,040**	**8,520**	**9,646**
YOY Growth		7.3%	6.0%	13.2%
Phase I	**2,064**	**2,127**	**2,281**	**2,516**
YOY Growth		3.1%	7.2%	10.3%
Phase II	**2,357**	**2,360**	**2,576**	**2,694**
YOY Growth		0.1%	9.2%	4.6%
Phase III	**1,025**	**1,006**	**1,009**	**1,020**
YOY Growth		-1.9%	0.3%	1.1%
Pre-registration	**220**	**214**	**199**	**246**
YOY Growth		-2.7%	-7.0%	23.6%
Registered	**116**	**150**	**152**	**130**
YOY Growth		29.3%	1.3%	-14.5%
Launched	**1,395**	**1,199**	**1,273**	**1,324**
YOY Growth		-14.1%	6.2%	4.0%

Source: Pharma Intelligence, "Pharma R&D Annual Review 2020."

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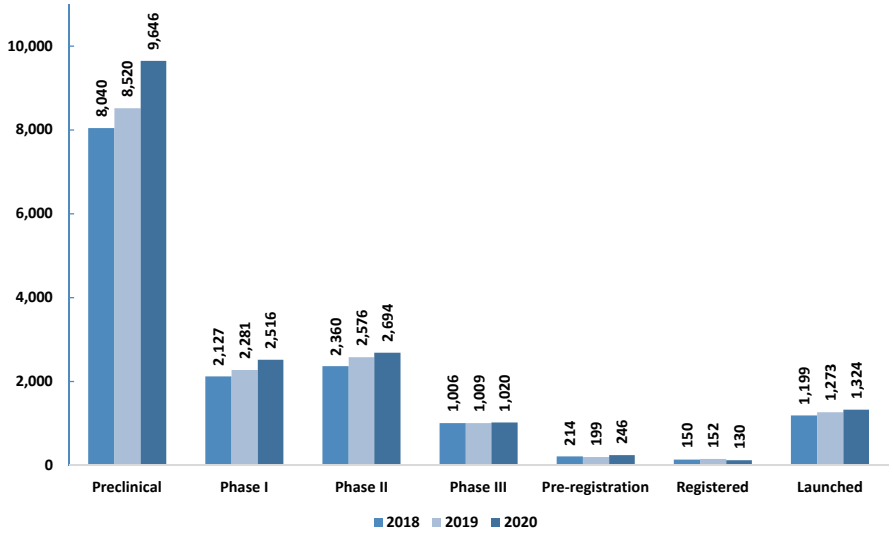
Veeva benefits from the faster growth in preclinical and early phase trials

Table 43, above, shows the drastic drop-off in the number of drugs in the pipeline as trials move to later phases. Figure 102 below gives a visual representation of this decline. While one may think that low success rates of later phase trials would be disadvantageous for a software life sciences company, Veeva actually benefits from faster growth in early phase trials. Veeva's relatively new entrance into the clinical trial software space has been focused more on earlier stage trials and a concentrated effort with a few customers in order to take a collaborative and iterative approach to their product development—which the company refers to as "The Veeva Way." Recent trends in preclinical and Phase I drug growth suggest that early phase trials should continue growing at a healthy rate, putting Veeva in a position to benefit from this trend for the foreseeable future.

Figure 102: R&D Pipeline Drops Off in Later-Stage Phases



Source: Pharma Intelligence, "Pharma R&D Annual Review 2020."

IQVIA Lawsuit Not a Major Threat to Veeva's CRM Business

There are several ongoing antitrust lawsuits between Veeva and IQVIA. Veeva originally filed an antitrust lawsuit in 2017, which alleged that IQVIA had exacted monopoly control over data and that the company was restricting freedom in clinical trial software and data management as a result. In July 2019, Veeva hit IQVIA with a $200M antitrust lawsuit claiming that the company was withholding critical health data from companies using competing reference software. Veeva claimed that when it attempted to roll out data products that competed with IQVIA's, it was denied access to that data, in violation of antitrust laws. Most recently, in the spring of 2020, Veeva filed a motion to extend the reach of the suit to include additional Veeva software applications, for which they claim IQVIA prevents clients from using with IQVIA-sourced data.

As it pertains to the impact of the IQVIA lawsuit on Veeva's business, we do not see it as posing a major threat to the CRM business. Veeva has already largely won the market, with over 80% in market share, and the market edge that IQVIA seems to be winning does not appear to be a serious threat to Veeva's position. In fact, 3Q21 saw Veeva record two competitive displacements against IQVIA. We still expect Veeva to grow its Commercial Cloud business at a mid-teens growth rate, and the company

has shown an extensive track record of being able to extend its growth and opportunity outside of just the Commercial Cloud business. The timeline of the IQVIA lawsuit has been slightly delayed by COVID-19, and the company now expects the suit to go to trial at the end of 2022.

Real Estate – Durable for Software Vendors

We look at the real estate market in Software Technology in three different segments:

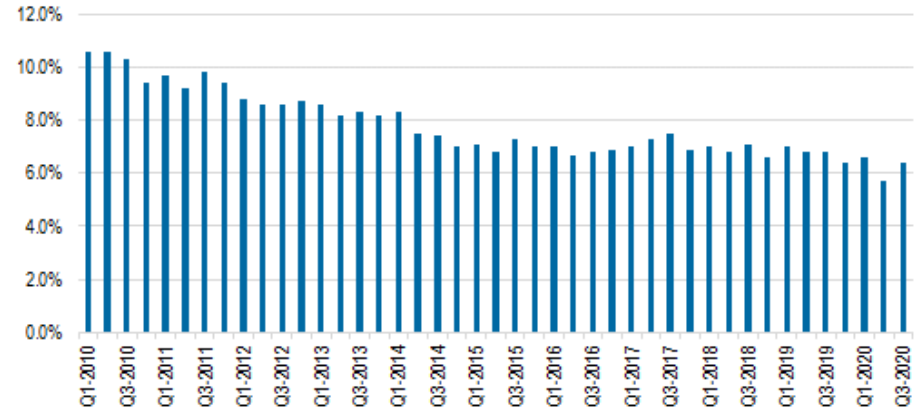
- Multifamily (rental)
- Residential housing (mortgage)
- Commercial real estate (CRE)

Real estate is the most cyclically sensitive industry in the US economy, but during this pandemic downturn software vendors have shown resiliency in growth. Partly that is due to the subscription business models that underpin a significant portion of the revenue for these vendors, and secondarily diversification efforts since the financial crisis have paid benefits.

Multi-Family Real Estate in the Middle of Conflicting Data Points

We heard for many years from multi-family technology providers that a slight degradation in the macroeconomic environment and occupancy rates would actually lead to an increase in spend from customers. The economic downturn came, but vacancy and the velocity of moving did not tick up – vacancy rates actually declined in the first three quarters of 2020, as we can see in Figure 103 below.

Figure 103: Vacancy Rates Down y/y Through 3Q20



Source: U.S. Census.

Supply remains strong but off the highs from March while rents fall

In general, vacancy rate and rents should have an inverse relationship, as owner/operators raise rents to meet demand (when vacancy is low) while the supply of housing catches up. Also, following the same line, when supply increases, rent increases subside, and vacancy rates should actually tick up with the influx of more

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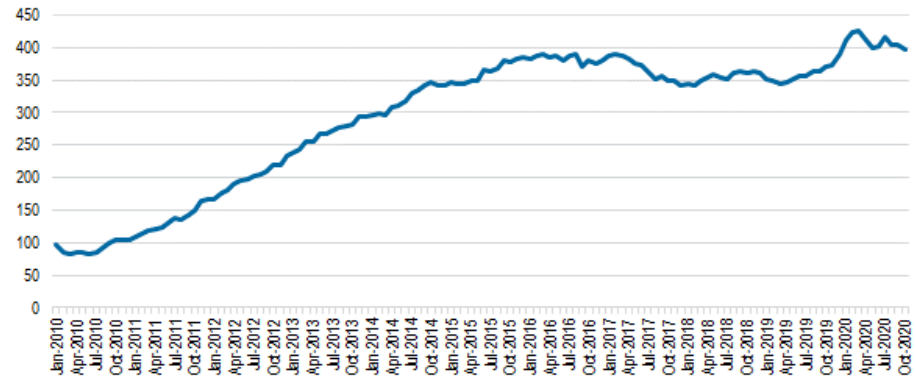
available units in the market. The pandemic turned these relationships on their heads. Rents, vacancy rates and supply are all falling through the year. With falling mobility, came lower vacancy rates and less demand for new units, and the economic slowdown meant rising rents were unpalatable. Figure 104 shows the supply of 5+ unit housing starts on a trailing-twelve-month basis. While starts in October of 2020 were still above previous cycle peaks, the total supply has been trending lower since peaking in March.

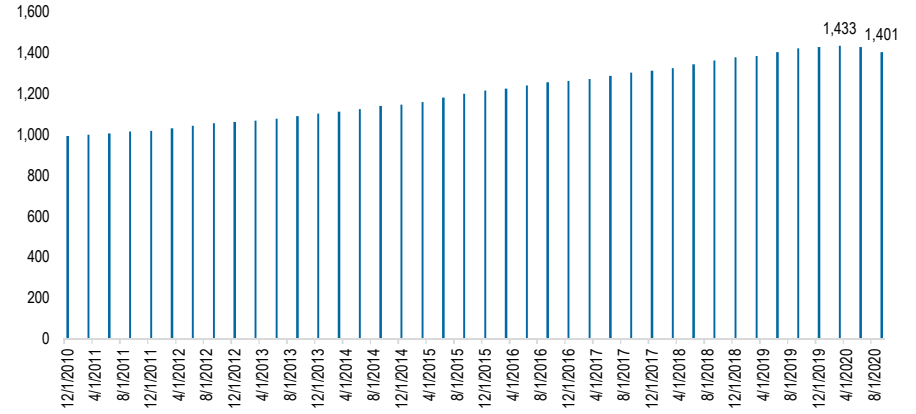
Figure 104: 5+ Unit Housing Starts Dipped Below 400K Units (TTM) in October



Source: U.S. Census.

Similar to supply, average rents also started falling through the year across the US beginning in May. RealPage's rental tracker shows that October was the first month that all three classes of rentals it tracks—A (most expensive), B and C (least expensive)—saw year-on-year price declines. The highest end apartments were hit the swiftest and hardest, with rents falling 3.2%, on average, for Class A units in September. Figure 105 shows the nationwide effective rent index, which, similar to the data from RealPage, shows that rents have fallen since the peak in March.

Figure 105: Rents have fallen in the 6 months since March peak



Source: Bloomberg Finance L.P.

Rent growth and improving timing of rental payment puts real estate customers in a better position to invest

The timing of rent payments was also under pressure due to the macro environment in 2020. According to the National Housing Multifamily Housing Council the percent of rent paid on the 6th and 20th days of the month and the percent of rent paid

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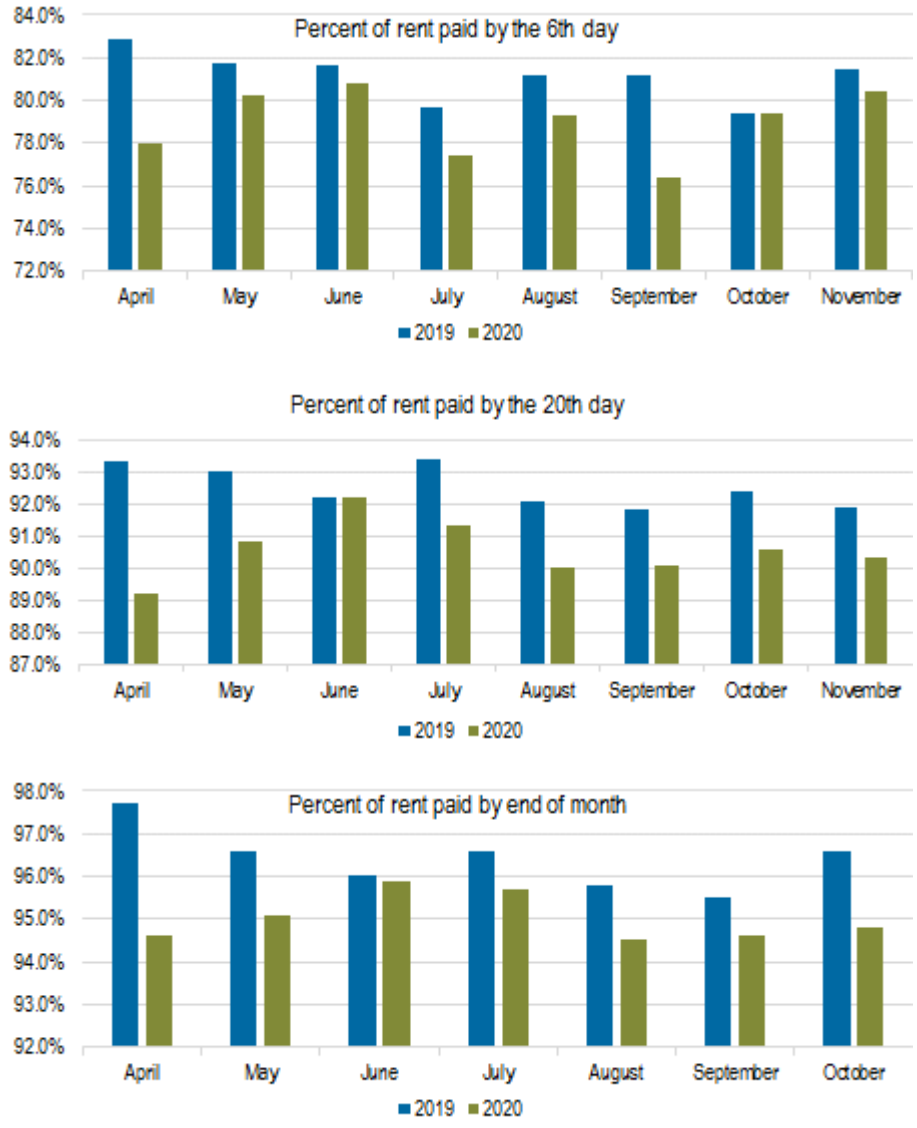
by the end of the month fell in each month of 2020 compared to 2019 beginning in April, as seen in Figure 106. Looking out to 2021, we expect an improving economy to drive rents, supply and vacancy rates in the right direction following a successful vaccine rollout. This, along with a return to 2019 levels of rent timing, would put real page and CoStar customers in a better position to invest in technology.

Figure 106: Timing of Rental Payments Fell in the Months Following the COVID-19 Shutdown



Source: NMHC.

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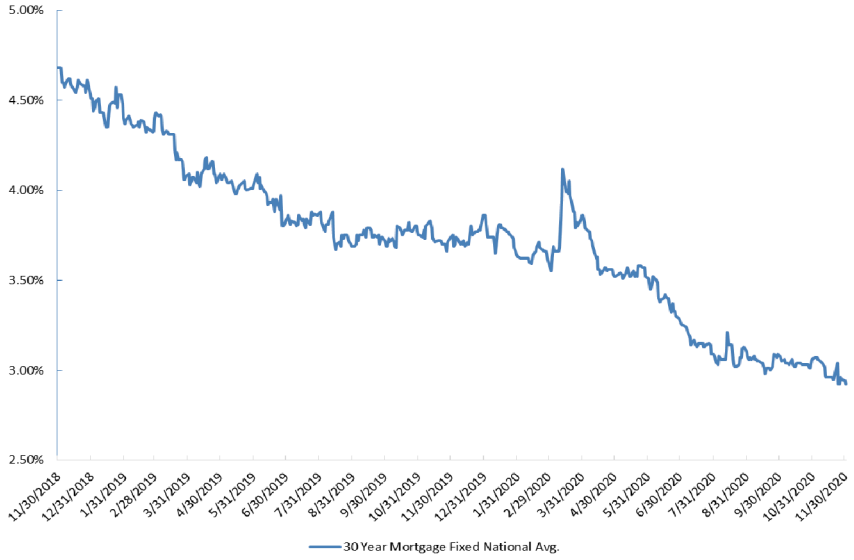
Residential Housing – Mortgage Rates Remain at Record Lows

Figure 107: Mortgage Rates Show Consistent Decline since March



Source: Bloomberg ILM3NAVG Index.

30-year mortgage rates fall below 3% and Fed maintains 0-0.25% benchmark interest rate range

Major economies slowed as the COVID-19 crisis began to unfold, and, in response, central banks engaged in rate cuts and asset purchases. The Federal Reserve cut its benchmark interest rate to 0% in March and launched a $700B quantitative easing program. Concurrently, 30-year mortgage rates fell from a high of ~4.12% on March 13th to the sub-3% range by November. The decreasing 30-year mortgage fixed national average is shown in Figure 107. At its early November meeting, the Federal Reserve voted to keep short-term borrowing rates anchored in the range of 0% to 0.25%, citing the fact that economic activity remains well below pre-pandemic levels.

Realtor.com sees 3.4% mortgage rate by end of 2021 and 7% home sales uptick

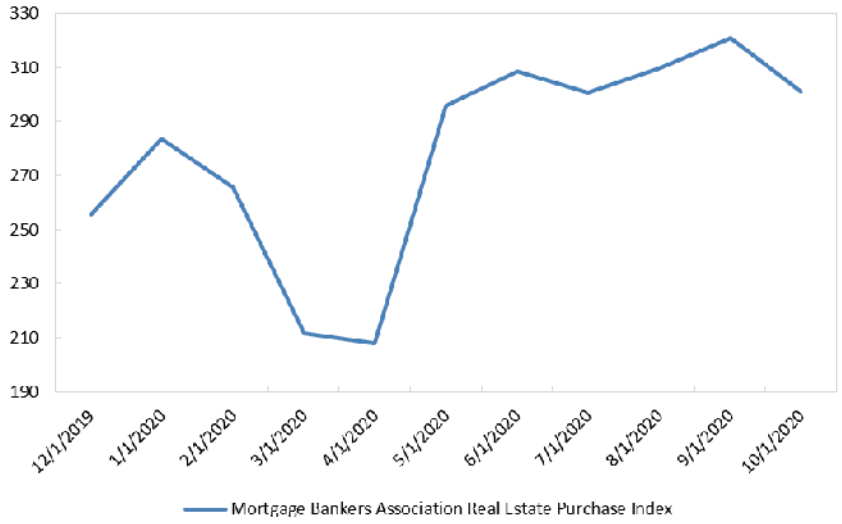
The Realtor.com 2021 National Housing Forecast estimates that mortgage rates will average around 3.2% throughout 2021 and increase to 3.4% by the end of the year. They believe there could be a fall-off in the novelty of sub-3% rates, causing buyers to wait to react until they see rate increases in the second half of 2021. 2021 home sales are expected to come in 7% above 2020 levels, as demand normalization should further normalize when COVID-19 vaccines are available to the public and consumer spending returns to historical levels. It is important to note, however, that the residential real estate market does also benefit from work-from-home trends, as more and more individuals are citing remote work as a key factor in their decision to purchase a home. From a supply perspective, Realtor.com believes that in 2021, inventories could register an increase for the first time since 2019.

Improved outlook for home sales supported by low interest rate environment

The Pending Home Sales index is a leading indicator for the housing sector, as it is based on pending sales of existing homes that typically close within two months of signing. In October, this index fell by 1.1% sequentially, but rose by 20.2% annually,

following its 20.8% annual growth in September. The J.P. Morgan Homebuilding team expects pending home sales to remain strong over at least the next 1-2 quarters, based on homebuilders' recent strong order trends, the 27% and 42% increases in existing home sales and new home sales in October, respectively, and strength in the MBA Purchase Applications index. Since hitting its trough in mid-April, this index has increased by 72%, and the most recent data point demonstrates 18% annual growth, as seen in Figure 108 below.

Figure 108: MBA Purchase Applications Index Shows Significant Growth since April Trough



Source: Bloomberg MBAVPRCH Index.

It is likely that the housing recovery will be spread out over at least the next two years, but preliminary data shows a strong bounce-back in demand since hitting lows in the spring of 2020. J.P. Morgan Homebuilding analyst Michael Rehaut expects the recently improved demand backdrop to persist over the next several months, supported by fairly tight inventory levels creating positive supply/demand dynamics and the current low interest rate environment.

Commercial Real Estate (CRE) Market – The Worst Is Likely Behind Us

Though many commercial real estate companies expected the CRE market to turn at some point over the past several years, the sector remained largely resilient and did not show cyclicality in the way that it once did. At the onset of COVID-19, however, the commercial real estate industry saw an almost immediate fall-off across all major categories, including transaction volumes, property prices, and property sales. After two quarters of strength in January and February, March deal activity for each property type dropped at a double-digit rate as the economic ramifications of COVID-19 began to manifest. These areas continued to slip over the following months as employees shifted to working from home and some employers let their commercial office leases expire. Despite the continued losses seen in recent quarters, commercial property databases like Real Capital Analytics have revised most of these transaction volume estimates to the upside. While it is clear that we are not out of the woods in terms of the CRE slowdown, it appears that performance in this segment is shaping up to be better than once feared.

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Preliminary volume and pricing data for Oct. shows sales volumes down 52.2%

The latest edition of Real Capital Analytic's U.S. Capital Trends report published in late November estimates that CRE sales volumes were $26.2B in October, down 52.2% annually. This represents the eighth straight month of a double-digit decline in transaction volume. RCA noted that deal volumes continue to be adversely impacted by the misalignment in pricing expectations between property owners and potential buyers; while buyers are still seeking steep discounts, many owners are unwilling to take significant losses given the challenging economic backdrop. The two sectors that fared the worst were retail and lodging, with deal volume in retail falling 73% from the same month last year, and investment in the hotel sector falling 84%. Areas that are beginning to see improvement are the industrials sector, for which levels have returned to those seen from 2013 to 2017, and the office sector.

JPM REITs team sees CRE broker volumes shaping up better than expected

Adjusting out entity deals for the year, such as large-scale M&A activity that tends to skew volumes higher, total 2020 volumes through October stand at $266.5B, down 42.4% annually. The J.P. Morgan REITs Equity Research team had originally forecasted a 40-50% decline in U.S. capital markets revenue for the largest brokers in the fourth quarter of 2020. Taking into account that October numbers are likely to be revised up and the expectation for improvement and market share gains in November and December, the team now believes their previous expectations for 4Q20 will be conservative. Overall, despite continued uncertainty surrounding further lockdowns and the timing of vaccine deployment, J.P. Morgan REITs analyst Anthony Paolone believes the volume picture for CRE brokers is shaping up positively compared to prior expectations.

Overall cap rate stayed the same in Oct. but showed variance by property type

As for cap rates, which represent year one unlevered returns on assets, the overall calculated cap rate remained at 5.95% in October, just 1 basis point higher than in September. On a per-property type basis, industrial cap rates increased by 12 basis points, office by 4 basis points, and apartments by 4 basis points, while retail and hotels were down 9 and 20 basis points, respectively. The REITs team believes this was a strong value/opportunistic play on the part of investors, who bid up the heavily impacted retail and hotel sectors and sold off more industrials and apartments. Their graph mapping the average cap rate over time against historical commercial sales volumes is shown in Figure 109 below.

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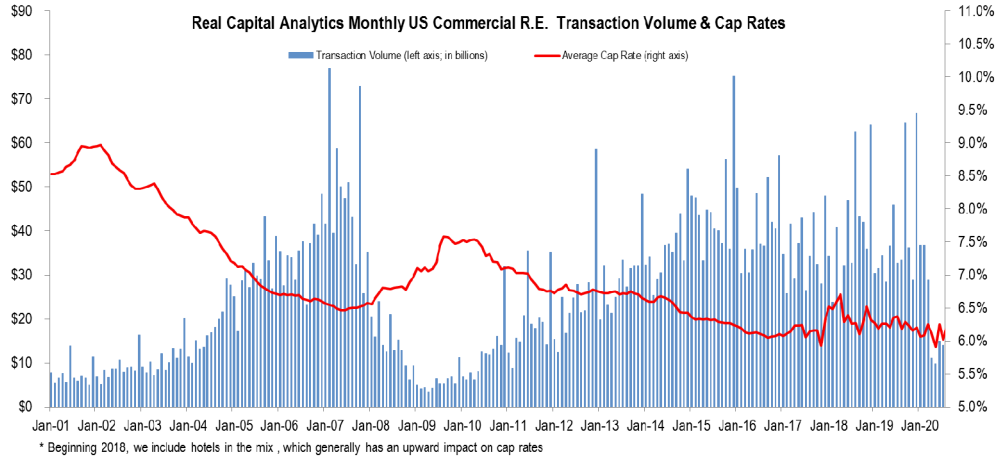
Figure 109: Historical Commercial Sales Volume and Cap Rates

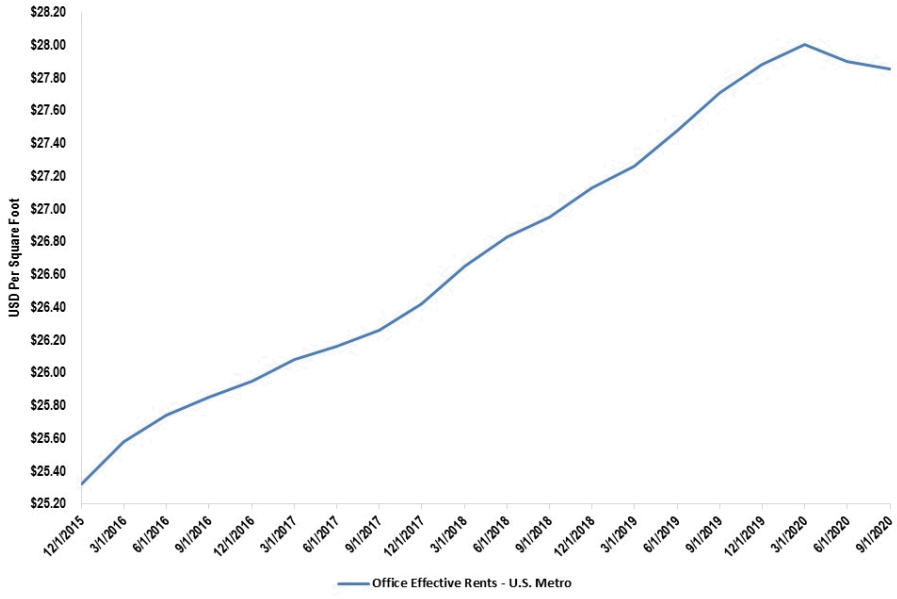


Source: J.P. Morgan REITs team, Real Capital Analytics.

Office rents fall for first time in years, while vacancy rates continue to increase

After over ten years of consistent increases, office rents per square foot fell from $28.00 in March, to $27.85 in September, as seen in Figure 110. These declines were prompted by lower demand for office spaces as companies allowed their employees to work from home, coupled with certain firms deciding to leave higher-priced areas and explore cheaper alternatives. Vacancy rates have been steadily increasing for several years now, but that expansion accelerated at the onset of the pandemic, as the office vacancy percentage jumped from 17% in March to 17.4% in September. As we have mentioned in years past, rising vacancy rates may not be such a bad trend for the commercial real estate spending market. CSGP is very diverse in its customer base of owners, brokers, banks, investors, etc., so it is difficult to tell exactly how buying patterns would be affected by material increases in vacancy, but there is a chance that we could see an efficiency-driven demand environment that is similar to the residential market.

Figure 110: Office Effective Rents – U.S. Metro



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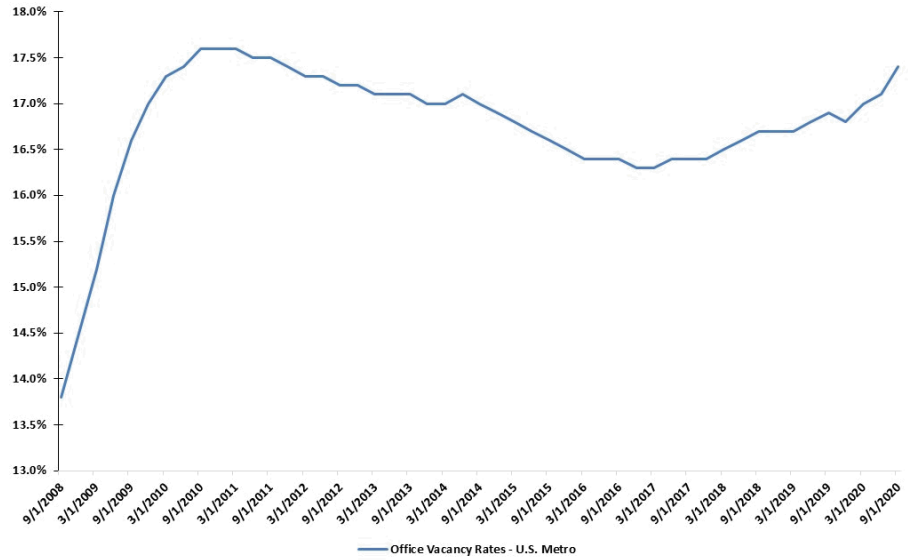
Source: ROFFUSME, Bloomberg Fiancne L.P.

Figure 111: Office Vacancy Rates – U.S. Metro



Source: ROFFUSMV, Bloomberg Finance L.P.

Office completions fell sharply in March but since then have steadily increased

The number of office completions, measured in millions of square feet, experienced a sharp fall-off in March of this year, dropping from 18.2M in December to 6.5M in March. Since then, the metric has consistently climbed back, reaching 8,857,000 in September. In recent years the market has been pressured by factors such as the rise of shared working environments and co-working, which decrease the need for discrete, single company office buildings. Abrupt lockdowns at the onset of COVID-19 significantly contributed to this pressure by making it nearly impossible for office projects to be completed. As lockdown restrictions relaxed, however, and the summer months began, many projects that were in later stages of construction or were awaiting receipt of certain occupancy certificates were finally completed. This is likely what caused the uptick in office completions in recent months, shown graphically in Figure 112 below.

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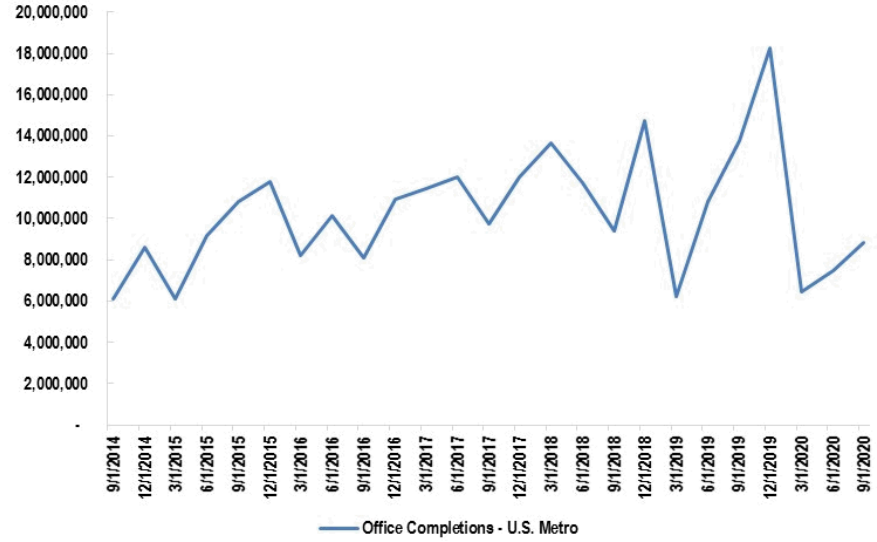
Figure 112: Office Completions Increasing since March



Source: ROFFUSMC, Bloomberg Finance L.P.

Distressed market growing faster than 2008-2010, led by retail and hotels

According to Real Capital Analytics, aggregate distress across all property types has grown at a much faster pace than that seen in the Global Financial Crisis. For an asset to be considered troubled, the company looks at direct signs of property-level distress, such as announcements of bankruptcy or default, tenant distress, or CMBS loans being transferred to a special servicer. Distressed inflows for 2020 are dominated by retail and hotel assets, which together were responsible for 92% of all troubled assets in 2Q20, compared to only about half of the total distress in the GFC. We note that the higher level of distress in retail and hotels this time around makes sense given that this economic downturn involves a health crisis that precludes shopping in brick and mortar businesses and staying at hotels. Total distressed asset sales have represented just ~1% of total transaction activity over the last two quarters, but this percentage is much higher for sectors like retail.

CSGP acquires Ten-X to enter distressed real estate market at opportune time

Just two months into the ongoing COVID-19 pandemic, CoStar Group acquired Ten-X, a digital transaction platform that liquidates distressed commercial real estate assets, and has executed ~$24B of sales on its platform. The Ten-X platform utilizes a database of 400,000 buyers across 73 countries to evaluate assets, identify buyers, qualify bidders, and provide a digital auction process. While the traditional method of selling distressed commercial properties involves an in-person broker and has a success rate of only 36%, CSGP marketed its first properties through Ten-X and saw a 70% sell-through rate, in addition to a 2x increase in the typical amount of bid activity. This transaction comes at an opportune time, and CSGP management believes the market opportunity amounts to $10B, which could eventually make Ten-X a larger revenue contributor to CSGP than the multifamily segment.

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Online Tech Learning – Transforming Information Consumption

The most common way that organizations train their employees is in classrooms with instructor-led training. However, with work-from-home and social distancing becoming the new normal, the virtual instructor-led training (v-ILT) and online learning is gaining traction. Even prior to the COVID-19, the in-person training programs were at least 2x more costly than what was available through online learning courses, where the employee has flexibility to consume the content at their own pace. These scenarios are opening up the gates for online learning tools to capture the opportunity. While our bottom-up analysis brings us to a TAM of ~$60B for online learning, we believe price erosion will keep ARPU in check, lowering the TAM to a value closer to Pluralsight's estimated $42B.

$42B Total Addressable Market Has Doubled since 2018

According to Training Institute (from Pluralsight S-1), the global spend on corporate training initiatives was estimated to be $359B in 2016. But this spend includes classroom training programs, and spend that is involved for all industry segments. To get a targeted TAM for Pluralsight, we perform a bottom-up analysis. Pluralsight's November 2020 Investor Presentation estimates the entire global corporate training market shifting toward technology training as over $300B by 2025. The company uses Evans Data Corporation estimates of 102M technical team members globally to arrive at a total addressable market of $42B, with an implied ARPU of $412. This $42B TAM is nearly double the $24B TAM that we calculated for online learning at this time in 2019.

Fully loaded ARPU across customer demographics gives us a ~$60B TAM, but price erosion can keep ARPU in check

Our bottom-up analysis of the total addressable market for online learning comes in roughly $20B above Pluralsight's estimate of $42B ($31B for Pluralsight Skills and $11B for Pluralsight Flow). PS's product offerings include those for personal use and those for business. Single-use contracts for B2C customers include a $299/year offering and $449/year offering under Pluralsight Skills. Multi-use contracts for B2B customers include a $579/year offering and a $779/year offering under Pluralsight Skills and a $499/year, $599/year and $699/year offering under Pluralsight Flow. The company has indicated that 88% of its billings come from business customers. We break down business segment in ratio of their TAM ($31B and $11B for Skills and Flow, resp.), meaning that the Skills business plans account for 65% and Flow accounts for 23% of overall billings. We use the Evans Data Corporation estimate of 102M technical team members globally to arrive at the total addressable B2B market and the total addressable B2C market by multiplying by .88 and .12, respectively.

We then assume equal adoption of different plans in both B2B and B2C offerings. Using these assumptions we arrive at a $60B TAM, as shown in

Table 44. However, we note that in order to get peak penetration within the addressable market, we would likely see price erosion take place over time. That is why we think PS's $42B TAM using a $412 implied ARPU is a more accurate representation of the potential market overall.

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Table 44: Total Addressable Market Calculation for Pluralsight

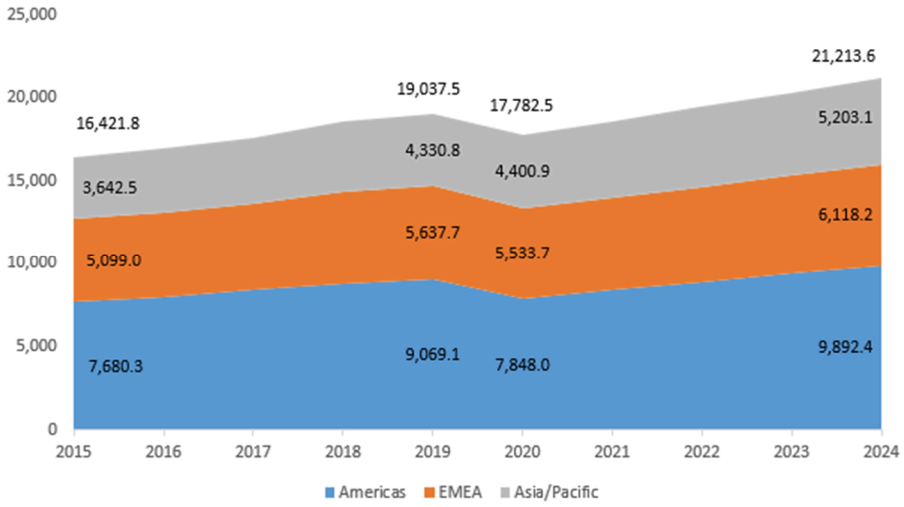
Customer Type	No. of Customers	ARPU	Total Market Size
PluralSight Skills			
Personal	6.1	$299	$1,830
Premium	6.1	$449	$2,748
B2C	**12.2**	**$374**	**$4,577.76**
Professional	33.1	$579	$19,180
Enterprise	33.1	$779	$25,805
B2B	**66.3**	**$679**	**$44,984.72**
PluralSight Flow			
Standard	7.8	$499	$3,910
Plus	7.8	$599	$4,694
Enterprise	7.8	$699	$5,477
B2B	**23.5**	**$599**	**$10,171.38**
Total B2C	**12.2**	**$374**	**$4,577.76**
Total B2B	**89.8**	**$599**	**$55,156.10**
Total TAM	**102.0**	**$642**	**$59,733.86**

Source: Company Investor Presentation, J.P. Morgan Estimates.
Note: All numbers in millions, except for ARPU

IDC data show under-penetrated growth story in online learning

IDC estimates that the worldwide spending on IT education and training services is roughly $17.7B for FY20, growing to ~$21.2B by 2024. The CAGR during this period is roughly 4.5%. As seen in Figure 111, roughly half of the worldwide IT education services spending is forecast to come from the United States.

Figure 113: Worldwide IT Education Services Spending by Region



Source: IDC, 2020.

The estimated current spend of $17.8B is less than half of the total addressable market for online learning calculated by Pluralsight, and roughly one-third of the TAM calculated in our bottom-up analysis. This suggests that the online learning market is vastly underpenetrated, meaning there is significant room for growth going forward. In sum, current total IT education services spending is around $18B, Pluralsight estimates its total addressable market as $42B, and our bottom-up calculation using PS's pricing and customer counts points to a total market size of $60B. Thus, the forecast penetration of the online learning market drastically differs depending on the growth drivers and pricing assumptions used.

PS Masters Tech within Competitive Landscape

In terms of competitors to Pluralsight, we think LinkedIn Learning, Udemy, Udacity, and few other private vendors offer the closest competition. But the depth of content and the relevance to the current programming methods are what differentiate PS from the competition, in our view. Moreover, PS offers a number of tools like RoleIQ and SkillIQ that help the employees find out the gaps that exist in their skills and what the modules are that they need to cover those gaps. This offers more curated content that is tailored for individual employees, rather than making them go through modules they might already be aware of. While we believe these characteristics differentiate PS from the competition and offer the company an edge when compared to its peers over the long term, September quarter billings weakness suggests that it is going to take longer for PS's top-line metrics to re-accelerate. In turn, we believe the stock will not keep up with other cyclically-sensitive names over the next few quarters.

Attracting talent to author content is another important differentiation

Although the royalty rates on Pluralsight are similar to those of many other on-demand platforms, the higher engagement to content (given the depth and brand) provides authors the potential to earn more as compared with other vendors. Although other vendors might have many more users on their platform, the overall engagement to the content is lower, as they attract a variety of people due to the breadth of content. Another key feature is that Pluralsight provides or reimburses the authors for the content development tools, so they have the flexibility of recording the content from the comfort of their homes. Other vendors might require authors to come to the studio to record the content. This might be challenging for authors who have full-time jobs and record content at night or on weekends.

Pluralsight is 2x cheaper and more flexible than in-classroom training programs

In the S-1, Pluralsight lists that organizations on average spent $1,273 per employee in 2016, according to Association for Talent Development. In contract, PS business licenses range from $579 to $779/year at list prices (this may be lower if companies buy enterprise-wide licenses (ELA). Apart from the lower costs, online training offers employees the flexibility to consume the content at his own pace.

An overview of Pluralsight's pricing and plan features is shown in Table 45. Since last year, the company has kept the prices of both personal and business plans unchanged.

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Table 45: Pluralsight Pricing and Plan Features

Price (Per user)	Plan	Features
	PlurralSight Skills	
$299/year	Personal	Entire Course Library
		Learning paths
		Channels
		Skill IQ
		Role IQ
		Course Completion Certificates
		Course learnings checks
		Course discussions
		Exercise files
		Mobile and TV apps
		Offline viewing
$449/year	Personal Premium	All personal features +
		Certification Practice Exams
		Interactive courses
		Projects
$579/year	Business	Individual Features +
	(Professional)	Basic Skills Analytics
		Basic Channels Analytics
		Certification Practice Exams
		Trend Analytics
		Usage Analytics
		Coding Challenges
		Team Management
$779/year	Business	Professional Features +
	(Enterprise)	Single Sign-On (SSO)
		Data Export
		API Access
		Advanced Channel Analytics
		Advanced Skills Analytics
	PluralSight Flow	
$499/year	Standard	50 repos
		GitHub, Bitbucket, GitLab
		Operational Insights
		Code Fundamentals
		Email & Phone Support
		Single Sign-on (add-on)
		API Access (add-on)
$599/year	Plus	Unlimited repos
		All Standard Features +
		Jira, GitHub Issues, Rally
		Code Review & Collaboration Insights
		Advanced Pull Request Reports
		Proficiency Report
$699/year	Enterprise	Unlimited repos
		All Plus Features +
		Delivery Insights
		Mob/Pair Support
		GitHub Enterprise, Bitbucket Server, GitLab Ente
		Self-hosted or cloud-hosted
		Priority Support and SLAs

Source: Company Investor Presentation, November 2020.

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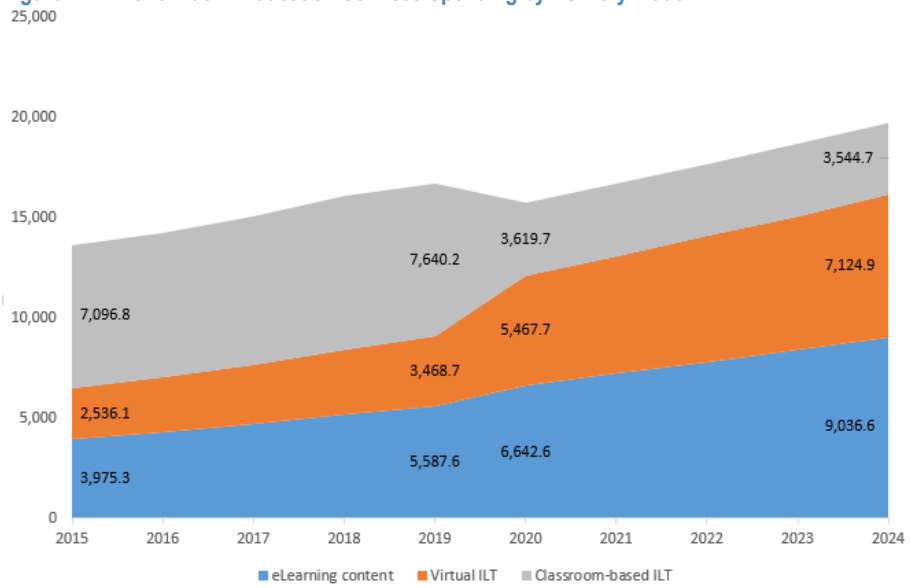
Changing Online Learning Landscape

As enterprises accelerate transformation strategies and with shift towards more flexible and remote working environment, there is a greater need to upskill the workforce with the technology. This being the new normal, companies have increased investment and adoption of on-demand eLearning and virtual instructor-led trainings and are moving away from in-person trainings, seminars and workshops.

IDC data show shift towards eLearning and v-ILT from classroom-based ILT
IDC data on worldwide IT education services spending shows that the landscape is changing for online learning industry. Corporates are shifting from classroom-based ILT to more virtual environments as remote working becomes the new normal amid COVID-19. These trends appear to be sticky and we believe can accelerate further. In 2019, IT education spending worldwide was dominated by classroom-based ILT, but 2020 saw a drastic shift away from it towards on-demand eLearning content and virtual-ILT. While on-demand eLearning and virtual-ILT are expected to show 10.1% and 15.5% 2019-24E CAGRs, respectively, classroom-based ILT is expected to shrink by 14.2% CAGR over the same period.

Figure 114: Worldwide IT Education Services Spending by Delivery Mode



Source: IDC, 2020.

Pluralsight following the shift with acquisition of DevelopIntelligence
Fundamentals of business are changing as businesses move on their digital transformation journey and there is a greater need to upskill employees. To keep up with the changing scenario, Pluralsight acquired DevelopIntelligence, a provider of skill consulting and virtual-ILT for IT, software development and engineering teams. Pluralsight aims to tap into this market opportunity through DevelopIntelligence's highly customizable virtual learning programs and strategic consulting services.

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Business Model Transitions Revisited (Subscriptions)

Since 2004 we have seen 15 software companies in our coverage make the transition from a traditional perpetual license model to software subscriptions. Now, as the number of companies accelerate their digital transformation journey while adapting to the remote working environment, SaaS adoption is increasing, pushing more companies to shift business models from licensing to subscription regime. Varonis and CyberArk are the newest additions to the subscription transition story. While Varonis completed its transition in over a year's time, CYBR has just embarked on the transition journey. These subscription transition, if done correctly, has been a recipe for significant share outperformance, as it leads to a more predictable and profitable software company. Success in the process is predicated on providing the right metrics, clarifying the time frame of transition and the target model coming out of transition to set the right expectations. Table 46 provides a number of metrics that each company provided as part of transitions.

Table 46: Subscription Transitions and Their Key Metrics

Company	Ticker	Transition Start	Transition End	Key Metrics
Synopsys	SNPS	Aug-04	Aug-07	• Backlog (annual) • Software Integrity segment
Advent	ADVS	Oct-04	Acquired by SSNC	• Annualized Recurring Run Rate • Annual Contract Value
Ariba	ARBA	Apr-05	May-12	• Subscription software revenue • Subscription software backlog
Cadence	CDNS	Jul-08	Jul-12	• Ratable bookings • Performance obligation balance • Billings • Backlog (annual)
Aspen Technology	AZPN	Jul-09	Aug-15	• Bookings • Annual customer spend • Target operating margin
Adobe	ADBE	Nov-11	Nov-17	• ARR (Creative and Digital Media) • Digital Marketing ARR • % of revenue that is recurring • Billings
Autodesk	ADSK	Oct-13	Mar-19	• ARR • ARPS • Billings • Subscription billings
Guidewire	GWRE	Mar-17	Not completed	• Total direct written premiums ($B) • ARR • Billings
Intuit	INTU	Aug-14	Aug-18	• QBO subscriber target • TurboTax segment
Model N	MODN	Feb-15	Not completed	• SaaS ARR • SaaS revenue • Revenue coverage • Billings
PTC Inc.	PTC	Apr-15	Jan-20	• ARR • Subscription Revenue
PROS Holdings	PROS	May-15	Not completed	• Recurring billings • ARR
Dynatrace	DT	2014	May-20	• ARR • Net Expansion Rate • Platform Customers • Billings
Cyberark	CYBR	Aug-20	Not completed	• Recurring revenue • ARR • Subscription and SaaS booking mix
Varonis	VRNS	Feb-19	Oct-20	• Subscription Revenue • Multi-year subscription deals

Source: Company reports and J.P. Morgan estimates.

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If done correctly, transitions can be a recipe for share performance

Table 47 illustrates the share performance for each name that went through a transition. Altogether these transitions outperformed the S&P 500 and S&P Software Index by 6-13,000 bps over the course of transition. Please note that Synopsys was the first company to make the transition, and the market did not appreciate the benefits, but now investors are much more aware of the transition process and give credit to the potential upside from the transition process, in our view. Some of the companies went through rough patches in addition to their efforts on transition to a subscription model that impacted performance. For example, we believe it is fair to look at the share price of CDNS once the current CEO was named in January 2009, as the share price during the two quarters after the announcement of transition appears to have been affected by changes in company management.

Table 47: Transition to Subscription Can Be a Recipe for Outperformance

		Date of				S&P Software	Over/Under Performance vs.	
Company	Ticker	Transition Start	Transition End	Total Return	S&P Performance	Index Performance	S&P 500	S&P Software Index
Synopsys	SNPS	8/18/04	8/22/07	21.1%	33.7%	43.8%	(1,263 bps)	(2,279 bps)
Advent Software	ADVS	10/21/04	4/7/07	72.6%	30.5%	24.4%	4,209 bps	4,818 bps
Ariba	ARBA	4/21/05	5/21/12	361.3%	13.5%	64.7%	34,782 bps	29,654 bps
Cadence	CDNS	7/23/08	7/25/12	11.2%	4.3%	19.8%	685 bps	(858 bps)
Cadence (With new mgmt)	CDNS	1/8/09	7/25/12	177.2%	47.1%	79.4%	13,012 bps	9,780 bps
Aspen Technology	AZPN	7/9/09	8/13/15	359.1%	136.0%	179.7%	22,310 bps	17,943 bps
Adobe	ADBE	11/9/11	11/9/17	547.9%	110.3%	168.7%	43,758 bps	37,917 bps
Autodesk	ADSK	10/2/13	3/1/19	275.5%	65.5%	174.7%	20,997 bps	10,074 bps
Intuit	INTU	8/21/14	8/23/18	158.6%	43.4%	123.5%	11,523 bps	3,516 bps
Model N	MODN	2/3/15	N/C	209.3%	76.7%	268.1%	13,267 bps	(5,877 bps)
PTC	PTC	4/30/15	1/22/20	108.5%	59.3%	152.5%	4,925 bps	(4,399 bps)
PROS Holdings	PRO	5/7/15	N/C	99.0%	73.4%	240.4%	2,558 bps	(14,142 bps)
Guidewire	GWRE	3/2/17	N/C	120.6%	52.0%	172.2%	6,856 bps	(5,163 bps)
Varonis	VRNS	2/11/19	10/26/20	91.4%	25.5%	58.1%	6,591 bps	3,336 bps
Mean				**187.4%**	**55.7%**	**130.1%**	**13,169 bps**	**5,734 bps**
Median				**120.6%**	**52.0%**	**152.5%**	**6,856 bps**	**3,336 bps**
Mean (With Cadence Starting With New Management)				**200.2%**	**59.0%**	**134.6%**	**14,117 bps**	**6,552 bps**
Median (With Cadence Starting With New Management)				**158.6%**	**52.0%**	**152.5%**	**11,523 bps**	**3,516 bps**

Source: Company reports, J.P. Morgan estimates, Bloomberg Finance L.P. NC = Not completed;
Note: For ModelN, PRO and GWRE prices as of 11/30/2020.

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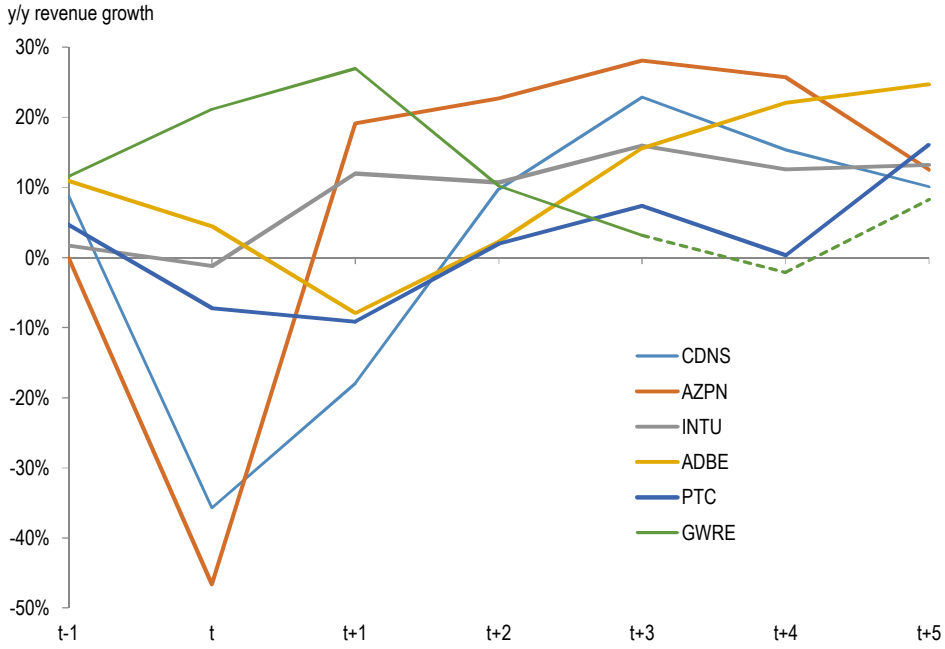
Revenue and margin benefit from the transition

Revenue initially declines as the company shifts from the license model to the subscription-based model, since what was recognized upfront is now spread out over time. This phase is generally followed by sustained growth as the transition gets completed, as can be observed from the y/y revenue growth chart below. We have excluded some companies like ADSK, as we believe its revenues were impacted by other events during the period, making it hard to observe the effect of the transition on it. The dotted lines represent our revenue growth estimates.

Figure 115: Impact of transition on revenue growth



Source: Company reports and J.P. Morgan estimates.

A similar trend can be observed in operating margins. After initially deteriorating, margins reaccelerated, as the companies benefit from a more stable recurring revenue stream and increased customer lifetime value.

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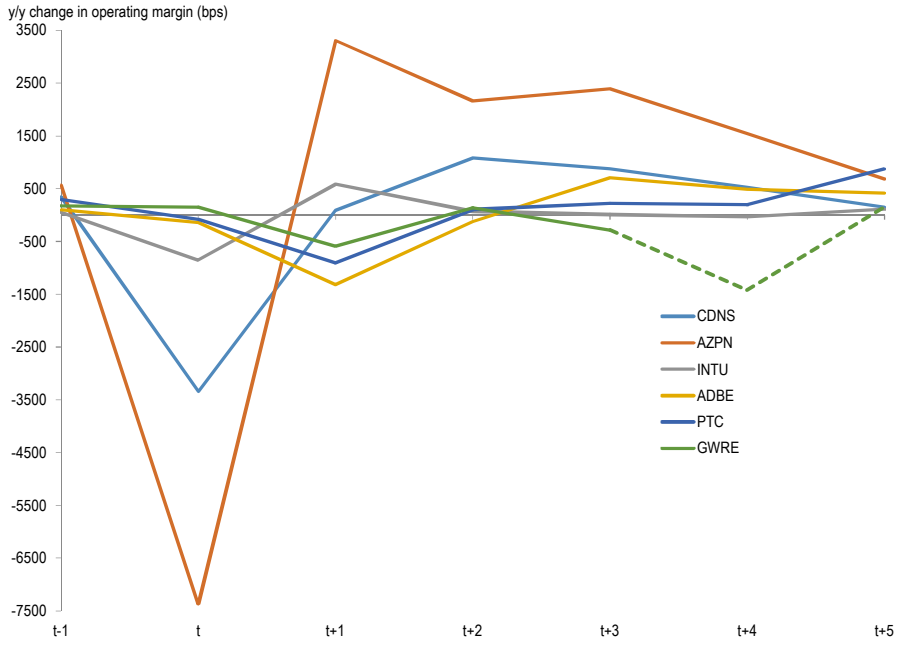
Figure 116: Impact of Transition on Operating Margins

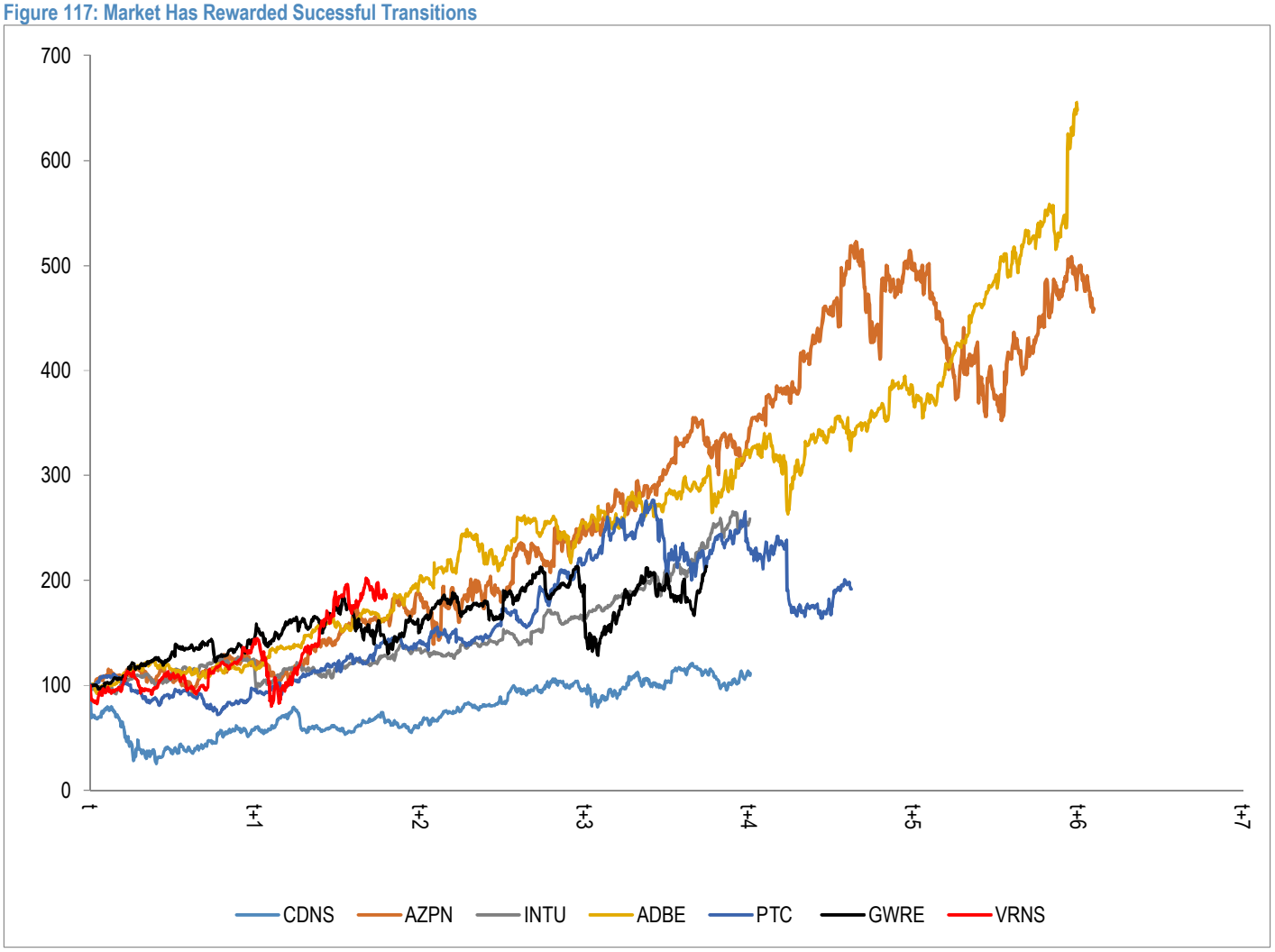


Source: Company reports and J.P. Morgan estimates.

The market has rewarded successful transitions

SNPS was the first company in our coverage universe to transition to a subscription model, but back then we believe the investor base was not well informed about the process and the markets did a poor job of evaluating the transition impact and separating it from other factors such as the macro environment. The stock has returned 21.1% during the transition period vs. the S&P software index's return of 33.8% for the same period. With increasing understanding in the investor base, in our view, the companies that sustained high levels of transparency and successful management of expectations throughout the process were very well received by the market, driving share performance. The graph below shows stock performance of the companies that went through or are currently in the transition process.

Figure 117: Market Has Rewarded Sucessful Transitions



Source: Bloomberg Finance L.P.

2020 Year in Review

Our software technology coverage has outperformed the market this year, generating a return of 62.1% YTD through November 30 compared with 12.1% for S&P 500 and 36.0% for NASDAQ Composite. The Communication sector stood out in terms of stock performance, generating a return of 131.5%. ZM and FIVN outsized the communication sector, generating 603.1% and 136.7% YTD returns, respectively. IT Operations and Internet Infrastructure sectors also outperformed our coverage, generating 82.2% and 79.8%, respectively. DDOG and NOW led the growth in IT Operations with 161.8% and 89.3% returns, while NET took the lead in Internet Infrastructure sector generating 340.1%. Security, Design, and Vertical App segments were comfortably ahead of the market, generating 35.0%, 49.4% and 51.1%, respectively. Newly public companies – JAMF, DCT, and FROG – also beat the market, generating 21.9%, 47.3% and 59.9% returns, respectively.

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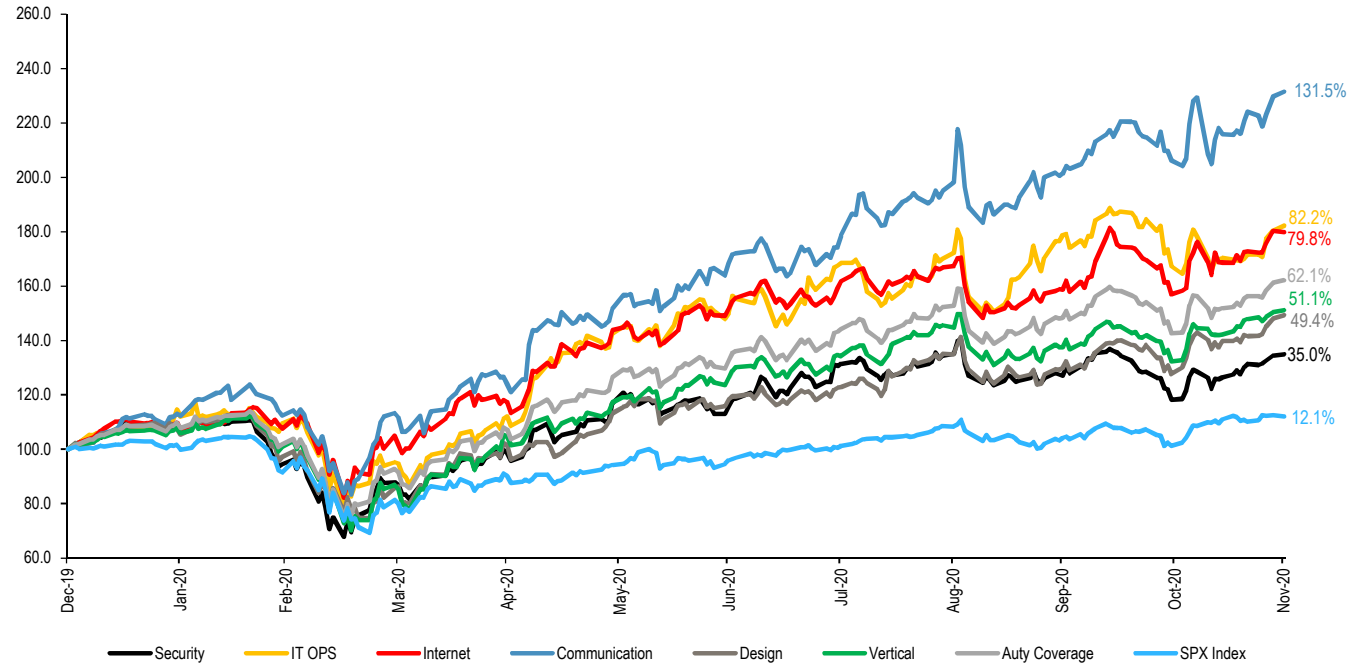
Figure 118: Coverage vs SPX



Source: Bloomberg Finance L.P., J.P. Morgan Research. Note: Prices as of 11/30/2020.

Coverage: What Worked and What Did Not

Within our coverage, Zoom, Cloudflare and Zscaler were the best-performing stocks, while Tufin Software, SecureWorks and PROS Holdings were the three worst-performing securities. Below, we show the performance of each of our coverage stocks for the year.

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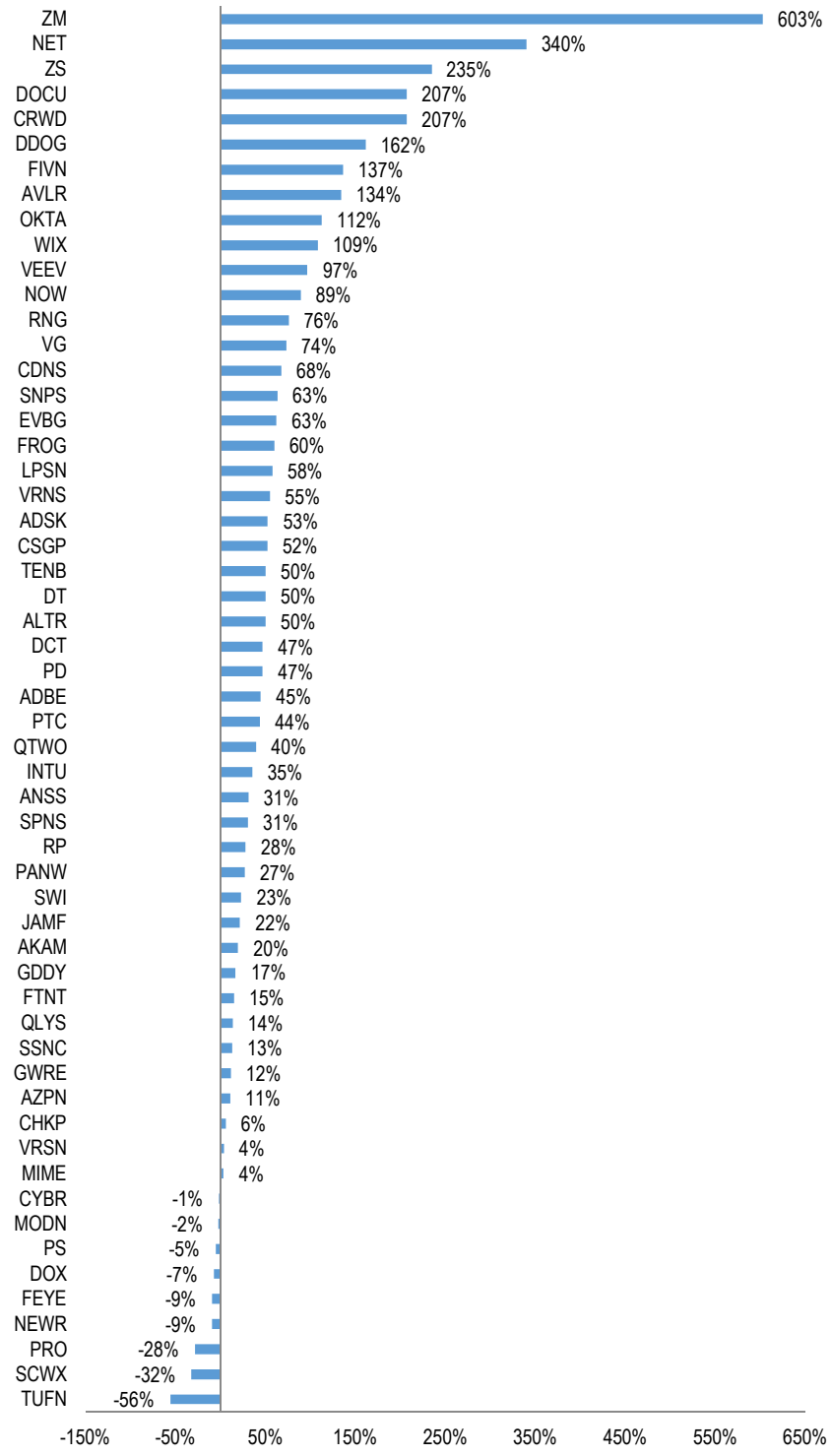
Figure 119: Coverage vs SPX



Source: Bloomberg Finance L.P., J.P. Morgan Research
Note: Prices as of 11/30/2020. For companies that went public in 2020, the return reflects performance since IPO pricing.

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Table 48: YTD Coverage Performance

Company	Ticker	Current Rating	Price Target	31-Dec-19 Price	30-Nov-20 Price	YTD Return	Rating Changes during 2020
Check Point Software Technologies Ltd	CHKP	N	$141	$111.0	$117.7	6%	
Crowdstrike	CRWD	OW	$160	$49.9	$153.3	207%	
CyberArk Software Ltd	CYBR	OW	$143	$116.6	$114.9	-1%	
FireEye Inc	FEYE	OW	$18	$16.5	$15.0	-9%	
Fortinet Inc	FTNT	N	$140	$106.8	$123.2	15%	Downgraded to N from OW on 07/07/2020
Mimecast Ltd	MIME	UW	$48	$43.4	$45.0	4%	Downgraded to UW from N on 08/04/2020
Okta Inc	OKTA	OW	$250	$115.4	$245.0	112%	
Palo Alto Networks Inc	PANW	N	$308	$231.3	$293.9	27%	Downgraded to N from UW on 02/25/2020
Qualys Inc	QLYS	UW	$90	$83.4	$95.0	14%	
SecureWorks Corp	SCWX	N	$18	$16.7	$11.3	-32%	
Tenable Holdings Inc	TENB	OW	$47	$24.0	$36.0	50%	
Tufin Software Technologies Ltd	TUFN	OW	$14	$17.6	$7.8	-56%	
Varonis Systems	VRNS	OW	$160	$77.7	$120.6	55%	
Zscaler Inc	ZS	OW	$190	$46.5	$155.8	235%	
Dynatrace	DT	OW	$50	$25.3	$38.0	50%	
Datadog	DDOG	N	$90	$37.8	$98.9	162%	Downgraded to N from OW on 11/11/2020
Jamf	JAMF	OW	$55	$26.0	$31.7	22%	
Jfrog	FROG	OW	$90	$44.0	$70.4	60%	
New Relic Inc	NEWR	UW	$59	$65.7	$59.7	-9%	Downgraded to N from OW on 08/05/2020; Downgraded to UW from N on 11/06/2020
Pagerduty Inc	PD	OW	$31	$23.4	$34.4	47%	
ServiceNow Inc	NOW	N	$550	$282.3	$534.6	89%	
SolarWinds	SWI	OW	$29	$18.6	$22.9	23%	
Akamai Technologies Inc	AKAM	OW	$125	$86.4	$103.5	20%	
GoDaddy Inc	GDDY	OW	$110	$67.9	$79.5	17%	Upgraded to OW from N on 08/06/2020
Cloudflare	NET	OW	$83	$17.1	$75.1	340%	
VeriSign Inc	VRSN	N	$246	$192.7	$200.7	4%	
Wix.com Ltd	WIX	N	$292	$122.4	$255.4	109%	
Amdocs Ltd	DOX	OW	$75	$70.9	$65.8	-7%	Upgraded to OW from N on 11/11/2020
Five9 Inc	FIVN	OW	$170	$65.6	$155.2	137%	
LivePerson	LPSN	N	$65	$37.0	$58.4	58%	
RingCentral Inc	RNG	OW	$375	$168.7	$297.1	76%	
Vonage	VG	N	$13.5	$7.4	$12.9	74%	
Zoom Video Communications Inc	ZM	OW	$450	$68.0	$478.4	603%	
Altair Engineering Inc	ALTR	N	$50	$35.9	$53.9	50%	Upgraded to N from UW on 08/07/2020
ANSYS Inc	ANSS	UW	$290	$257.4	$338.1	31%	
Aspen Technology Inc	AZPN	N	$130	$120.9	$134.5	11%	Upgraded to N from UW on 03/16/2020
Autodesk Inc	ADSK	UW	$239	$183.5	$280.2	53%	
Cadence Design Systems	CDNS	N	$122	$69.4	$116.3	68%	
PTC Inc	PTC	UW	$88	$74.9	$107.9	44%	
Synopsys Inc	SNPS	OW	$230	$139.2	$227.5	63%	
Adobe Inc	ADBE	OW	$550	$329.8	$478.5	45%	Upgraded to OW from N 03/13/2020
Avalara Inc	AVLR	OW	$195	$73.3	$171.8	134%	
CoStar Group Inc	CSGP	OW	$925	$598.3	$910.6	52%	Upgraded to OW from UW on 07/29/2020
DocuSign Inc	DOCU	OW	$271	$74.1	$227.9	207%	
Duck Creek	DCT	N	$50	$27.0	$39.8	47%	
Everbridge	EVBG	N	$150	$78.1	$126.9	63%	
Guidewire Software Inc	GWRE	OW	$140	$109.8	$122.5	12%	
Intuit Inc	INTU	UW	$300	$260.0	$352.0	35%	
Model N Inc	MODN	OW	$48	$35.1	$34.5	-2%	
Pluralsight Inc	PS	N	$20	$17.2	$16.4	-5%	Downgraded to N from OW on 11/06/2020
PROS Holdings Inc	PRO	UW	$35	$59.9	$42.9	-28%	Downgraded to UW from N on 07/31/2020
Q2 Holdings Inc	QTWO	OW	$125	$81.1	$113.4	40%	
RealPage Inc	RP	N	$72	$53.8	$69.0	28%	
Sapiens	SPNS	OW	$40	$22.9	$29.9	31%	
SS&C Technologies Holdings Inc	SSNC	OW	$78	$60.9	$68.9	13%	
Veeva Systems Inc	VEEV	N	$297	$140.7	$276.9	97%	

Source: J.P. Morgan, Bloomberg Finance L.P.

Table 49: Performance of Companies Initiated in 2020

Company	Ticker	Current Rating	Price Target	Price at Initiation	30-Nov-20 Price	Return since Initiation	Initiation Date
Varonis Systems	VRNS	OW	$160	$94.2	$120.6	28%	Initiated coverage at OW on 07/01/2020
Jamf	JAMF	OW	$55	$38.3	$31.7	-17%	Inititated coverage at OW on 08/17/2020
Duck Creek	DCT	N	$50	$37.3	$39.8	7%	Inititated coverage at N on 09/08/2020
Jfrog	FROG	OW	$90	$76.7	$70.4	-8%	Inititated coverage at OW on 10/12/2020
Sapiens	SPNS	OW	$40	$28.8	$29.9	4%	Inititated coverage at OW on 10/26/2020
Zscaler Inc	ZS	OW	$190	$149.0	$155.8	5%	Inititated coverage at OW on 10/26/2020

Source: J.P. Morgan, Bloomberg Finance L.P.

M&A

2020 saw healthy M&A activity in the software industry, with many notable deals such as BlueJeans's acquisition by Verizon in March, Intuit's $7B purchase of Credit Karma and Slack acquisition by CRM in December. While we saw good number of acquisitions by companies in our coverage, we saw only one company in our coverage get acquired, and that was ForeScout, which was bought by Advent. Below is a list of software M&A in 2020.

Table 50: Software M&A in 2020

Announced Date	Target	Acquirer	Value ($M)	EV / LTM Revenue	Rationale
1/6/20	Armis Inc	CapitalG +2	1,100	-	PE transaction
1/6/20	*Segasec*	*Mimecast*	*24*	-	*Strengthens cyber resiliency by blocking potentially malicious domains quickly*
1/7/20	S2 Systems	Cloudflare	40	-	Acquisition will help protect endpoints from zero-day vulnerabilities without sacrificing speed and experience
1/9/20	Veeam Software	Insight Venture Partners	5,000	-	PE transaction
1/13/20	ID Analytics	Lexisnexis Risk Solutions	480	-	Acquisition help provide comprehensive approach to fraud and identity and credit risk management
1/13/20	SCI Solutions	R1 RCM	190	-	Enhanced customer support through expansion in digital front door strategy
1/13/20*	Plaid Inc	Visa Inc	5,300	-	Allows entry to new businesses while delivering enhanced VAS to fintech developers
1/22/20	Looms Systems	ServiceNow	58	-	Extends AIOps capabilities by proactively pin-pointing and resolving operational issues
1/23/20	Regulatory DataCorp	Moody's Corp	700	-	Strengthen BvD acquisition by efficiently accessing counterparty risks and managing AML and KYC requirements
1/24/20*	Galvanize Inc	K12 Inc	165	-	Acquisition will accelerate K12's entry into technology staffing and develop talent and capabilities for corporates
1/27/20	Blackstone Federal	ASGN Inc	85	-	Acquisition aids ASGN's strategy to scale ECS business to over $1bn
2/4/20	Infor Enterprise Application	Koch Industries Inc	13,000	-	Acquisition help accelerate digital transformation and grow expertise in mission critical software in industries particularly healthcare
2/6/20	Localytics	Upland Software	68	-	Integration enables higher product personalization to drive offer conversion and reduce churn across targeted audiences
2/6/20	ForeScout Technologies	Advent International +1	1,316	3.9x NTM Sales	PE transaction
2/7/20	RSA Security	Ontario Teachers' +2	2,075	-	PE transaction
2/12/20*	RentPath LLC	CoStar Group	588	-	Benefit from synergies through brand and traffic building to provide improved quality and quantity of lead flow to ads client
2/18/20	Saber Interactive	Embracer Group AB	153	-	Provides long term synergy in publishing, development and IP utilizations
2/19/20	Saba Software	Cornerstone OnDemand Inc	1,295	-	Increases competitive product differentiation for people development and talent experience software
2/24/20	Vlocity	SalesForce.com	1,330	-	Acquisition help Salesforce to increase industry capabilities and product knowledge
2/24/20	Credit Karma Inc	Intuit Inc	7,100	-	Acquisition helps create and deliver personalized tools for managing personal finance
2/25/20	Seal Software	Docusign	188	-	Enhances DocuSign's contract management capabilities by improving analytic

					discovery and data extraction
2/27/20	Azul Systems	Vitruvian Partners LLP	340	-	PE transaction
3/31/20	BlueJeans	Verizon	400	-	BlueJeans video solutions to be integrated into Verizon's 5G products giving secure and real-time engagement solutions
3/31/20	CloudGenix	Palo Alto Networks	420	4.8x 2019 billings	Integration will accelerate shift from SD-WAN to SASE platform across its customer base.
4/6/20	Neustar Inc	GoDaddy Inc	215.9	-	Helps deliver better domain name choices and provides enhanced scalability for future growth
4/9/20	Cloudneeti	Zscaler	9	-	Enhances data protection capabilities and organizations' cloud security by eliminating common causes of data breach and compliance violations
4/16/20	Voci Technologies	Medallia Inc	59	-	Live call transcription analysis help determine customer satisfaction and deliver exceptional customer experience
4/22/20*	Candywriter	StillFront Group	70	-	Acquisition to diversify portfolio in terms of genre, audience and addressable market
4/23/20	Divvy Cloud	Rapid7	145	-	Acquisition helps customers to accelerate adoption of cloud services through secure and accessible infrastructure
4/28/20	Innovest Systems	SS&C Technologies	120	-	Integration will simplify wealth management with single stop solution for wealth and trust reporting and accounting
4/30/20	eRx Networks	Change Healthcare	213	-	Provides synergy for wider portfolio of solutions to pharmacies and life sciences companies
5/5/20	CyberX Inc	Microsoft Corp	165	-	Provides visibility to existing IoT devices and manage and improve security
5/5/20	Collaborative Solutions LLC	Cognizant Technology	385	-	Acquisition adds finance and HR advisory and implementation services to Cognizant's cloud offerings
5/13/20	IDaptive	CyberArk	70	4x ARR	Integration to provide AI and security-first approach based identity security platform with reduced risks
5/13/20	Ten-X LLC	CoStar Group	190	-	Integration will synergize by bringing large consumer base to Ten-X auction platform
5/27/20	Tagomi Trading LLC	Coinbase	100	-	Provides trading features and prime brokerage services on one platform to provide seamless experience to crypto investors
5/28/20	Edgewise Networks	Zscaler	31	-	Helps broaden cloud-native platform and secures application-to-application communication for stronger security in public cloud and data centers
5/28/20	Eggplant Inc	Keysight Technologies Inc	330	-	Synergizes automated software test market across physical and protocol layers and application layers as well
6/1/20	PDX Inc	Change Healthcare	208	-	Acquisition fuels innovation and long-term growth, creating integrated development and cross selling opportunities
6/23/20	Finicity Inc	Mastercard Inc	825	-	Estb Mastercard as strong open banking partner and streamline credit decision process and improve ACH and real-time payments experience
6/25/20	Syntellis Performance Solutions	Madison Dearborn Partners LLC +1	500	-	PE transaction
7/13/20	Silver Peak Systems Inc	Hewlett Packard Enterprise Co	925	7x TTM Sales	Strengthen cloud capabilities through SD-WAN to simplify office and WAN deployment and enable cloud-connected distributed enterprises
7/13/20	4C Insights	Mediaocean	150	-	Integration will provide transparency, neutrality, intelligence and accountability in omni-channel advertising
7/15/20	SocialChorus	Sumeru Equity Partners +1	100	-	PE transaction
7/16/20	InnerWorkings Inc	HH Global Ltd.	322	-	Helps broadening product offering and expand global reach
7/20/20	OPAQ Networks	Fortinet Inc	8	-	Help deliver integrated suite of cloud security providing true zero trust security
7/20/20	GlobalSCAPE	Help/Systems LLC	217	-	Merger will augment data security business that includes data prevention and data classification software
7/20/20	Majesco	Thoma Bravo	644	-	PE transaction
7/30/20	MessageControl	Mimecast	17	-	Helps improves cybersecurity at email perimeter with advanced protection against phishing and impersonating attacks
8/3/20	Consignor LLC	Francisco Partners	1,500	-	PE transaction
8/7/20	ThousandEyes Inc	Cisco Systems Inc	1,000	-	Helps to pin-point deficiencies and improve network and application performance; accelerates digital transformation for enterprises
8/11/20	VitalWare LLC	Health Catalyst	120	-	PE transaction
8/19/20	Centuari LLC	KBR Inc	800	-	Helps expand in military space and intelligence business and build on already strong cybersecurity and missile defense solution
8/24/20	Branfolder Inc	Smartsheet Inc	155	-	Helps offer solutions for workflows around content and collaboration through DAM capabilities and work engagement platform
8/24/20	Crypsis Group Holding LLC	Palo Alto Networks	265	-	Acquisition will strengthen Cortex platform with expert services for incident response and proactive assurance
8/25/20	Blockfolio Inc	FTX Cryptocurrency Derivatives Exchange	150	-	Helps expand into retail market leveraging Blockfolio's customer base

8/25/20*	OSIsoft Software LLC	AVEVA Group PLC	5,019	-	Helps provide full stack end-to-end solutions for industrial IoT deployments
8/27/20	Signal Science Corp	Fastly Inc	775	18x NTM Sales	Acquisition will power Secure@Edge for unified application and API protection solution
8/27/20	Open Systems International	Emerson Electric Co	1,600	-	Emerson's Ovation control system will optimize energy efficiency and enable renewables integration and grid stability
8/31/20	Epicor Software Corp	Clayton Dubilier and Rice LLC	4,700	-	PE transaction
8/31/20	Rosetta Stone Inc	Cambium Learning Group	734	-	Help deliver expansive solutions to teachers and learners with best digital solutions for personalized instruction
9/8/20*	MyCase Inc	Apax Partners LLp	193	-	PE transaction
9/8/20	Chef Software Inc	Progress Software Corp	220	-	Acquisition will strengthen core offerings and respond to business demands efficiently
9/10/20	Virtusu Corp	Baring Private Equity +1	1,795	-	PE transaction
9/14/20	XCM Solutions LLC	Wolters Kluwer NV	136	-	Acquisition enables integration of XCM workflow tools with CCH ProSystem fx on-premise software
9/14/20*	CNET Media Group	Ruby Sub LLC	500	-	Helps deliver rich content and greater editorial expertise
9/16/20	Odo Security	Checkpoint Software	30	-	Helps deliver secure remote access with unmatched security through integration with Infinity architecture
9/16/20	AppDirect Inc	Caisse de Deport et Placement du Quebec	185	-	Private Transaction
9/16/20*	Portworx Inc	Pure Storage Inc	370	-	Help deliver data platform to manage storage and protect data for Kubernetes applications
9/17/20	Cradlepoint	Ericsson	1,100	8x TTM Sales	Help deliver full 5G-enabled services for enterprise with dedicated networks and global IoT platform
9/21/20	Rundeck Inc	PagerDuty Inc	100	-	Help automate response lifecycle reducing cost and time and optimized experience
9/23/20	Preempt Security Inc	Crowdstrike Holdings Inc	96	-	Plans to offer enhanced zero trust security and strengthen Falcon platform with conditional access technology
9/28/20	MobileIron Inc	Ivanti Inc	749	-	Acquisition will strongly place Ivanti in unified endpoint management, zero trust security and enterprise service management
9/30/20	Pipeworks Inc/OR	Sumo Group PLC	96	-	Help establish presence in US market and add Client-IP games to portfolio
10/8/20	iCiDIGITAL Inc	Infosys Ltd	125	-	Helps strengthen end-to-end customer experience offerings and deepens capability in Adobe ecosystem
10/12/20	Segment.io Inc	Twilio Inc	3,200	-	Acquisition helps companies understand customers and engage with them through Customer Engagement Platform
10/13/20	Eximius Design LLC	Wipro Ltd	80	-	Acquisition will integrate with EngineeringNXT framework to strengthen presence in VLSI and system design market
10/14/20*	E2open LLC	CC Neuberger Principal Holdings	1,634	-	PE transaction
10/19/20*	128 Technology Inc	Juniper Networks Inc	450	11x NTM Sales	Strengthen AI-driven enterprise network portfolio and accelerate evolution from first gen SD-WAN technology
10/23/20	SQL Sentry LLC	SolarwWinds Corp	143	-	Helps serve database and performance management challenges and deepen support for Microsoft and Microsoft Azure environments
10/26/20	CENTRA Technology Inc	PAE Inc	208	8.8x CY20 EBITDA	Acquisition expands TAM, broaden offerings and customer base and provide stability to financial profile
10/26/20*	Analytical Graphics Inc	ANSYS Inc	700	-	Acquisition expands offerings beyond traditional component or product level to mission level
10/27/20	CPS Payment Services LLC	Repay Holdings Corp	78	-	Acquisition enhances B2B offerings and introduce products to new verticals with payment workflow management and automation
10/29/20	Inference Solutions Inc	Five9 Inc	148	-	Helps expand self-service offering through leading IVA solution and adds to global footprint
10/29/20*	Lon Operations LLC	Alliance Data Systems	450	-	Integration of pay-over-time solutions with existing private label and products help expand payment options and capabilities
11/2/20	Llamasoft Inc	Coupa Software Inc	1,500	-	Helps deliver powerful business spend management platform through sophisticated modeling and huge transactional data
11/2/20*	Endurance International Group	Clearlake Capital Group	2,940	-	PE transaction
11/3/20*	Cimatron Ltd	Battery Ventures LP	65	-	PE transaction
11/5/20	ShopKeep Inc	Lighspeed POS Inc	473	-	Deepens Lightspeed's presence in US through ShopKeep's merchants and SMB customers
11/9/20*	Workfront Inc	Adobe Inc	1,500	-	Workfront's APIs enable seamless connection to Abode Creative Cloud and Experience Cloud to bring efficiency to marketing teams
11/10/20*	Planview Inc	TPG Capital Management	1,600	-	PE transaction

11/11/20*	Expanse Inc	Palo Alto Networks	670	11.9x NTM Sales	Enrich Cortex platform through external, internal and threat data to provide CISOs with better view of vulnerabilities
11/20/20	Respond Software	FireEye	86	20x TTM Sales	Opens new market to deliver XDR capabilities through Mandiant Advantage platform
11/22/20*	Homesnap Inc.	CoStar Group	250	-	Acquisition open new space and expands TAM and increase professionals, brokers and active agent users on platform
11/23/20*	e-MDs Inc	CompuGroup Medical SE & CO KgaA	240	-	Broadens services for Ambulatory Information Systems and enhance product portfolio in US
11/30/20	Kustomer Inc	Facebook Inc	1,000	-	Bolster efforts to monetize messaging business through automated tools to handle customer requests using bots
12/1/20*	Slack Technologies	SalesForce.com	25,766	~26x NTM Sales	Integrating Slack to Salesforce Customer 360 to transform collaboration and communication and create open ecosystem for business

Source: Company Press Releases, J.P. Morgan Research and Bloomberg Finance L.P. as of 12/1/2020.

IPOs

2020 saw a significant increase in IPO activity compared to 2019 despite macro headwinds. Issuance in the first half of the year was muted due to the market volatility from COVID-19, but the second half saw a significant number of companies going public as valuations saw sharp recovery from the lows in 1H20. 25 companies went public in 2020 compared to 16 IPOs in 2019. Investors generated an average profit of ~72% on the IPO price. Palantir, BigCommerce Holdings and Dye & Durham Ltd stood out in terms of stock performance, generating over 200% returns for shareholders from its IPO price. Below we provide a list of software IPOs in 2020.

Table 51: Software IPOs in 2020

Name	Company Description	Ticker	Trading Date	IPO Price	Price 11/30/20	% Change
1Life Healthcare	Provides healthcare membership software based on consumer enrollment	ONEM	1/31/20	14.00	32.87	134.8%
ZoomInfo Technologies	Provides B2B database to sales and marketing professionals to identify and connect to qualifies prospects	ZI	6/4/20	21.00	51.25	144.0%
VerifyMe	Offers software solutions to protect against counterfeit	VRME	6/18/20	4.60	3.41	-25.9%
Agora Inc.	Provides range of APIs for real time video and voice functionalities	API	6/26/20	20.00	38.45	92.3%
nCino Inc.	Offers end-to-end digital banking platform enabling high productivity and enhanced consumer experience	NCNO	7/14/20	31.00	81.49	162.9%
Dye & Durham Ltd.	Provides cloud-based software solutions for legal and business professionals	DND	7/17/20	7.50	27.63	268.4%
Jamf	Offers on-premise and cloud-based mobile device management for Apple devices	JAMF	7/22/20	26.00	31.70	21.9%
Vertex Inc.	Provides tax compliance software	VERX	7/28/20	19.00	25.24	32.8%
Bigcommerce Holdings Inc.	Offers SaaS platform for cross-channel and cloud based e-commerce solution	BIGC	8/5/20	24.00	80.66	236.1%
Rackspace Technology	Provides managed cloud and hosting, enterprise security and data protection services	RXT	8/5/20	21.00	17.96	-14.5%
Kubient Inc	Offers cloud platform for advertisers and publishers to transact directly	KBNT	8/12/20	5.00	4.18	-16.4%
Duck Creek Technologies	Offers core system solution and services to property and causalty and general insurance company	DCT	8/14/20	27.00	39.76	47.3%
Lightspeed POS Inc.	Provides cloud based POS systems	LSPD	9/11/20	30.50	52.05	70.7%
Snowflake	Develops database architechure, data warehouse and query optimization solutions	SNOW	9/16/20	120.00	325.84	171.5%
Jfrog	Provides tools for software development through power of DevOps	FROG	9/16/20	44.00	70.36	59.9%
Sumo Logic	Cloud based log management and analytics services for enterprise to collect and analyse machine data	SUMO	9/17/20	22.00	26.20	19.1%
Unity Software	Provides graphic tools for content for mobiles, tabs, PCs, VR and AR devices	U	9/18/20	52.00	151.98	192.3%
Bentley Systems	Offers software solutions for design, construction and operation of infrastructure	BSY	9/23/20	22.00	35.27	60.3%
Asana	Provides web application for work collaboration with in a team	ASAN	9/30/20	21.00	27.95	33.1%
Palantir	Develops software for data-driven analysis and decisions	PLTR	9/30/20	7.25	27.11	273.9%
Intrusion Inc	Provides security products against network based attacks along with intrusion detection and vulnerability assessment sys	INTZ	10/9/20	8.00	12.12	51.5%
Datto	Provides applications for data processing, management and backupwith server automation and remote monitoring	MSP	10/21/20	27.00	27.89	3.3%
McAfee	Provides antivirus, cloud and endpoint security solutions	MCFE	10/22/20	20.00	16.05	-19.8%
Root Inc	Offers mobile telematics and technology platform for pricing and risk management in insurance industry	ROOT	10/28/20	27.00	17.70	-34.4%
Absolute Software	Provides firmware-embedded endpoint visibility and control platform	ABST	10/28/20	11.00	10.30	-6.4%

Source: Bloomberg Finance L.P., Company Press Release, J.P. Morgan Research.

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