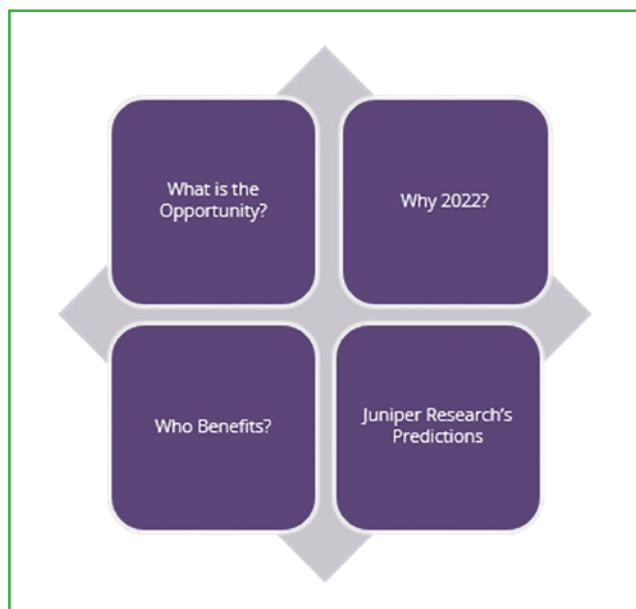


Top Ten

Tech Trends 2022

By Juniper Research

Juniper Research have followed up on their predictions for 2021 in the most unprecedented of times, issuing this latest report. COVID has seen the acceleration and increased adoption of a number of technologies with some surprising outcomes. Read on for a comprehensive look at the landscape in 2022.



Our Top Ten Tech Trends Evaluation Framework

#10: 5G-enabled Low Latency to Drive Adoption of Private Networks

Private cellular networks have seen strong adoption over 2021, with thousands of new networks being established. These are networks that only allow specific authorised devices to connect, rather than being publicly accessible. This

allows data traffic to be more closely controlled, and adds an additional layer of security into the network. Many of these private networks are using 5G technologies, and we expect this to accelerate in 2022.

This will be driven by 5G features, far more than speed: network slicing and guaranteed levels of coverage and latency will be key among these, as well as more flexible architecture.

These features are far more useful for private networks than the raw increases in speed 5G will bring. This includes being able to deploy networks in environments that other forms of connectivity struggle with, allowing more companies to leverage private networks in a variety of hostile environments, such as offshore platforms and remote areas.

5G has been one of the primary drivers for interest in private networks, despite private 4G LTE networks having been around for several years. Our recent report on private networks shows the degree to which 5G networks will be a core part of these, with 5G networks rapidly rolling out as the first private networks which many businesses are deploying.

With several features of 5G networks being promoted as 'enterprise first' in a way that 4G networks never were, interest for enterprise connectivity is building far faster for the new standard than any before it. With specialist devices and networks present in many industries, private networks will be a vital part of that future.

Trends	Result
AI to Accelerate Automation Amidst Market Shocks of Pandemic	
Rapid Expansion of Extended Reality within Online and Mobile Commerce	✗
COVID-19 Pandemic to Increase Investment in Chatbot Automation Capabilities	✓
Blockchain to Escape the Hype, but Only in Certain Areas	✓
Remote Solutions for Working & Operations to Establish New Frameworks	
Virtual Workspace Innovation to Accelerate as the Future of Work Evolves	✓
Multiservice Subscriptions to Proliferate	✓
eSIM Management Tools to Enable Intelligent Control	✓✓
Digital Health & Wellbeing Solutions Enter Mainstream Health Market	
Digital Therapeutics to Become Major Part of Healthcare Delivery	✓
Wearables Key to Combatting Spread of COVID-19, Once Privacy Concerns Are Addressed	✓
Concept of Sexual Wellness to Drive Sextech Adoption	✗
Development of Intelligent Connectivity Solutions to Increase Network & Service Resilience	
Increasing Development of Private Network Capabilities	✓✓✓
Standalone 5G to Drive Further Core Network Virtualisation	✓✓✓
Confidential Computing to Ease IoT Security Concerns	✓

Juniper's Previous Predictions

With several countries set to allocate spectrum for 5G and specifically for private networks in the next year, the regulatory landscape is more supportive of 5G private networks in 2022 than it has been in recent years.

While spectrum typically used for 5G has been available for private network use in some countries from late 2020, a third wave of countries is due to assign spectrum in 2022, which will bring these technologies to countries like Turkey and many parts of the Middle East and Africa. This, coupled with an increasing range of hardware for 5G deployment from network vendors means that 2022 will see a large number of roll-outs of private networks in these regions, particularly those that focus on industries like mining and energy.

We expect the adoption of 5G private networks to benefit a large array of stakeholders. Enterprises will be able to leverage extended and accelerated connectivity, which will allow for greater efficiency in their operations, including automation in many cases. In particular, we are expecting adoption from the industrial sector for more flexible manufacturing, connected offshore operations and an extension of connectivity into mining operations. Healthcare will also benefit, as these will allow the adoption of more data-intensive technologies, such as surgical robotics, as well as giving an additional layer of security by limiting what devices can access networks holding healthcare data.

This will bring the global total of private network deployments to over 48,000 by the end of 2022. The precise revenue opportunities in each of these verticals is given in our

private networks research, with the biggest industries being manufacturing and mining.

Network hardware vendors will have a broader range of potential clients and the ability to assume a role of network manager, not necessarily a role that they have historically played in deployments of public networks, that have been dominated by large network operators.

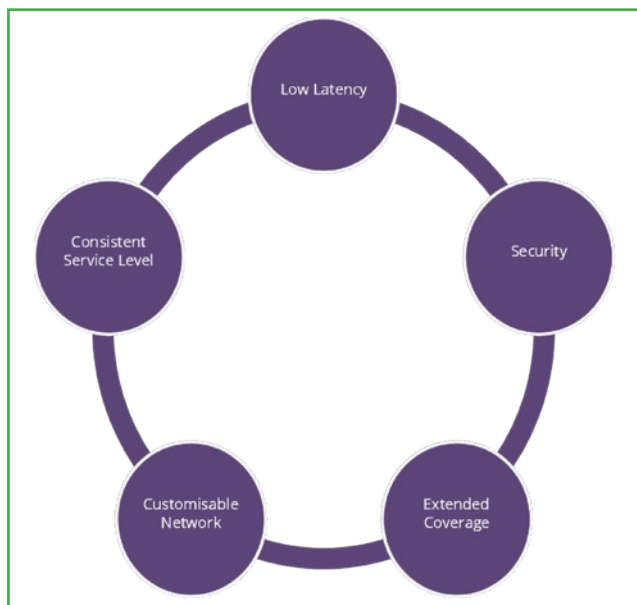
We also anticipate a number of technology integrators and smaller network operators to take the opportunity to establish themselves as network providers in a way that has not previously been possible for public connectivity.

We have already seen signs of this in the allocation of spectrum in Germany, and the success of Nokia, Citymesh and other non-traditional operators leading the development of private network operations at ports throughout Europe.

However, such initiatives will often remain bound by national restrictions based on spectrum, meaning that many of these new players will remain limited by the territories where they have been able to secure spectrum arrangements, either with governments or spectrum owners.

#9: Video Games Subscriptions to Consolidate to Focus on Content

The past year has seen subscription-based video game services become a key part of the distribution landscape, with our research showing this to be a vital part of the video games industry; generating \$8.4 billion in 2022.



Private Network Benefits

The success of Microsoft's Gamepass and PlayStation's PS Now services are the most obvious, but many major games publishers are also providing subscription services as a way to access their content.

Like the video streaming platforms before them, we anticipate that subscription platforms will drive consolidation in the video games industry in 2022.

2022 will be a vital year for these platforms, as the world begins to open up again. The lockdown restrictions of the past two years enabled streaming platforms to grow, indeed thrive, but now that the worst of this is behind us and we are out living our lives again, retaining subscribers is proving a challenge and it is increasing competition amongst providers. The increasing cost of living in many countries only exacerbates matters. There is only so much disposable income per household after all.

As a result, publishers and other platform providers will be keen to make their offerings more compelling to retain subscribers in the face of increased competition, and for bigger publishers, acquisition of smaller developers making popular games is a quick and easy way to do this.

Microsoft has been particularly aggressive in this area, with the acquisition of Zenimax Media adding several titles to its Gamepass library, as well as offering compatibility with EA Play as part of the service. Other publishers will need to offer similarly broad services rapidly in order to compete successfully in this area.

The early winners in this market have been Microsoft and Sony, following this pattern. We do not expect other players to disrupt this to any great degree, because of the hardware and software integration available for the PlayStation and PC/Xbox ecosystems. Google Stadia had attempted something like this with its own content studios, but these have ceased operation. Because of this lock-in effect, many of the acquired companies will struggle to make an impact outside of these platforms, and that exclusivity will be the defining feature of many of the titles and companies acquired.

As a result, many of these platform subscriptions will ultimately be driven by 'tent-pole' game launches, and customers' loyalties will change to other platforms when different studios release key games through them. There will be exceptions to this when partnerships can be agreed, such as that between EA and Microsoft for EA Play access via Gamepass, but these will be very much the minority.



Game Studio Acquisitions by Microsoft, Sony, EA & Ubisoft

#8: Streaming Platforms to Capitalise on Rise of eSports

We believe that the COVID-19 pandemic heightened consumer awareness of eSports, enabling this form of digital entertainment to gain a cultural foothold. With national stay-at-home orders and government-enforced lockdowns in place within some countries, and official sports fixtures cancelled by professional leagues, eSports provided the entertainment offered by spectator sports, whilst also adding an additional interactive element.

This increase in content has boosted viewership and revenue for streaming platforms that host eSports events, making it a vital part of the platform providers' streaming businesses.

We believe that online streaming will remain the core means of eSports content consumption in 2022, with major platforms including Twitch and YouTube being used in conjunction with social media platforms, such as Twitter and Facebook, for additional promotion. We expect Facebook to have an advantage as this element increases, as it can integrate streaming and social media sharing, although its currently small market share will make this growth slow.

The establishment of these partnerships will increase exposure and revenue for eSports tournaments, benefitting both the broadcasting platforms and competitive gamers involved. In our eSports and Games Streaming research, we forecast that the global eSports and games streaming industry will be worth \$3.5 billion by 2025; rising from \$2.1 billion in 2021. This represents a growth of 70% over the next four years.

#7: Smart Grid Deployments to be Accelerated by Environmental Concerns

A smart grid is where analytics are used to make a utility grid more efficient and effective, reducing cost and energy usage.

A traditional grid generally involves large power plants, centralised networks, no real role for the end user and limited data to analyse. This is limiting, as it restricts the grid's ability to cope with new energy sources. The smart grid fundamentally changes this equation – it handles smaller-scale renewable generation, decentralises the grid, includes a more active role for end users in monitoring their energy usage, and offers the prospect of advanced data analytics.

Utility companies are currently in a precarious position. The wholesale cost of electricity and gas has been fluctuating wildly in many markets, particularly the UK, which has left utility providers very exposed and vulnerable to business failure.

Traditional Grids	Smart Grids
 Large Power Plants	 Smaller-scale, Renewable Generation
 Centralised Structures	 Decentralised Structures
 Passive User Role	 Active User Role
 Limited Data	 Advanced Data Analytics

Smart Grids vs Traditional Grids

Utility companies need to ensure that they can lower their costs, while providing a reliable service to end users. Smart metering has rolled out to a strong extent in many markets in Europe, North America & Asia, which can support innovation with smart grids.

Investments into these platforms will expand rapidly in the wake of the COP26 conference and the ongoing massive publicity around sustainability. Utility companies need to be seen to be doing their part, and smart grid is a concrete way in which they can achieve this.

Over the next year, we expect this trend to accelerate as pressures only intensify. However, this will require significant regulatory pressure to increase the rate of adoption – regulators have a very large role to play in how grids function, and different initiatives will be required in order to stimulate growth going forward.

We expect smart grid deployments to accelerate quickly in 2022, as utility companies seek to build networks fit for the fundamentally different, low-carbon future that we are faced with. This will be a major opportunity for smart grid vendors to win major multi-year projects for network transformation.

Our recent Smart Grid research found that once these initiatives are realised, we will see substantial energy savings, of up to over 1,000 terawatt hours in 2026.

#6: Edge Computing to Drive New Healthcare Applications

Edge computing is a form of distributed computing that enables computationally intensive tasks such as data analysis, to be undertaken not at a remote cloud storage facility, but at a location closer to the end user.

Edge computing can provide significant reductions in latency and lag when compared to cloud computing. This enables effective, efficient connections for use in cases where real-time delivery is a necessity – such as connected vehicles, industrial sensors, and more recently, healthcare.

We believe that 2022 is the year where the use of edge computing in healthcare settings will move from pilot tests and small-scale deployments to becoming a vital element of future healthcare delivery, particularly in three use cases: remote monitoring, connected ambulances, and surgical robotics.

These technologies generate significant quantities of data, which as we have discussed, can become disrupted or distorted; resulting in significant risk to patients.

The ultra-low latency afforded by edge computing, however, reduces this risk, improving workflows and enabling clinicians to focus on delivering the best possible patient care. Smart hospitals will be a major aspect of future healthcare delivery around the world, a market that our research indicates will grow from \$29 billion in 2021 to over \$59 billion by 2026.

Likewise, there are obvious benefits for consumers; besides benefitting from a better standard of care, edge computing enables consumers to engage with an emerging healthcare delivery model that prioritises proactive diagnosis: identifying, managing, and mitigating health conditions before they require serious medical intervention, as opposed to the reactive model used over the years that favours medical intervention only as and when it is required.

Deployment of edge computing within healthcare is likely to be restricted to developed regions for the time being, with deployments in developing regions occurring in the long term.

#5: Electric Vehicle Charging Network Interoperability to Improve EV Accessibility

In the last few years, the automotive industry has begun the process of a radical change, with electric vehicles beginning to become popular with end users. One major contributing factor here has been government incentives, such as grants to purchase electric vehicles, which have had a big role in increasing adoption.

We are now reaching a point in electric vehicle adoption where public charging must improve, or it will fail to meet the needs of the growing user base. The level of electric vehicles in service is becoming higher, and the barriers must break down between providers to correctly serve these vehicles.

There are also signs that interoperability is beginning to emerge. Tesla is already opening up its Supercharger network to the charging of third-party vehicles, with a pilot programme underway in the Netherlands right now. On top of this, we have begun to see the emergence of vehicle manufacturer-led charging networks, which are generally apps aggregating different charging points. One such example is Kia Charge, but there are several others. Accordingly, we expect rising interoperability to be matched by other large charging networks in 2022.

By offering apps and services that aggregate different charging networks, vehicle manufacturers will gain a greater role in the charging market, providing additional revenue to them and possible customer loyalty benefits. It also makes them more likely to be able to sell electric vehicles – current concerns around charging limit their prospects, whereas if manufacturers can ensure that there are much better charging options, they will reap benefits in terms of sales. Gaining more control will be of greater importance to manufacturers as the need to charge batteries at faster charging stations increases, as vehicle range increases.

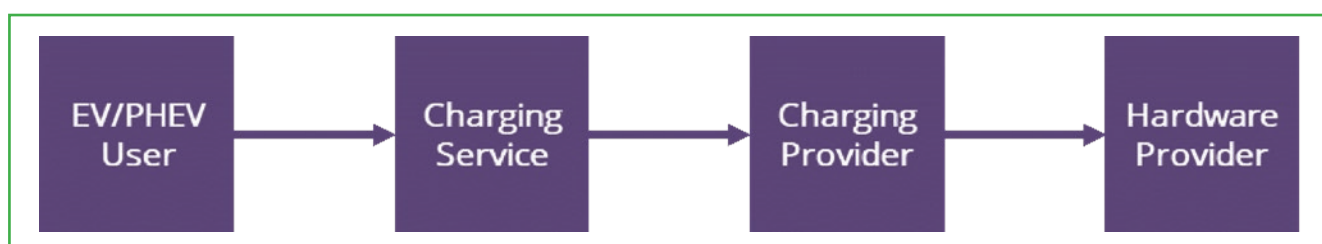
We also believe that, in resolving this, vehicle manufacturers will play a much bigger role in the market, which will fundamentally alter the charging network, and this will have many repercussions over the coming years.

#4: Flash Calling to Disrupt Operators' Business Messaging Revenue

Flash calling is a process which brands and enterprises can use to authenticate areas of client interactions.

Juniper Research defines flash calling as:

'An authentication process that leverages mobile voice networks to authenticate users or actions. A missed call is placed, with the incoming number acting as the one-time password which can be processed automatically.'



EV Charging Market Landscape



Best practices for identity authentication call for the use of two-factor authentication, which requires a mobile channel. Whilst SMS will remain the most popular channel for identity authentication during 2022, flash calling offers notable benefits above operator business messaging. Flash calling provides a level of simplicity that operator business messaging cannot match.

Flash calling does not require any further input from the user over the majority of devices, as the call is connected and immediately disconnected. In some instances, the user may require information from the phone number itself to input into a third-party platform. However, the A number, or the originating number, from the flash calling service provider is used as the authentication code, which can be done automatically over most smartphones.

Importantly, whilst a number of OTT application players have launched flash calling services, these applications suffer from a significant degree of regional fragmentation. As a result, larger brands and enterprises who operate on an international basis will continue to favour operator-led services, such as operator business messaging, in order to standardise the authentication procedure across countries.

#3: 5G & IoT to Drive Mobile Roaming Market Disruption

5G and the IoT are both set to disrupt the roaming market in 2022. This is due to the fact that 5G networks and roaming IoT connections will necessitate the entrance of new market stakeholders that are responsible for the rise in IoT roaming data.

We have seen similar processes happen for voice and SMS roaming. Voice roaming required massive infrastructure investment to enable co-operation between operators on an unprecedented scale. This investment would eventually lead to the roaming wholesale market.

SMS roaming was largely driven by the rise of the business messaging market in the 1990s. International termination for SMS was now required, and there was no regulation. This was a progression of the market and further operator co-operation was required.

Out of this market, roaming vendors emerged that provided services that could standardise the billing and payments processes between operators.

5G connectivity is increasing and IoT users are beginning to partner with a single operator for roaming connectivity. With the greater capabilities of 5G, we expect an increase in the number of 5G roaming connections, placing further strain on incumbent roaming vendors. There is an opportunity for new entrants to capitalise on this demand for better data roaming services.

We have already seen a number of acquisitions in the space, starting with Cisco's acquisition of Jasper a few years ago.

We expect roaming vendors who capitalise on the rise of roaming IoT connections will gain the additional revenue from IoT connectivity. Alongside this is a rise in the data, which will grow to 64.5 petabytes in 2022. One of the key drivers behind a rise in this figure is the obvious recent launch of 5G networks and the increase in 5G roaming connections.

As the number of devices available continues to grow, we expect a greater number of these to be permanently roaming, owing to novel roaming agreements.

Whilst the growth in the number of IoT devices represents a lucrative revenue opportunity for operators, there is the potential for issues to arise. With IoT devices capable of permanent roaming behaviour, operators must ensure that connected devices do not impact network capacity; signalling capabilities or processing power.

Using SA (standalone) 5G networks, operators will benefit from new insights that enable the identification and analysis of connected devices; allowing for enhanced network control.

It is important for operators to implement dedicated 5G roaming agreements that can handle this traffic. As the cost to carry IoT data across multiple operator networks increases, so will the demand from IoT users. Roaming vendors are not well prepared to deal with this at present. As a result, we are seeing more and more CSPs (Communication Service Providers) emerge to provide these data roaming services.

Due to the growth in the number of connected devices and sensors, it is important for operators to implement dedicated IoT roaming agreements in order to ensure the effective monetisation of device traffic.

We expect the transition of IoT devices to 5G networks will be gradual. Whilst only a limited number of IoT use cases require

roaming capabilities, these applications will require the level of service that can only be realised from 5G SA networks. The ability to support blended traffic, in terms of both 4G and 5G, will remain crucial in the current mixed roaming environment that includes both SA and NSA (Non-standalone) infrastructure.

#2: Supply Chains to Utilise Advanced Technologies to Increase Resilience

The impact of the COVID-19 pandemic has left many companies exposed to severe supply chain problems, in particular a lack of assessment of third-party vulnerabilities and security practices as the strains imposed by the pandemic have caused severe supply chain uncertainty.

This is particularly acute in the case of the semiconductor shortage, which has impacted many different industries, from white goods providers to automotive manufacturers. In addition, the increasingly digital nature of much of the supply chain, and its reliance on potentially insecure software, has come into sharp focus, particularly following the SolarWinds cyberattack, where vulnerabilities in a single software platform left tens of thousands of businesses open to attack by cybercriminals.

The ability to be vulnerable to cyberattacks because of a supplier's non-secure practices is a real risk for businesses, which many companies will move to remedy in 2022, following a large shift towards digital in all industries owing to COVID-19. The accelerated digitalisation of supply chains and this inherent complexity mean that 2022 will see companies reaching for security solutions to help manage these issues;

leveraging a number of technologies to increase the resilience of their supply chain, particularly the ability of third-party suppliers to withstand various operating stresses.

We expect that software supply chain cybersecurity will emerge as a prominent concern for many industries next year, beyond those that have been traditionally aware of such needs. This includes diverse industries from healthcare to food processing, all of which have suffered due to supply chain insecurities.

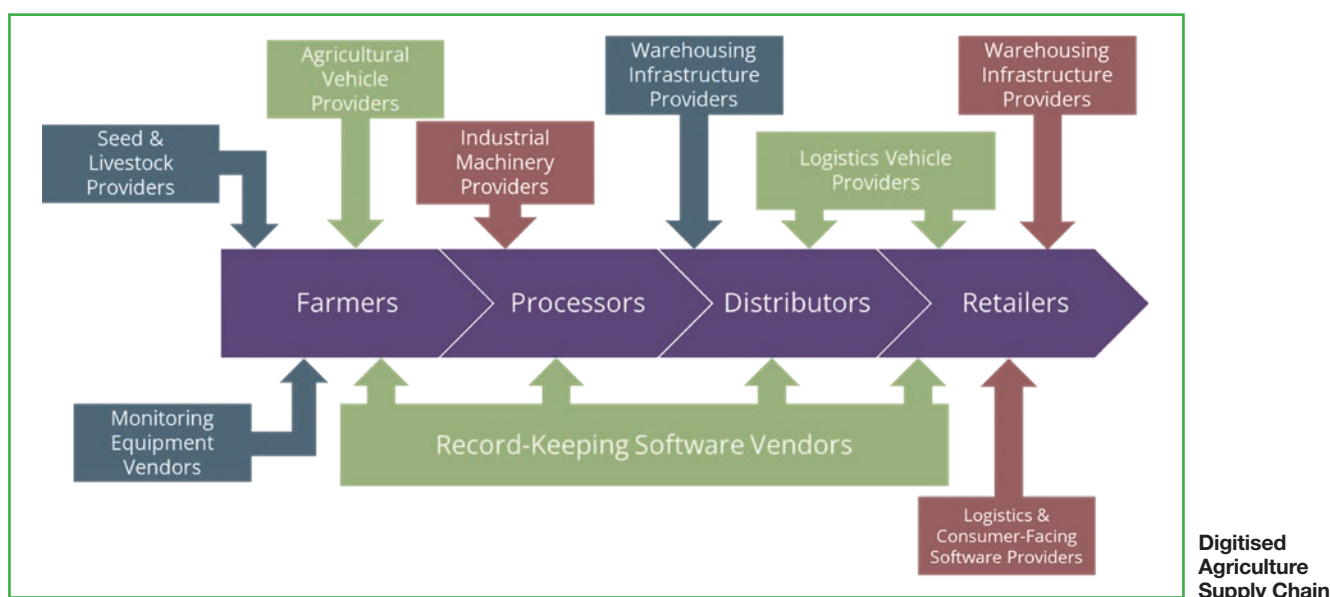
#1: Consumer Data Platforms to Increase Customer Satisfaction

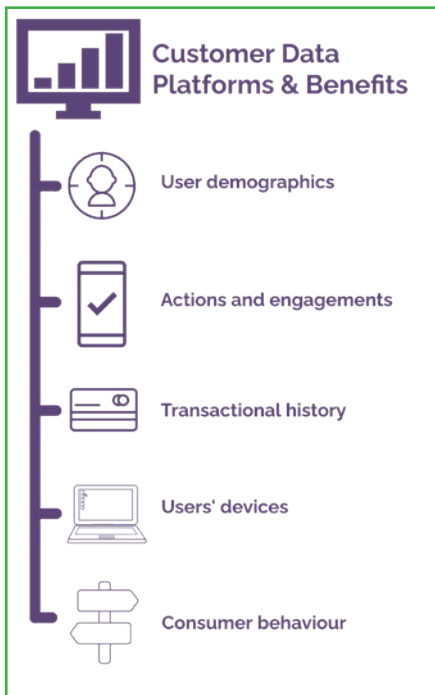
CDPs (Customer Data Platforms) are software that combine data from multiple sources to provide advanced insight into consumer preferences, typically in a messaging context.

These will enable brands and enterprises to deliver a better customer experience by collecting an increasing amount of relevant data on customer preferences which can then be passed to enterprises. They then benefit from the greater insight into their customers.

Regulatory adherence will be a key area of focus next year, as CDPs are increasingly used by communications platforms. We also expect consumers to become increasingly aware of the data being collected on them by third parties. CDPs will need to convince consumers that their data is safe.

Brands and enterprises will be the main beneficiaries of CDPs. The acquisition of customer data platforms will enhance a platform's ability to better understand end users. In turn this





CDP Benefits

creates a more valuable service for the platform with the aim of attracting the highest spending brands to their services. The companies realising the most benefits will be those closely aligned to advertising and marketing, which has similar approaches to this level of customer insight.

CDPs now must increase their value to the brand or enterprise, which will be done by providing the CDP with an increasing amount of data sources. However, supplying this data will raise privacy concerns.

At present, the majority of messaging that stand to benefit from CDP functionality are delivered by SMS. Our most recent CPaaS research estimates that SMS represents about 95% of the market's value. However, by 2026, our research predicts that SMS will only represent 70%. As rich media messaging becomes more integral to mobile communications, the value of these CDPs will increase, as brands and enterprises can do more with native messaging clients.



For more information, see www.juniperresearch.com



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