



Policy's 5G Edge

The enhanced role of policy control
for 5G – and its role in resurgent 4G



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Introduction

The reinvention of telecoms is underway. Digital transformation, 5G roll-outs and getting ready for Stand Alone 5G are having a major impact on service providers. This is especially true in IT and network software, as these functions evolve from being 'back office' functions to becoming front and center enablers for service providers' evolution and change.

In this paper we explore the importance of policy control in 5G and how it will play an increasingly important role in the management and monetization of 5G offers and networks.



The Expanded Role of Policy in 5G: The "Brains of the Operation"

5G's expanded ecosystem and expectations

As has been well described elsewhere, 5G is not a mere extension of 4G. It is a new ecosystem providing a rich set of capabilities to ignite new services. Many of these services are yet to be imagined but will be based on the enormous expansion of possibilities that 5G allows, especially in terms of latency, speed, coverage, capacity and density.

This expanded set of capabilities requires a much more nuanced control of resources – even though 5G is much more cloud-based. Due to its much greater potential, 5G requires much more granular visibility and control due to the enormous diversity of oncoming services. This more powerful control down to a user application and access level is needed in order to meet and exceed more demanding 5G expectations as well as balance of commercial diversification and social benefits to which service providers aspire (Figure 1).

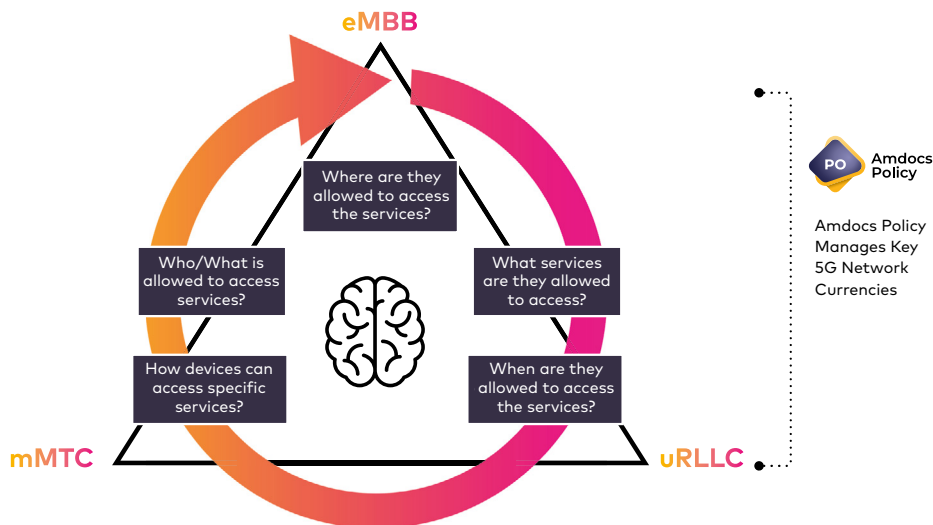


Figure 1: Critical Role of Policy for 5G

The "brain" of 5G: Policy rebuilt for an expanded 5G ecosystem

Policy already had to respond to much higher expectations as a key function within 4G networks. Ahead of 5G, service providers were looking to diversify their businesses in areas such as IoT, media partnerships and enterprise enablement. Now, with the extended 5G capabilities mentioned above, the options for diversity of service offerings are much more expansive. No wonder then that policy (or the Policy Control Function i.e. PCF) in 5G is increasingly being described as the "Brain of 5G". It has moved way beyond "just" being the quality-of-service (QoS) and quota management function of a 3G/4G network to being more akin to a highly trained or even automated air-traffic controller. That controller now has to handle a much wider range, as well as a higher volume of traffic types.

As well as increased and diverse demand on it as a function, policy has had to respond to expectations of how it would deploy in 5G as compared to 4G. It would have to be more open than ever with standardized REST interfaces towards other functions. It would have to be built by leveraging the most flexible, open-source microservices-based tools available and it would have to be hybrid (public or private) as well as multi-cloud-provider compatible. It would have to be extremely user-friendly for service provider teams and would be required to consign organizational divisions between network and IT teams to history. All of these demanding requirements have made policy a cornerstone of 5G roll-out. It puts policy center-stage when it comes to business-led decisions for service providers.

Self-service expectations and the continued rise of "on demand"

We are in an 'on-demand' digital economy where customers expect everything just to work, and in real-time. If customers are on one subscription bundle and they need to switch, in real time, to another then they are certainly less forgiving of service providers that do not allow them to do so. The boundaries between prepaid and postpaid are subtly breaking down in favor of more customer-oriented offerings such as "pay less now or pay later". The term "subscription bundle" has increasingly been replaced with "whatever you need, whenever you need it". The origins for this may have been in the webscale over-the-top (OTT) providers but users expect it to apply everywhere. The expansion of service expectations can only be expected to accelerate (Figure 2).

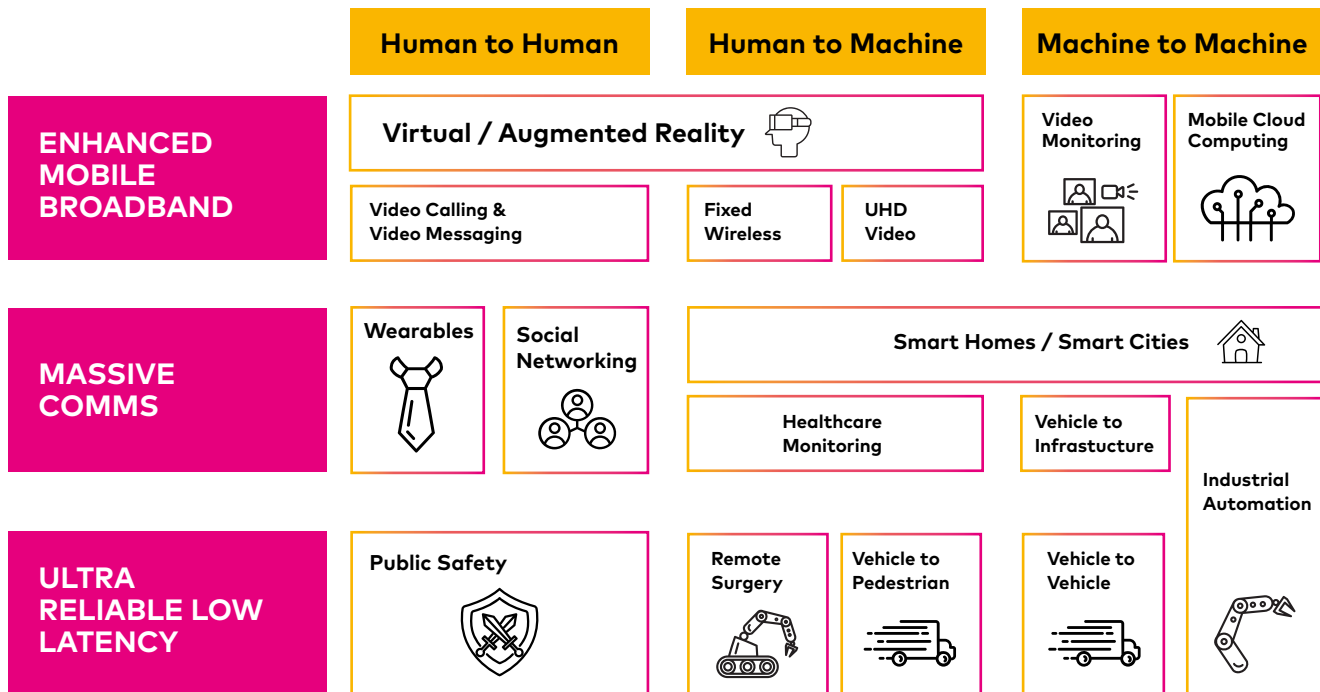


Figure 2: Service Expansion with 5G

The Key Role of Policy as Anchor for Adjacent Functions

5G's momentum

5G is well past the proof-of-concept stage in many networks and is already showing some strong revenue improvement for early services such as fixed wireless access (FWA) and some standard 5G-enabled smartphone packages. As 5G moves beyond Release 16 and on to Release 17, the early promises of 5G will rapidly come with certainty attached. The variety of ultra-reliable low latency (uRLLC) and massive IoT (mIoT) in addition to enhanced mobile broadband (eMBB) as well as combinational services will be unencumbered by standards requirements (Figure 3).

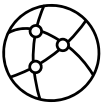




		5G RELEASE 16	5G RELEASE 17
5G RELEASE 15 Enhanced Mobile Broadband 	Industrial IoT 	<ul style="list-style-type: none"> • Ultra-reliable Low Latency • Private Networks • Time Sensitive Networking • NR in Unlicensed Spectrum 	<ul style="list-style-type: none"> • Time-sensitive Communication (TSC) • "NR-Light" for Industrial IoT • Neutral Host • High-accuracy Positioning
	Other Verticals 	<ul style="list-style-type: none"> • Vehicular Communication • Cellular V2X 	<ul style="list-style-type: none"> • Sidelink Enhancement for Public • Safety and Pedestrians
	Network Deployment & Automation 	<ul style="list-style-type: none"> • Network Slicing & Automation (Phase 2) • Wireless-wireline Convergence • Full 5G System Resilience • Integrated Access & Backhaul 	<ul style="list-style-type: none"> • Multi-cast • Railway (Application Layer) • Non-terrestrial Networks • (Satellite & HAPS)
	Device Enhancement 	<ul style="list-style-type: none"> • Device Power Savings • Mobility Enhancement • Enhanced MIMO 	<ul style="list-style-type: none"> • Further Device Power-saving • Further Enhanced MIMO • Multiple USMs • Cloud Gaming QoS • "NR-Light" for Consumer IoT

Figure 3: 5G Release & Service Evolution

Self-service expectations and the continued rise of "on demand"

Policy, albeit in an early form, existed in 3G/4G mainly as a service-enabler attaching and controlling quality of service (QoS) and quota to already defined services. With 5G it advanced dramatically as a focal-point for diverse service definition across a massively diverse service landscape. 5G moves policy to a new position of potential such that new functions depend on policy (PCF) maturity for their success. This includes new, policy-adjacent functions such as the Network Exposure Function (NEF) as well as Network Data Analytics Function (NWDAF) and of course the significantly evolved Charging Function (CHF). These functions hold incredible potential in their own rights but have commonality in that they depend on the early success of the 5G "brain" i.e. policy, in order to build success upon.

Many new 5G services and business models will involve service providers partnering with companies. Making the 5G network available to their partners, via NEF, allows opening up of the new 5G currencies defined and controlled by policy – especially: latency, speed, coverage, capacity and density. This can make available an explosive amount of new value for service providers as well as via partners, and allow entry into new verticals with specialist offers. These offers can be led either by the partners or service provider. After all, many service providers will admit that they are not specialists in say content or drone strategy.

This opens new opportunities for service providers and their new partners, as it provides both parties with new routes to market, which they can manage by applying (and monetizing) the newly available network currencies such as quality of service guarantees or reliable latencies, or even full network slice access. This in turn will drive significant customer offerings that were never previously available. Policy becomes both a supplier to these other functions as well as a consumer. So, for example, a drone may need additional bandwidth certainty (allowed by policy), but in turn may provide local network condition information back to policy so that it can optimize network traffic for other service applications. Much more diversified monetary value will certainly follow for such evolved service providers. A large proportion of it will be derived from advanced 5G network features and managed via policy control (Figure 4).

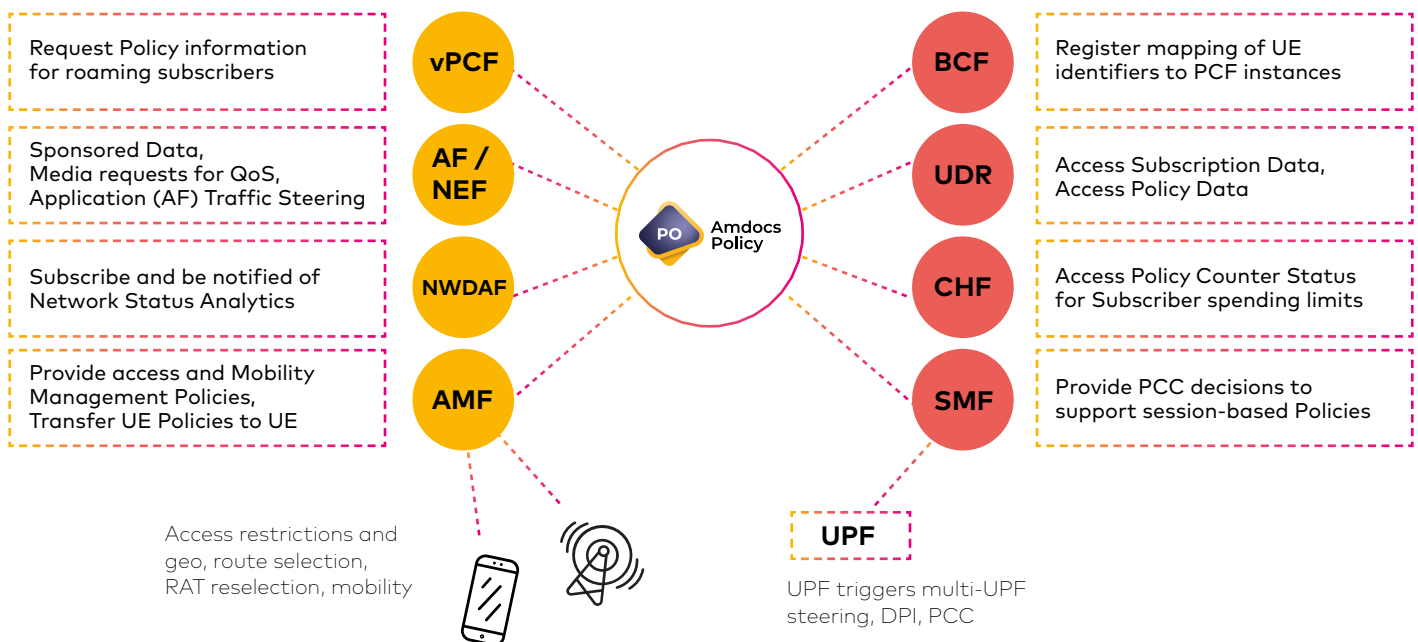


Figure 4: Policy's Central Role in 5G (The "Network Brain")

Policy's Key Role in Use Case Diversity and Strategic Choices

Consumer vs Enterprise debates; Pandemic acceleration and the role of Government

Prior to advances with 5G, many service providers suffered flattening revenue or worse for some time. Occasionally, new devices such as connected smart watches would provide some respite. Some service diversification such as forays into home security or banking would provide further opportunities albeit with many months if not years of planning. Meanwhile, enterprises constantly felt under-served and over-charged. Small and medium enterprise (SME) personnel often simply got treated as consumers and larger organisations were treated as being too costly to serve – because they often were. Consumer segments often led the way for many years and provided the lion's share of revenue. That was further fuelled by innovations in the form of over-the-top (OTT) services with rapid consumer uptake. Enterprises often followed with "enterprise grade" social media or video or whatever. But they followed.

Meanwhile, pandemic events of 2020-21 have placed requirements and spotlights on certain aspects of government resources as never before, especially in areas such as healthcare, education and transport. These government or semi-state segments are more certain of wanting to try aspects of 5G that could have taken them several more years.

It's no longer "either / or" when it comes to consumer 5G vs enterprise 5G

Many elements are now in play such that the enterprise market especially is likely to expand dramatically in a 5G context. The promised network slicing is maturing to the point of availability to mid-sized companies with usability and "out of the box" features that make it instantly understandable.

For many, the network features of 5G described above (especially latency, speed, coverage, capacity and density) mean that it will be of far more interest to enterprise and perhaps government segments than to consumers. That consensus is usually built upon the quality of 4G being "sufficient" or "more than most consumers need right now". It may hold true for many consumers right now but in the history of telecoms "good enough" is rarely good enough for consumers for very long. Ask any serious gamer if their 4G latency or mobile bandwidth is good enough and they'll almost certainly advise they don't rely on 4G but prefer proximity to fixed lines and fibre especially. The rapidly growing and multi-billion dollar gaming industry still remains relatively untapped by – especially mobile – service providers.

So this is not an "either / or" choice between consumer and enterprise markets. It is a new era of opportunities for service providers to define and control based on newly available resources or "currencies". The range of capability within the 5G network is such that multi-feature offerings can rapidly be made to a wide variety of segments. Launch times can be reduced to days, hours or even minutes with devices working out of the box. Service providers may of course have brands with either a consumer or enterprise segment focus – but they no longer have to be so focussed as network flexibility will allow them to cater for all segments.

Device Impetus

Further adding to the momentum around 5G is the increased speed and diversity of devices relative to the rollout of 4G. With the concentration of 4G having been so focussed on smartphones, this really adds a new dimension to 5G. As the smartphone has matured, resulting replacement cycles have lengthened. Device manufacturers have broadened their form-factor portfolios for 5G and will continue to do so. This means that more and more devices from smart speakers to smart meters to cars and traffic lights will simply have 5G "baked in" as they arrive to market. The inclusion of e-SIMs will make rollout faster still. All of these devices will need to be acknowledged and controlled by the network as they are unwrapped.

Partnership like never before

This expanded set of "currencies" from the network and expanded segmentation as well as network exposure means a massively expanded range of opportunities for many service providers. For most, this will mean that going it alone will no longer be an option. If partnership was a challenge as well as an opportunity previously, that universe is set to expand at an increasing pace.

By definition, service diversification will mean one of two things. Either service providers will move into hitherto existing but unaddressed markets (think again of home security or banking). Or they will move into markets yet to be fully defined or formed (such as the much vaunted vehicle-to-vehicle communications market). This latter form of innovation especially will often involve partnership and potentially partner access directly to service provider network resources as part of a larger offering. Service chains may need to form spontaneously. In terms of resource access, policy as well as the aforementioned NEF will play key roles in terms of network currency access and exposure.

Slicing – for consumers as well as enterprises; SLA guarantees

The great opportunity for service providers is in the extreme flexibility that 5G will make available. By definition this wide-ranging service capability will involve a variety and possible intensity of customer relationships and partnerships that many service providers could not have considered technically or strategically until now. But as mentioned above, new policy-supported functions such as NEF ensure that partnerships can be spontaneous, scale infinitely and be dramatically automated relative to previous forms of partnership. 5G is cloud-based by design and much more securely open via web-style REST-ful interfaces than previous generations of networks could have anticipated.

These partners can spontaneously access the grade of slice they need. Whether it's enhanced mobile broadband (eMBB), massive IoT (MIOT) or ultra-reliable low latency (uRLLC) slices or combinations of features within them, they can be self-accessed and defined with service-level agreements (SLAs) packaged as part of an offer. As can be seen in Figure 5 service providers (and their partners) can use policy to easily set and manage different characteristics (QoS, UpLink, DownLink, Latency, etc) for different slices to ensure the right network experience is delivered for the right service. Customers and partners expect to simply access what they need, when they need it from preferred service providers. App-store expectations will apply to enterprises as well as consumers.

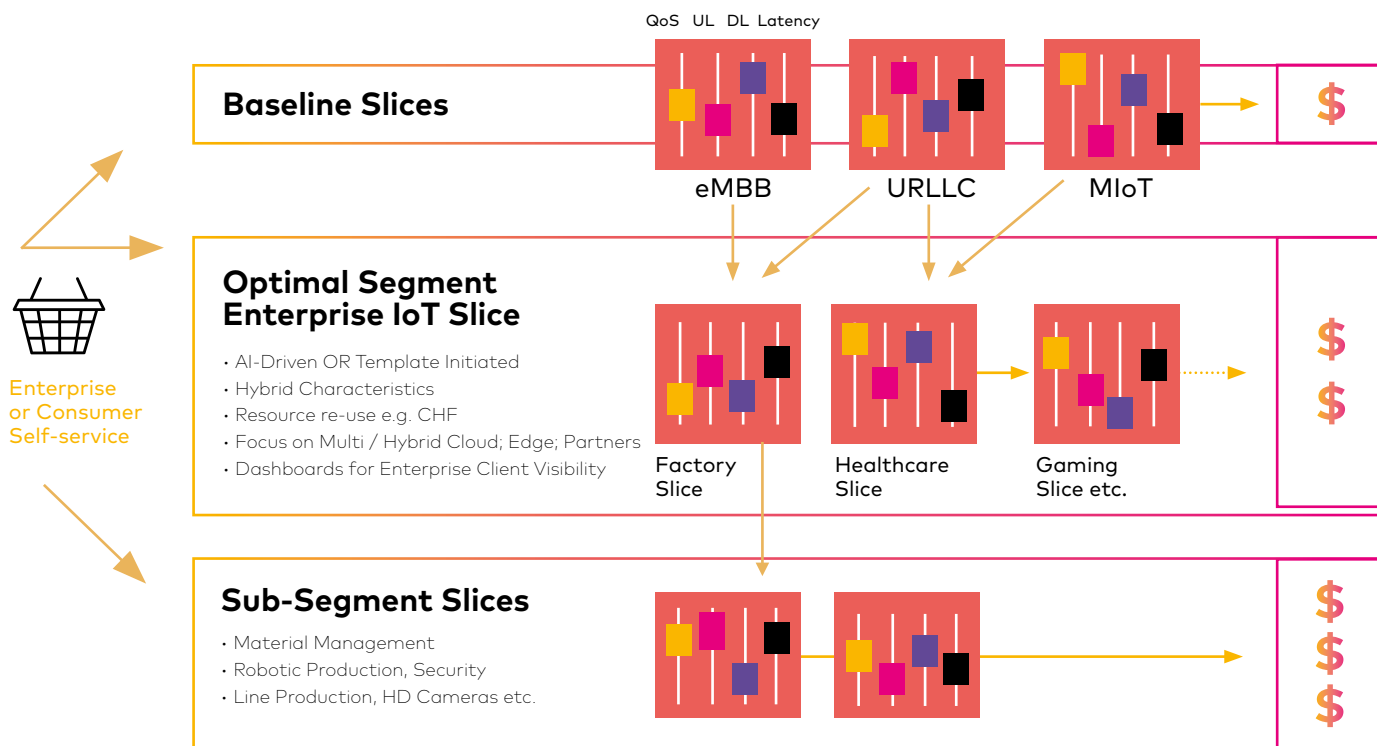


Figure 5: Slice Creation, Templating and Self-Service

To infinity and beyond: Moving from dozens of bundles to 1000's of discrete services and on to infinity

This implies a dramatic shift in differentiated "bundle" types to the point of the much talked-about but seldom supported "segment of one" that became fashionable to mention during the growth of 4G. In reality, the data management involved in allowing self-service, real-time adjustment and bundle add-ons simply became unrealistic for service providers. "Service choice" became another expression for "overheads and costs". Various service providers went through cycles of reducing the number of services offered. But in a more flexible yet controllable, data-assured 5G environment the ability to cater for an almost infinite variety of tastes becomes much more realistic. Adding new services or upgrading or eventually scaling back on some services no longer result in downtime since vital tools such as policy control are microservices and are cloud-based.

Policy at the Edge; Strategic Cloud Partnerships and Policy's Edge Roles

Policy deployment at the edge and for slicing; policy as a foundation stone of 5G Standalone (SA)

Policy's enhanced role in 5G is of course much derived from its more flexible deployability at the edge in partnership with cloud providers. These providers (especially Amazon, Microsoft and Google) are playing increasing roles in the activation of edge use cases. The benefits of edge in terms of low latency as well as security have only started to manifest – especially for such uRLLC use cases as AR/VR/xR, robotics and machinery control. As more and more beneficial use cases come to the fore, the value will become increasingly easy to describe and monetize.

Some partnerships will be relatively complex to begin with. For example, vehicle manufacturer partnerships with cloud providers as well as telco service providers have potential to enable much safer as well as richer passenger experiences. One such example is the partnership between Vodafone and Ford and in turn the partnership between Ford and Google. Key to the value in such partnerships may well turn out to be the service provider's control (via policy) in its network and the ability to automatically allocate resources, in a pre-defined way as needed by the device (in this case the vehicle) or enduser. Some allocations of resources may even be in the background. So for example, the vehicle may need to "talk" to other vehicles to avoid collisions or to upload performance data at night time while parked in the garage. Many will require the benefits of 5G to be defined and controlled by policy. What is clear is that service providers are potentially uniquely positioned in such value chains. Their network assets at the edge can also fuel additional value and partnerships such as real-time advertising and dynamic up-selling such as VR gaming or other entertainment.

Hybrid and multi-cloud flexibility to release new service value more easily

To be most valuable for a service provider, policy needs to be deployable in a variety of ways to cater for such large enterprise partners as auto-manufacturers. In some cases, deployment in a private telco cloud may not be sufficient for specific edge use cases. It needs to be flexible enough to deploy at local cloud outposts or in a hybrid of both central and local cloud. It will need to be deployable in a range of cloud provider assets with multicloud flexibility to cater for various large enterprise preferences (Figure 6).

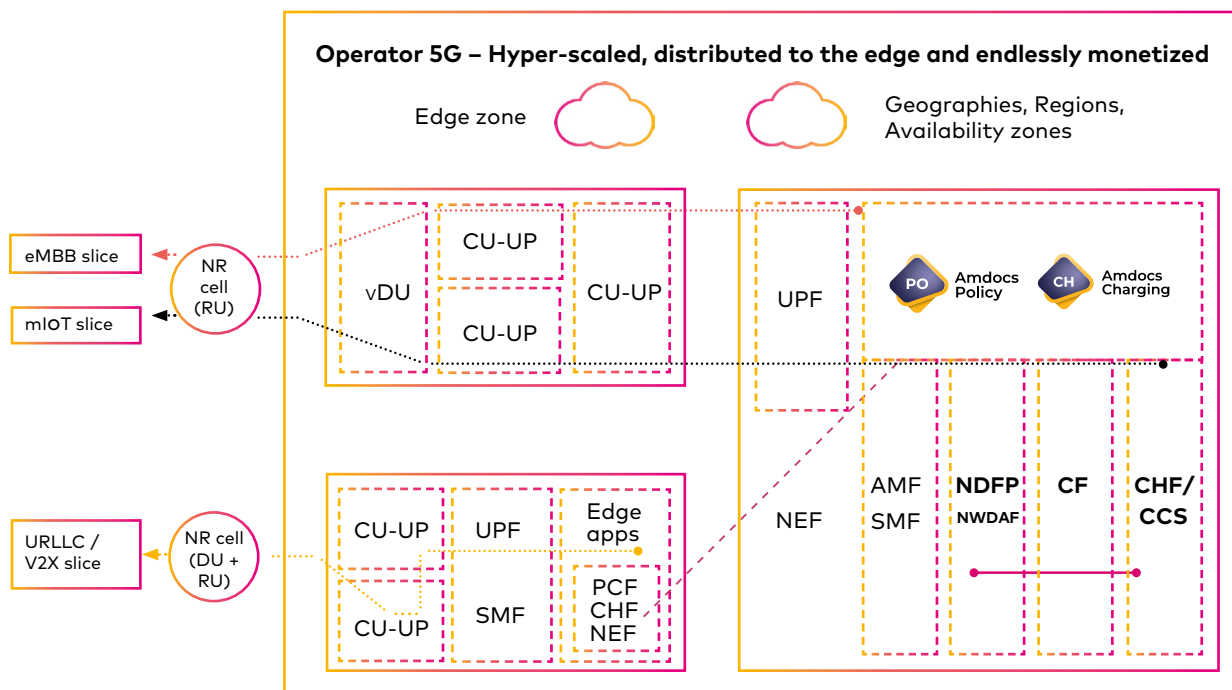


Figure 6: Central / Edge Deployment Flexibility

This multi-cloud and ultra-flexible policy is now, more than ever, a "provider" to other telco (especially IT) systems as the increasingly diverse "currencies" from the 5G edge orientated network need to be managed and monetized by the IT side of the service provider. Customer care teams are already much more easily defining and monetizing such currencies more or less on the fly as required by end-users, enterprises and IoT devices. Policy at this level becomes a key focal-point for network monetization. It has itself become distributed precisely so that it can better serve a key role in service definition, differentiation and control across the increasingly distributed service provider's network. The IT side of the service provider in turn needs to combine more seamlessly with this distributed complexity. Policy serves IT more than ever to enable as a continuous network and IT "value plane" that is often under-valued in many, especially more traditional service providers.

Serve and Protect: The Hyper-flexible Engagement of Enterprises and Consumers

Looking outwardly at the competitive environment, such "hyper-flexibility" as newly available but backwards-compatible 5G policy can provide is also an added insurance against the threat of new and competitive entrants. Since it forms a key role in new 5G service creation, network exposure, service chaining and SLA management it can reduce the likelihood that new service providers or virtual providers (MVNOs) can provide defensible value in an existing marketplace.

Policy can jump-start a service provider in its key role of tight service slice definition and edge control whilst reducing the need for enterprise customers to build their own end-to-end networks. It plays an essential part in a more flexible multi-tenant, yet controllable network. As service quality and variety expectations rise amongst enterprise as well as consumer segments, it forms a centerpiece in the armory for service providers with ambitions to more fully service a wider range of segments and market-makers that are now more serviceable with 5G (Figure 7). This extends to include a new array of advancing partners such as satellite providers that see their time has come for extending geographic coverage as well as competing with traditional service providers. At the heart of this serviceability and flexibility control is a new generation of policy.

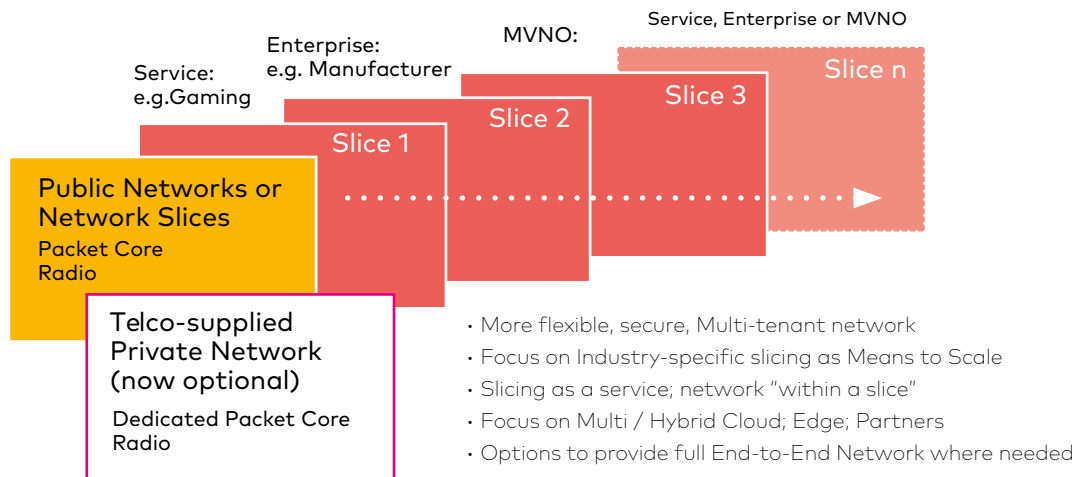


Figure 7: 5G's Flexibility in Multi-Tenant Enterprise & Partner Delivery

4G Resurgence: Consolidated Policy as Enabler for Both 4G and 5G

New approaches and backwards compatibility of 5G technology are also benefiting 4G services

We are already past the beginnings of 5G. Various elements are now converging including: necessary 5G functions, devices, spectrum and even coverage – especially in urban locations. This is great news for workforces, gamers and enterprises.

5G has often been talked about in terms of benefit to 4G – by freeing up huge capacity at peak periods. But 5G generally and policy in particular as a key 5G function are already providing some less-talked-about benefits back to 4G in terms of tools and best practices with resulting value for advancing service providers. Key enablers of 5G policy are providing wider advantages.

Microservices

Portability and updatability benefits of 5G functions built as microservices have been talked about in a 5G context for quite some time. But what about the application of such benefits to 4G? Of course amongst these microservices are “conversion” microservices such as Amdocs’ own 4G to 5G “data bridge” microservice. But what if 4G could more generally enjoy the benefits of microservices advantages? This is music to the ears of service providers’ accountants who are already enjoying the benefits of scale and licensing models from microservices for 5G policy. Microservices better suit flexible business i.e. revenue requirements of service providers in a digital age.

Cloud and open-source

It seemed that, amongst other things, 2020-2021 saw a huge surge in public-, hybrid-, and multi-cloud deployment discussions and decisions. Many of these decisions were driven by 5G. But these decisions also have implications for older 3G and 4G equipment. What if the scaling benefits of cloud (down as well as up), already being enjoyed by 5G policy deployments, could also be applied retrospectively to 3G/4G assets? What if all existing hardware, even commoditised 3G/4G hardware on premises, was no longer needed and could also be more efficiently managed via the cloud? These drivers are why some service providers are re-factoring 4G PCRF (policy control) functionality for cloud deployment in addition to being microservice-based.

DevOps

Perhaps DevOps is the secret sauce for true differentiation from which even smaller, more flexible, service providers can gain advantage. 4G missed out on it pretty much but it has been maturing nicely in a more complex 5G environment. Now that it has been proven with 5G-oriented DevOps teams interfacing effectively with the best vendors in this space – those teams can also turn their attention to 4G. After all, best practice is best practice. Whether that applies to 5G or 4G or 3G it doesn't matter, as long as it is applicable.

All of this has implications for the service provider organization more generally. Rather than building a new 5G stack and skill base that somehow sits in parallel to the rest of the 3G/4G organization – with resulting overheads, the “new” organization becomes “the” organization. It provides benefits to end-user services also. Services are not seen as “3G/4G services” as opposed to “5G services” that need to battle for internal resources. Instead, the user is put at center stage along with service continuity regardless of the “G”. Early policy deployments are anchoring this synergy (Figure 8). End-users will rejoice as well as accountants.

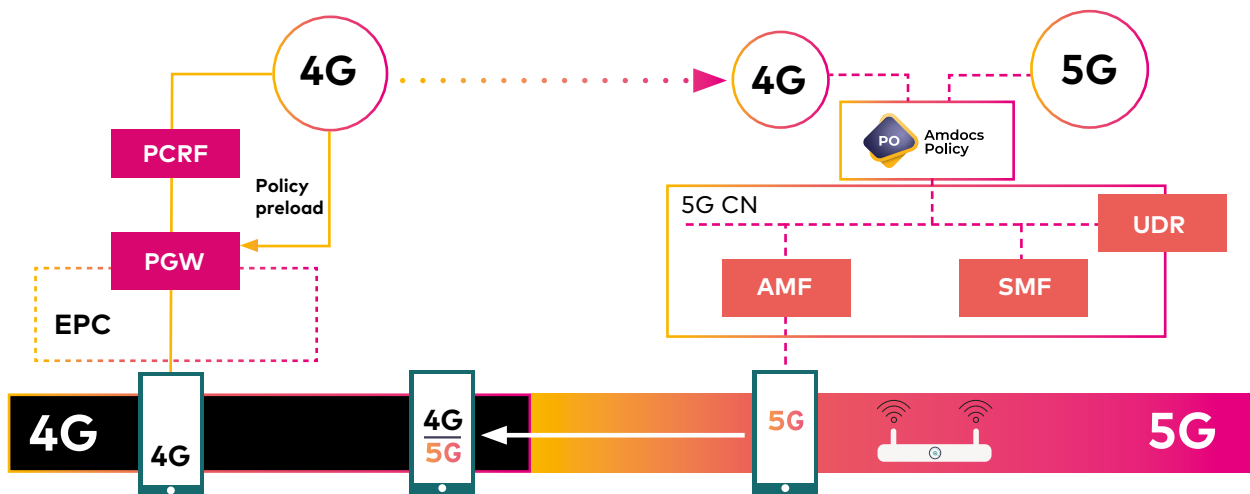


Figure 8: 4G Bridging and Consolidation; Anchoring Role of Amdocs Policy

Multiply & Monetize: Adding Data and Evolved Charging

Automating network analytics in real-time to deliver intent-based networking

One of the key promises of 5G was that it – or rather the various new functions – would themselves become smarter via the amount of data they would produce. That data in turn would allow those functions and adjacent functions to behave smarter still. Collectively it (5G) would behave in a more intelligent and automated way with machine-learning built in. The efficiencies as well as data volumes would be enormous and self-perpetuating. Key to this will be the Network Data Analytics Function (NWDAF) which has considerable impact on the 5G business as the continuous tuning, anticipation and optimization of resources influence not only end user experience, but also the entire total cost of ownership of the 5G network.

As a key function NWDAF will manage and automate an enormous amount of 5G data. It will establish hitherto unthought-of patterns of service opportunity that are in turn defined and controlled by policy.

This vision is still taking hold for many service providers but with key 5G functions deployed and large sums spent on spectrum, service providers are starting to see efficient application of data in innovative ways already. It is especially critical during the complicated but inevitable combined use of 4G as well as 5G which can be expected for most service providers for some time. Real-time use of data, the bridging of 4G and 5G and migration towards 5G with smart policy controls may be the key battleground for leading-edge service providers during what is likely to be a multi-year phase. Smartly combined however, these assets as well as the network efficiencies and improved user experiences in the context of massive service diversity offer bedrocks for 5G effectiveness.

Once these key 5G building blocks are in place the further 5G objective of intent-based networking is within reach (Figure 9). Additional features including auto-scaling, machine-learning and closed loop or zero-touch network adjustments are already being tested by advanced service providers and demand for specific 5G services will drive them further. Policy can be a key focal point.

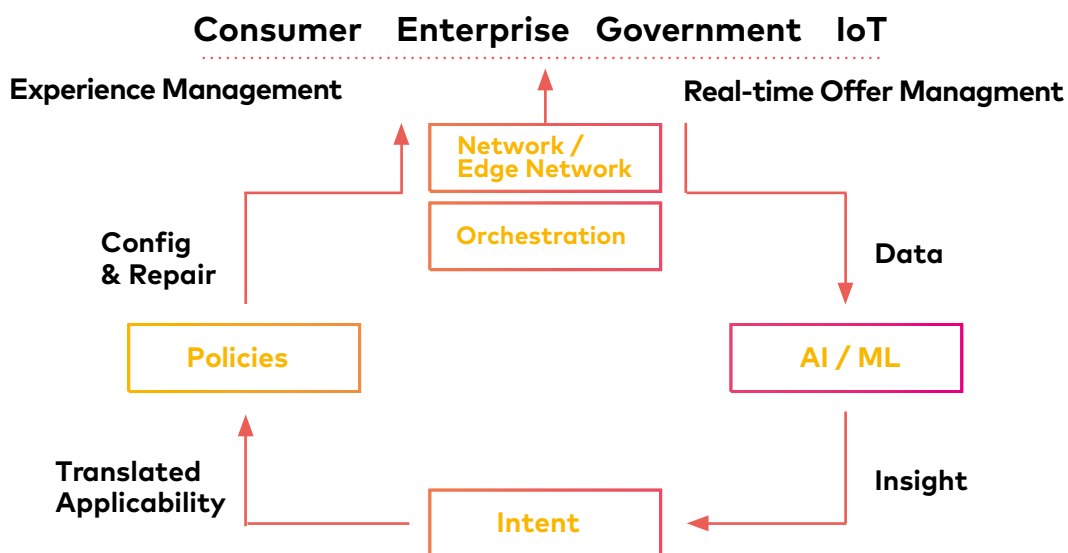


Figure 9: Automated & Intent-Based Policy

Monetization: capturing the moveable feast

All of this control and diversity points to a future that was unimagined until recently but is in touching distance for advanced service providers already. It moves way beyond “unlimited data” that has often been resorted to in the past. As the 5G opportunity expands with the foundations in place, the challenge for many service providers is how to innovatively monetize their newly tradable currencies that 5G enables and 5G policy controls. As the web-scale providers have often successfully explored over the past decade or longer, service diversity and scale can be monetized in a multitude of innovative ways – but they must be monetized at some relatively early point. Customers are however very open-minded to new forms of commercial relationships.

For this reason, the control function (policy) should be tightly coupled to an ultra-flexible, consolidated charging capability that allows real-time experimentation and encompasses commercial models to suit a spectrum of newly forming offerings (Figure 10). In combination, this policy plus charging (or PCC) forms an even more powerful “single source of truth” for service providers. It already provides microservice synergies across both (policy and charging) functions. Services will be increasingly SLA-driven. This is especially likely for enterprise-grade services but also for discerning consumers such as gamers or home-office users. 5G holds both promise and risk for advancing service providers. Control has never been more important.

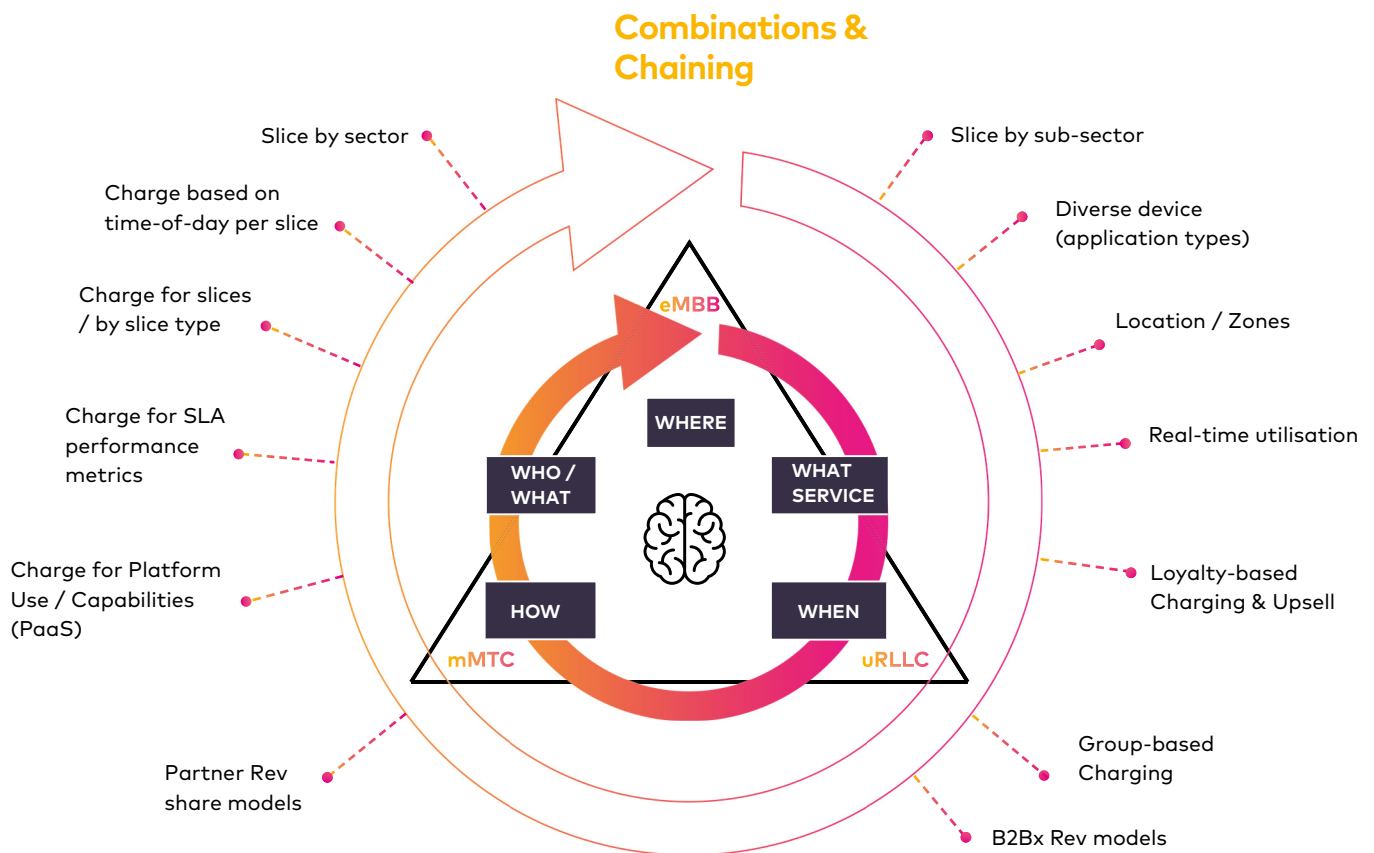


Figure 10: Policy & Charging Combined (PCC) to realise newly tradable 5G features (Sample Additional Charging Models)



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