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Achieving Success with Intent-Driven Next-Generation Networks

Laying the Right Foundations Today for an Intent-Driven Tomorrow

RESEARCH BRIEF

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RESEARCH BRIEF

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Laying the Right Foundations Today for an Intent-Driven Tomorrow

Introduction and Background

Recent global events have shone a spotlight on the importance of communication networks. Consumers and corporations in both developed and developing countries have realized their dependence on the telecommunications infrastructure for business, education, entertainment, healthcare, government services, and social communications. Nearly every aspect of everyone's business and consumer lives will be connected in the next decade.

To enable this anytime, anywhere communication, communication service providers (CSPs) and infrastructure providers worldwide are stepping up investment in wireline, wireless, and satellite infrastructure. Public and private infrastructure investment is funding the installation and upgrade of national and regional fiber footprints, laying of subsea cables, upgrading of mobile networks to 5G, and even the launching of satellites into space.

CSPs urgently need to increase scalability, improve manageability, and maintain reliability and quality-of-service (QoS) while controlling CapEx and OpEx. With the expected two to three orders of magnitude increase in connected devices (~30B networked devices by the end of 2023[1]) and the concurrent growth in management complexity, CSPs must transform today's siloed, legacy networks into modern, autonomous end-to-end systems covering the access, transport, core, and data center domains to meet new expectations and demands.

This research brief examines why an intent-driven approach is vital to CSP success. Even as standards bodies, vendors, research organizations, and hyperscalers evolve towards intent-driven networking, CSPs must lay the foundations today by making informed and strategic investments across network and cloud automation, end-to-end orchestration and assurance, cross-domain inventory, data analytics, and artificial intelligence and machine learning (AI/ML) initiatives. The brief will additionally highlight how recent developments on the network analytics front, particularly in 5G, can facilitate multi-vendor intent-driven networking.

Why Intent and Why Now?

Much of the focus today is on 5G networks. While wireless and wired connectivity are both growing, the new service-based architecture (SBA) of 5G, its cloud-native focus, and the promise of private 5G have captured CSPs' imaginations and hopes. CSPs aspire to build 5G networks that are cloud-based, virtualized, disaggregated, open, distributed, and massively scaled across core, transport, and radio access network (RAN). The wired network, to a lesser extent and under a smaller spotlight, is undergoing the same transformation.

CSPs aspire to build 5G networks that are cloud-based, virtualized, disaggregated, open, distributed, and massively scaled.

The combination of growth in demand, corresponding network build-out, and the modernization of network platform architecture is driving up the deployment and management complexity of these next-generation networks (NGNs). Hundreds to

[1] Cisco Annual Internet Report 2018-2023 https://www.cisco.com/c/en/us/solutions/collateral/executive-perspectives/annual-internet-report/white-paper-c11-741490.html

thousands of managed network elements will balloon to tens and hundreds of thousands, to millions of disaggregated components at the hardware, virtualization, and network function layers. The simultaneous move to a software-defined framework, while allowing for increased agility and innovation, explodes the number of configurable parameters for these networks.

A human-driven approach to network management cannot scale to meet the needs of these NGNs. Even humans augmented with network automation cannot react in time to handle real-time reconfiguration upon failure or perform near-real-time optimization of parts of the network in response to demand spikes and other external events.

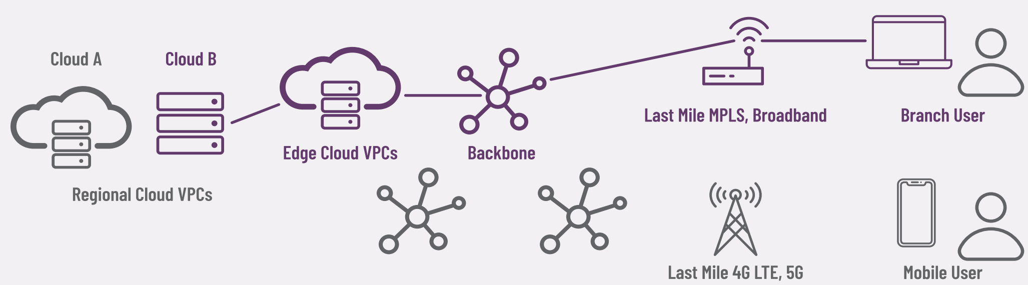
An intent-driven system is much better at managing, optimizing, and maintaining large-scale and complex NGNs. On the technology supply side, recent advances in data management, analytics, software-defined architecture, and AI/ML allow building of increasingly sophisticated and intelligent intent systems. The combination of market need with technology advancement has sparked and fueled interest and investment in building intent-driven networks.

What is Intent?

When discussing intent, we say that intent describes the "what" that should be achieved, not "how" that goal should be achieved. Networking vendors today liken intent-driven networking to self-driving vehicles. Instead of taking explicit actions of turning the steering wheel, operating the accelerator, and applying the brakes to get from point A to point B, we simply tell the AI/ML-enabled autonomous vehicle to get to point B. We can specify other constraints, like the avoidance of toll roads, and what to optimize for: shortest time, shortest distance, or smoothest ride. The expression of intent: "get me to point B, avoid toll roads, and optimize for the shortest time" is a declarative approach, as opposed to taking imperative actions like turning left and right or pressing the accelerator.

To understand how intent could apply in the networking domain, and delineate between intent/non-intent approaches, we provide the example of an enterprise network consisting of multiple user locations and virtual private clouds (VPCs) in a public cloud.

INTENT EXAMPLE - ENTERPRISE SD-WAN, CLOUD VPC



What is Not Intent?

Imperative – explicit instructions with detailed steps for every system

For server A in VPC B hosting application C, assign an external IP address D.

Create an overlay VPN from D to branch Y at IP address E.

Configure the laptop of user Z on the LAN with an appropriate subnet and gateway Z on the branch router at Y to reach the external IP address D.

<.... Repeat for all other users, sites, networks combinations ...>

What is Intent?

Declarative – describe outcome: requirements, goals, constraints

For all sales users in the network, ensure they can reach all sales application instances securely.

Enable low latency and appropriate bandwidth for 4K streaming media with good experience.

Optimize for lowest costs (while meeting quality constraints).

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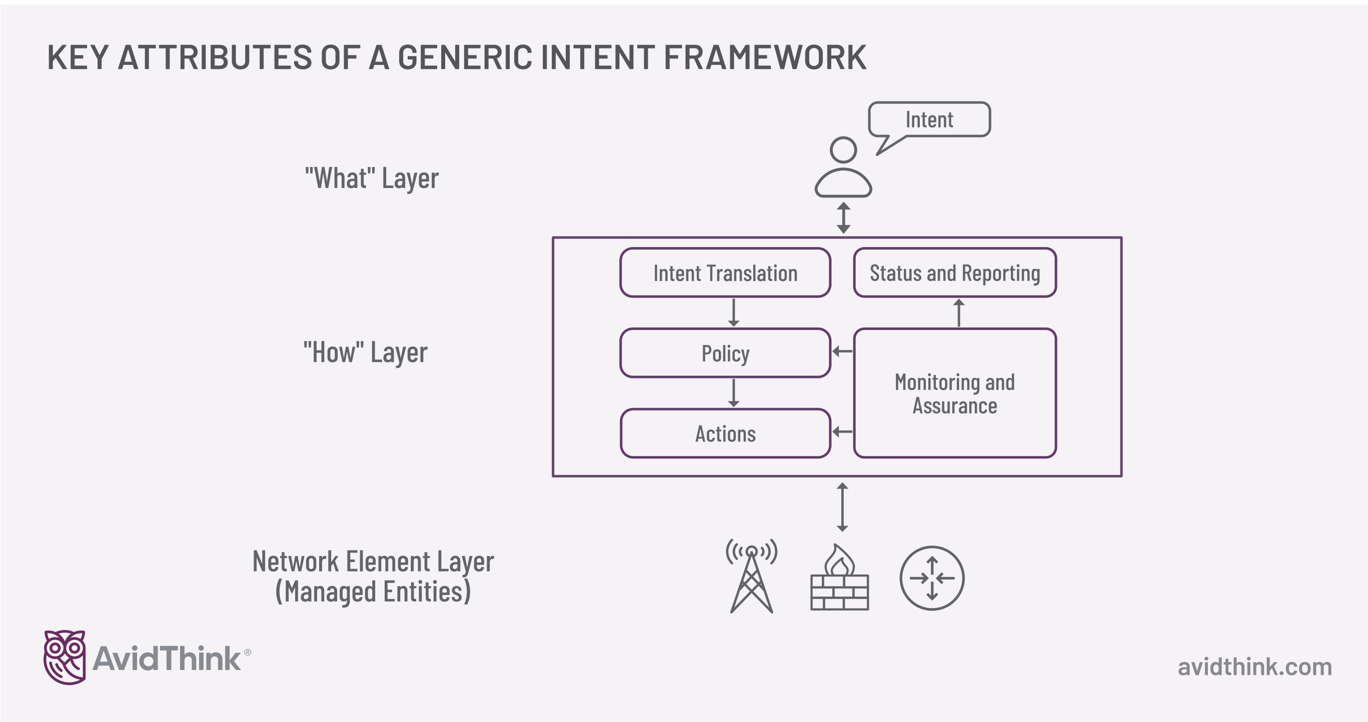
In the example, the goal is to connect authorized users to relevant application resources. The simplicity and convenience of an intent-driven approach are apparent, but it should also be equally evident that a massive amount of technology underneath is needed to perform the heavy lifting.

Examining Intent

Intent approaches have been around for decades and are rooted in the policy-based network management[2] movement. The formalization of intent can take different forms. Networking and independent software vendors (ISVs) claiming intent will have various architectural block diagrams describing their approach. Nevertheless, many intent frameworks look like this:



On the topmost level, an operator's expression of intent (or output of a business workflow) must be translated into a set of policies or rules that can be enacted on an abstraction of the underlying network elements. In parallel, to ensure that the intent is achieved (or to alert if unachieved or violated), a monitoring and assurance subsystem is needed. This assurance component can trigger the policy and action subsystem to autonomously remediate any issues that might arise.

As the system operates, intent may be changed and updated, resulting in a revision to the translated policies and regeneration of the intent data model.

The translation or mapping capability may involve AI/ML to improve the system's sophistication. However, any system outcome will remain restricted to the defined data models and the inherent expressiveness of the policy language. AI/ML can also be leveraged by the assurance subsystem to keep the system compliant with the defined intent.

[2] Strassner, J. "Policy-Based Network Management: Solutions for the Next Generation," Elsevier, 2003, ISBN: 008049210X, 9780080492100

Intent is network-agnostic and domain-agnostic — wireless, wired, data center and RAN are all applicable domains. For instance, an intent system could govern how the elements in a 5G Open RAN with radio units (RUs), distributed units (DUs), and centralized units (CUs) are configured. The system can tweak the numerous parameters in each element to achieve overall goals including network performance or power savings.

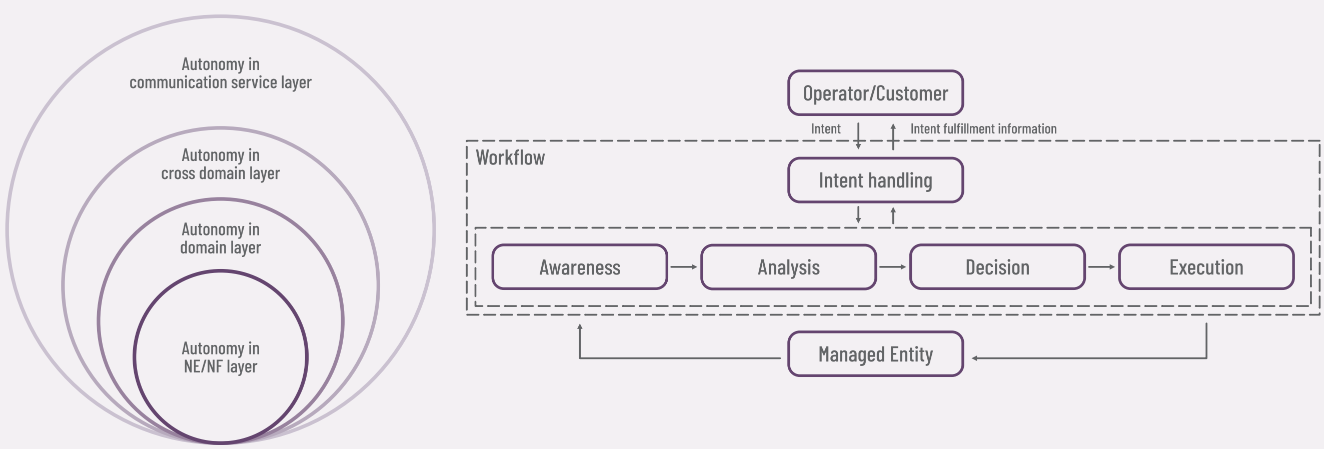
Despite their powerful capabilities, intent-driven systems cannot create or generate new actions or invent capabilities not encoded within the system — they must conform to pre-existing data models. In our autonomous vehicle example, an intent-driven system cannot suddenly manifest flying or sailing as a new mode of transportation or take the vehicle off-road to reduce travel time.

Intent-driven systems cannot create or generate new actions or invent capabilities not encoded within the system — they must conform to pre-existing data models.

Intent Implementation and Standardization

Standards development organizations (SDOs) in the telecom ecosystem recognize the value of intent. ETSI 's Experiential Networked Intelligence Industry Specification Group (ENI ISG) and the Zero-touch network and Service Management (ZSM) Group are active in developing and incoporating intent frameworks. Meanwhile, TMForum has released the second version of its "Autonomous Network Whitepaper" that provides guidelines for closed-loop management across four domains along with their IG1253 Intent in Autonomous Networks Report. 3GPP in Release 17 is likewise focused on abstractions in autonomous networks[3] and is examining the concepts and scenarios for intent-driven management while trying to make intent more actionable[4]. In parallel with the development of intent, 3GPP self-organizing networks (SON) that can configure/plan (self-configuring), optimize (self-optimizing), and heal (self-healing) have also seen strong interest and development in the area of 5G RAN[5].

3GPP WORKING CONCEPTS ON AUTONOMOUS NETWORKING AND INTENT



Adapted from 3GPP draft TS 28.100

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[3] 3GPP draft TS 28.100 Management and orchestration; Levels of autonomous network

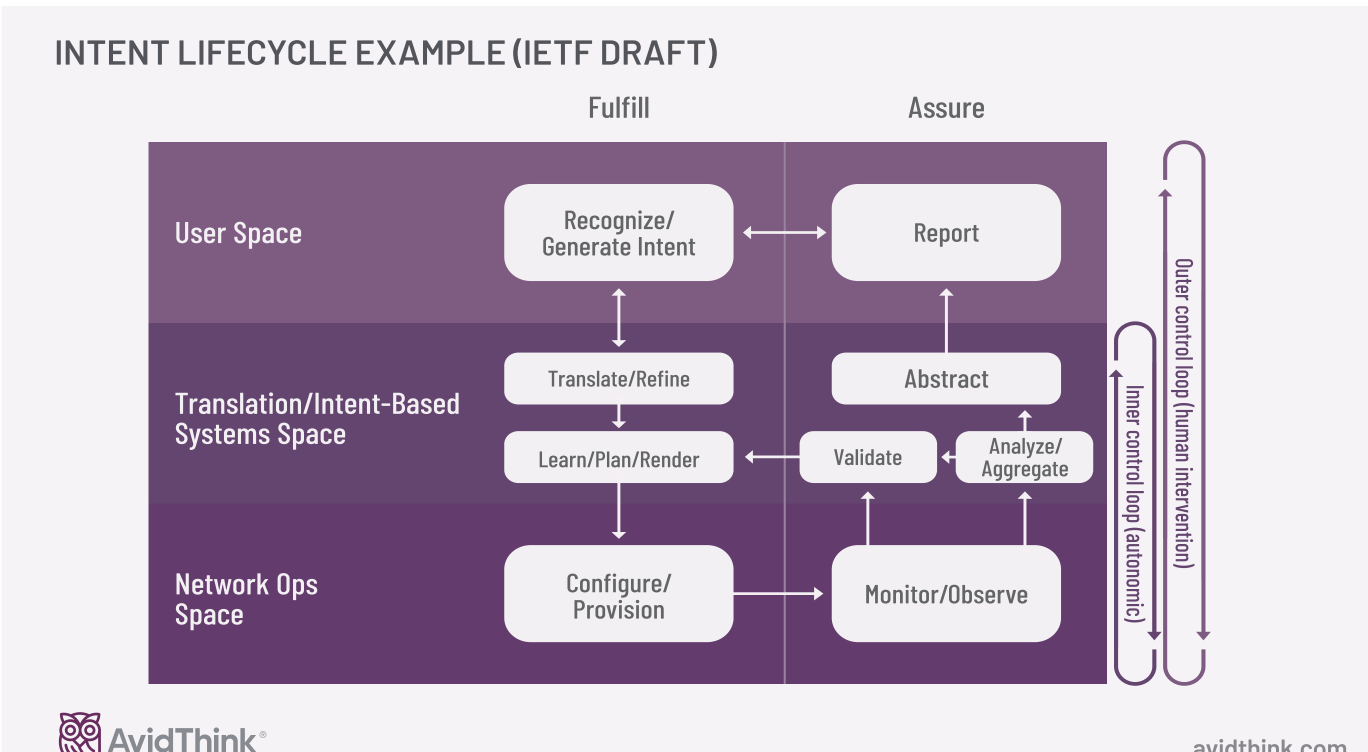
[4] 3GPP TR28.821 Telecommunication management; FMC model repertoire, 3GPP draft TS28.312 Management and orchestration; Intent-driven management services for mobile networks

[5] 3GPP TS 32.500 Telecommunication management; Self-Organizing Networks (SON); Concepts and requirements and 3GPP TS 28.313 Management and orchestration; Self-Organizing Networks (SON) for 5G networks

Coincidentally, many of the SDO efforts define autonomous network levels that mirror those of self-driving vehicles set by SAE International[6], which depicts six levels of automation (with level 0, no automation, and level 5, full automation) and characteristics at each level — making our automobile analogy above even more apt. Further, SDOs recognize that automation will evolve across multiple management scopes, from network functions or element layers to domain, to cross-domains, and eventually to an end-to-end service level.

As a final example, the IETF, in their work on Intent-Based Networking - Concepts and Definitions, has proposed an intent lifecycle depicted in the diagram below. Note the authors calling out an inner autonomous closed control loop versus an outer open control loop that requires human intervention — we'll dig into this later.

The key takeaway from the SDO world is that intent-driven networking standards are a work-in-progress with many parties evolving their view of intent semi-independently. AvidThink anticipates harmonization efforts will continue over the next few years.



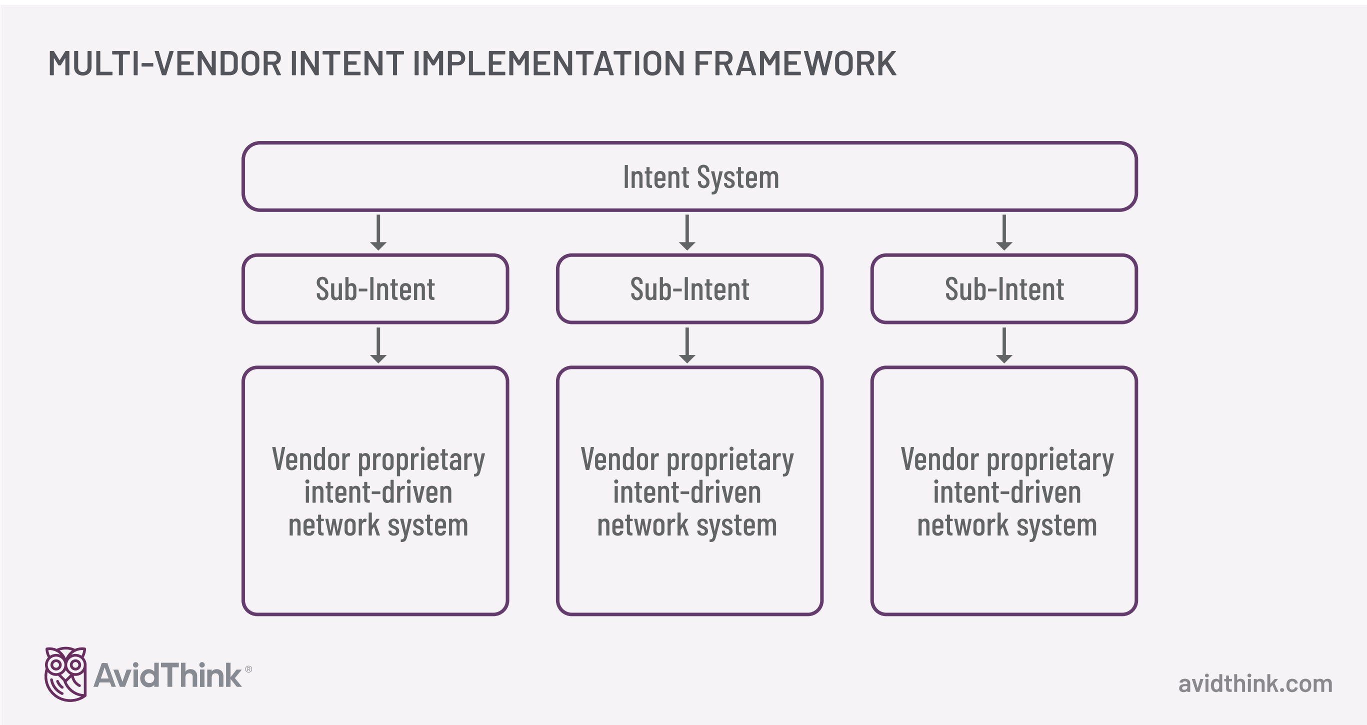
Adapted from Intent-Based Networking - Concepts and Definitions (ietf.org)
https://www.ietf.org/archive/id/draft-irtf-nmrg-ibn-concepts-definitions-09.html

[6] Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles SAE J3016_202104

State of Vendor Implementations of Intent-Driven Networking

On the vendor side, different vendors advertise different approaches to intent and policies. A few provide intent-driven management of their data center switches, WAN offerings, or campus wireless solutions. There's no normalized, standardized, intent framework across the various networking domains, much less cross-domain. We also see "intent-washing," where vendors claim that policy-based or rules-based systems are intent-driven.

Regardless, each vendor offers a variety of APIs for management, programmatic control, discovery, telemetry, and troubleshooting, with each conforming to different data models of network elements — attributes and parameters of one vendor's router may differ from another. This complicates life for CSPs who need to offer services that span multiple domains, utilizing multi-vendor equipment. The result is that CSPs are left with the sub-optimal situation of figuring out how to implement the top levels of the intent architecture displayed below.



Approaching Intent

CSPs need intent-driven networks but comprehensive solutions are not yet available. Meanwhile, the rapid rollout of NGNs such as 5G means CSPs need to find effective ways of supporting network monetization today and tomorrow. With the realization that raising the average revenue per user (ARPU) for consumers for 5G enhanced mobile broadband (eMBB) services isn't feasible, CSPs know they have to continue to lower their operating costs while enabling new services to increase profitability and recoup their billions in CapEx. Intent-driven networks can help with both cost savings and revenue enhancement.

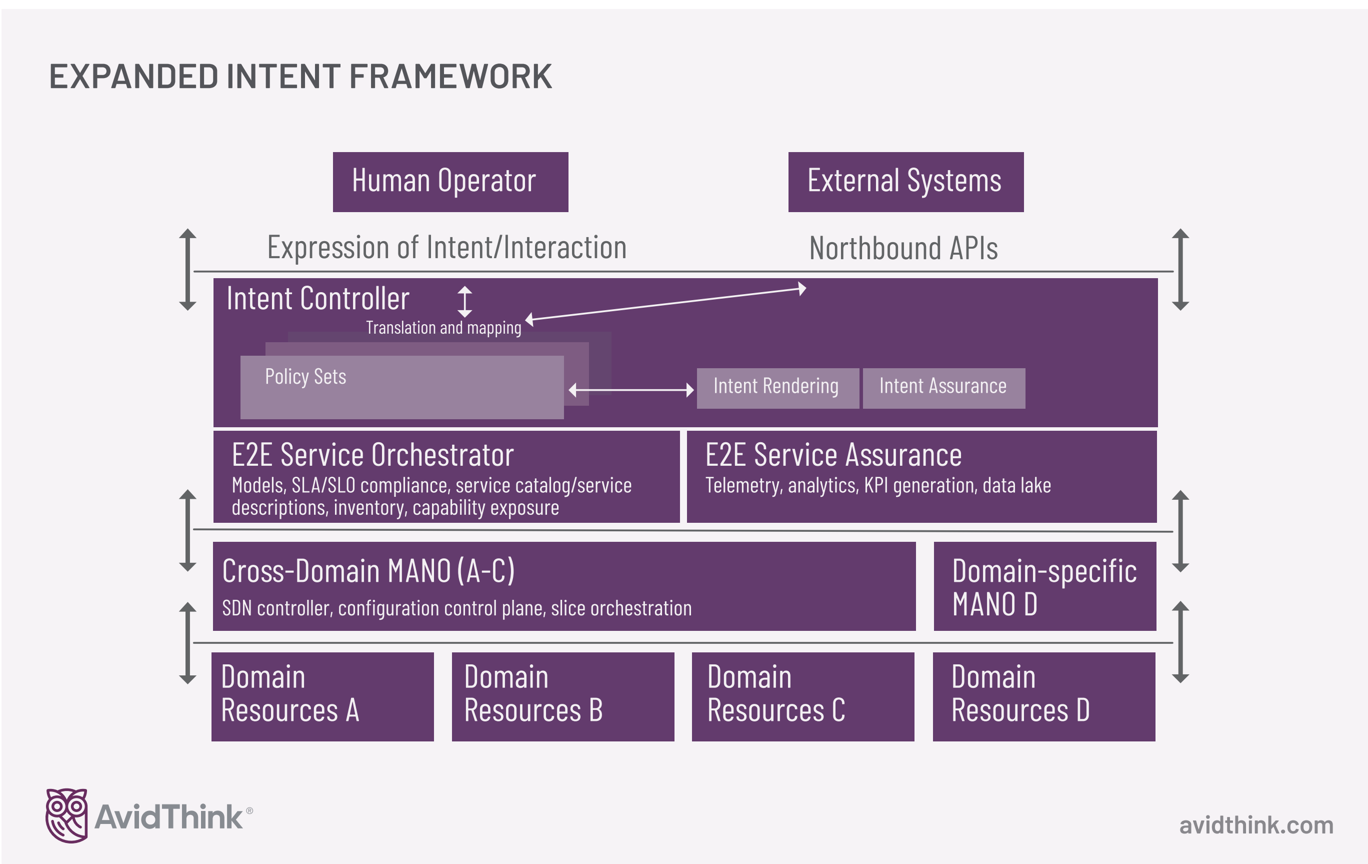
Driven by Monetization

When we examine monetization schemes in NGNs like 5G, it's seldom as simple as implementing network slicing. End-to-end (E2E) slicing is hard enough with a fixed number of slices today; dynamic slices enabling sophisticated services will require more development. AvidThink expects that monetization from 5G and NGNs will require going beyond network slicing. CSPs will have to explore novel integrations with applications and build innovation platforms that enable new business-to-business (B2B) or business-to-business-to-consumer (B2B2C) services.

Some examples include getting paid directly or indirectly by providing improved and measurable quality-of-experience (QoE) for gaming applications; or robust quality-of-service (QoS) for control applications for inspection drones at a construction site. And yet, few carriers in 2022 will offer these services in their 5G networks. CSPs remain bogged down by inflexibility in their static networks and slow transition to cloud-native networks. Their sluggish transition is evidenced by the lack of modernization in operations support system (OSS) and business support system (BSS) stacks across carriers.

Criticality of End-to-End (E2E) in Intent

It's increasingly clear that new services will be end-to-end (E2E) and cross-domain. Businesses and consumers will seek more complete solutions instead of piecemeal offerings that they have to stitch together. In today's outcome-focused business environment, the CSP that can offer E2E platforms, monitor and report on E2E service-level objectives (SLOs), and provide robust E2E service-level agreements (SLAs) wins. This has implications for the underlying intent-driven framework, a simplified model which we show below:



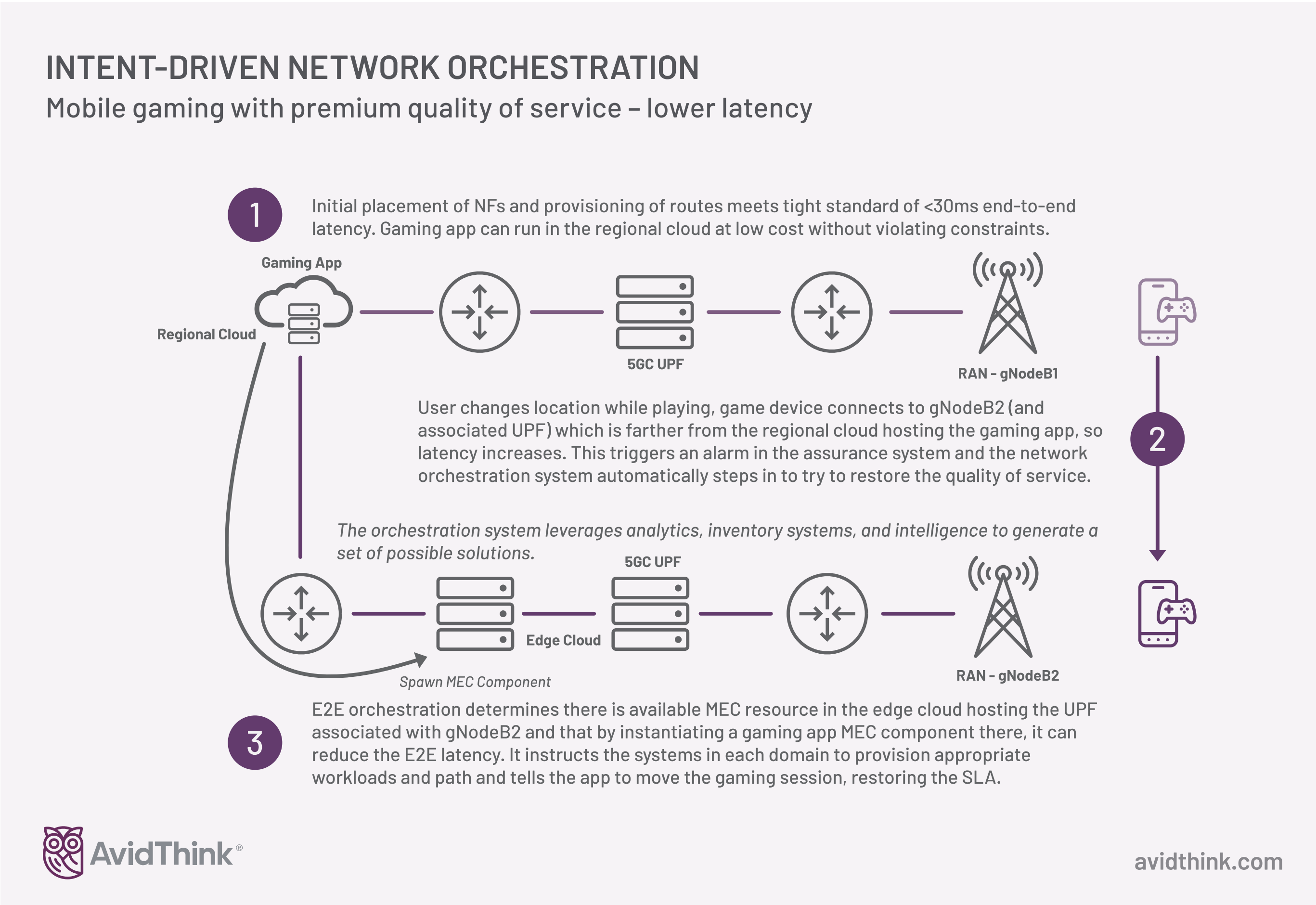
While today's vendor intent-driven offerings tend to be domain-specific, CSPs must evolve to E2E intent-driven solutions. Critical components of an E2E intent solution that CSPs need to pay attention to include:

- **E2E Intent System** — Ensuring that the intent translation capability and data model encompass E2E services across domains. The system must support rendering of intent through hierarchical **translation and decomposition** of E2E intent using a reference design or model. **Verification** of the policies to ensure correctness is next. Ultimately, the output will be a set of policies that can be applied by the orchestration and automation systems.
- **E2E Orchestration** — The orchestration system will need an accurate multi-domain resource inventory to track available resources. In cross-domain deployment, a federated approach might be necessary to build an accurate source of truth reflecting all available resources. The system also captures networking models that dictate how policies can be applied via each element's automation APIs. If insufficient resources are available or if the risk is high that resources will become unavailable, the system can reject an intent request.
- **E2E Assurance** — Once the configuration is pushed out, the system will **continuously validate** that the original E2E intent of the system is met. This requires consuming continuous telemetry across multiple domains and running assurance logic to ensure that the business service is meeting its obligations — multi-domain E2E service assurance. The E2E assurance system will likely operate a data lake that takes in telemetry across multiple domains. The data can be used to generate necessary analytics, calculate key performance indicators (KPIs) for reporting, and for training AI/ML models to improve the intent system performance. If the system is not meeting SLAs, **additional actions** can be taken to deploy more resources, reconfigure existing resources, or generate alerts that the system is out of compliance with the intent.

This ongoing intent fulfillment-assurance cycle is an integral part of the framework. Fulfillment relies on sufficiently rich models and sophisticated mapping, and a reliable source of truth reflecting accurate inventory and resource availability within the network to determine how best to place workloads and provision the necessary computing, networking, and storage resources.

Assurance relies on detailed, real-time analytics from the various network and application elements that impact the relevant services. Analytics, in conjunction with a cross-domain inventory system which tracks relationships between services and their supporting resources, feeds the source of truth that allows the intent system to adapt to real-time and real-world conditions. Adaptation might involve reconfiguring systems, provisioning, and de-provisioning resources to ensure that the system's goals are met (and will continue to be met for the duration of the service obligation). Advanced analytics, big data, AI/ML, and historical context can be employed to optimize the ongoing assurance process.

To help make these concepts more concrete, we'll look at an example of a 5G mobile gaming application with a tight E2E latency constraint. The example demonstrates how the fulfillment-assurance subsystems work together in the provisioning and maintenance of an E2E slice transporting game application data.



When an event occurs — movement of the user causing a handoff to a new cell site — the intent system takes steps to automatically remediate to achieve the desired SLA. Note that the intent system needs visibility into all resources via cross-domain inventory and access and control over all domains and resources to perform its duties. This requirement supports the use of E2E multi-domain orchestration and assurance systems that work hand-in-hand with the intent system.

Loops and Intent

Speaking of auto-remediation, one of the key concepts in intent is open-loop versus closed-loop. Historically, CSPs depended on open-loop systems where traditional fault-management or performance-management products would generate alerts, and human operators would use the available information to troubleshoot and remediate. However, for intent-driven networks, operators need to trust closed-loop systems that can auto-remediate to ensure the system achieves its intent. If you recall the diagram on page 5 from the IETF Intent-Based Networking - Concepts and Definitions draft, you can see the comparison between the two loops.

The other concept revolves around domain-specific versus end-to-end loops (and also loops at different abstraction layers). As we've explained, E2E intent will be decomposed into policies executed within each domain (core, transport, RAN). For each domain, an in-domain loop will execute a local fulfillment-assurance cycle, while cross-domain loops will focus on achieiving E2E intent.

For instance, with the evolution to cloud-native, there will be domain-specific loops focused on the underlying telco cloud, and network function workloads in each domain. Meanwhile, there will be an E2E fulfillment-assurance cycle to ensure E2E intent is being met. The scope of each loop is different, but both are necessary to achieve the intent. As the industry evolves from domain-specific loops into E2E loops, CSPs will want to adopt a flexible E2E intent framework that supports this path.

New Analytics Sources Power Intent

Determining whether intent policies are working requires measuring a network's KPIs. Any self-correcting or self-adjusting control system is dependent on underlying telemetry and KPIs being available promptly — orchestration systems and control loops need quick feedback to know whether they are achieving their goals. And when controlled readjustments to the systems are performed as part of onoing assurance, analytics provide immediate feedback on whether reconfigurations are having their desired effect.

When unexpected events occur on the network that potentially impact the service, the intent-driven system also relies on real-time analytics to know what's going on and which elements of the networks are deviating from expected behavior — facilitating rapid root-cause analysis. This allows the systems to take appropriate remediation action and to alert end users if corrective action is ineffective.

Analytics and telemetry also feed ongoing SLA reporting and charging, providing the backing data and enabling productive customer interactions on both fronts.

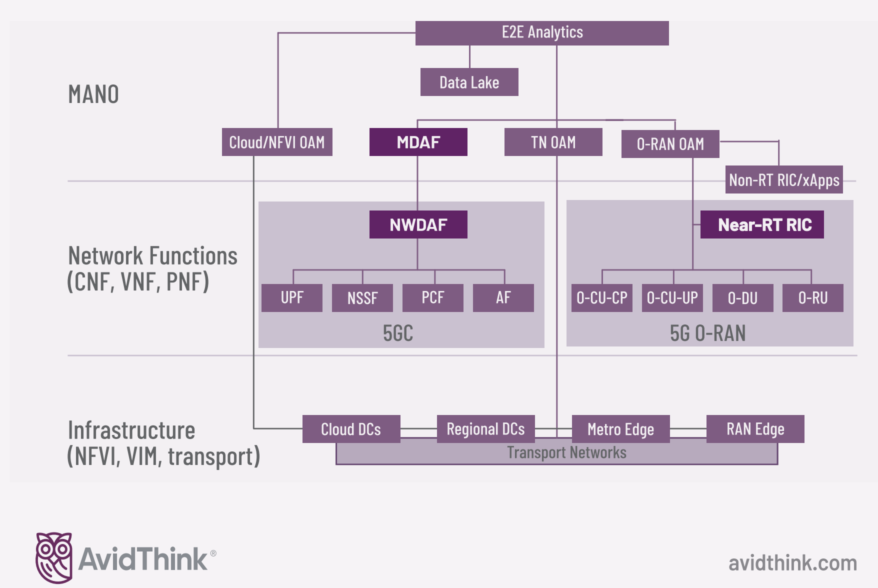
In the longer term, telemetry and analysis data will be fed into data warehouses and data lakes that can be used for training AI/ML systems that will, in turn, lead to increased autonomous control of networks. Using this data can provide accurate baselines that improve planning and orchestration decisions; the data can also be used to identify both performance- and security-related anomalous network behavior.

5G Analytics — Sources of Interest

While our discussion of intent and analytics can be applied across all networks, the arrival of 5G has brought new analytics standards in mobile 5G core (5GC) and 5G RAN (including Open RAN). Pre-5G networks provided vendor-proprietary analytics critical to managing such networks, but 5G working groups are pushing standard and more holistic approaches. In 5GC SBA, we have the network data analytics function (NWDAF) and the management data analytics function (MDAF). For CSPs deploying Open RAN, the service management and orchestration (SMO) platform includes a RAN intelligent controller (RIC) — a software-defined element in O-RAN that controls and optimizes RAN functions. Collectively, the MDAF, NWDAF, and RIC provide vendor-agnostic standards-based analytics that facilitate intent-driven networks.

We envision that the combination of aggregate analytics will be critical to supporting E2E intent: MDAF at the management layer, NWDAF at the network functions layer, and RIC for the RAN component. Further, as described earlier, we anticipate that the coordination point where these analytics come together will be in the form of a data lake that's managed by an E2E assurance system.

ANALYTICS SOURCES IN 5G NETWORKS



NWDAF

Since its debut in 3GPP Release 15, the network data analytics function (NWDAF) in 5GC has received wide attention as a centralized function that can provide statistical and predictive analytics for multiple use cases in a 5G network, with network slice analytics as one of the early use cases. Many networking vendors view the evolving NWDAF standard as a holy grail for 5G networks analytics, with 3GPP adding more use cases in Release 16 and yet more to come in Releases 17 and 18.

NWDAF, as defined in 3GPP specifications[7], incorporates standard interfaces from the service-based architecture to collect data through a subscription or request model from other network functions. The NWDAF can then provide a unified network analytics function for automation or reporting, solving custom interface or format challenges.

NWDAF continues to evolve to include more data producers and consumers, and is expanding its use case coverage. Without going through an exhaustive listing of the supported use cases, here are a few salient examples to demonstrate its versatility:

- Load information
    - Load-level computation and prediction for network slice instances (NSI)
    - Network load performance computation and future load prediction
    - Load analytics information and prediction for specific NFs
- UE-related
    - UE expected behavior prediction
    - UE abnormal behavior and anomaly detection

Intent is more of a journey today than an immediately achievable end goal. We should not expect a Big Bang event where an entire E2E 5G network is suddenly put under intent-driven control.

Multiple vendors are pushing hard on NWDAF, from orchestration and management to analytics, to assurance and security vendors, all looking to leverage this centralized standard to add value to 5G networks. This makes NWDAF a compelling area in analytics for CSPs to focus on.

MDAF

On the management plane, the management data analytics function (MDAF) provides the management data analytics service (MDAS) that collaborates with NWDAF and other systems to gain visibility and control over multiple elements in a 5G network. The MDAF provides MDAS for multiple NFs, network slice instance (NSIs), and network slice subnet instances (NSSIs) and can act at different levels, including at the domain level (RAN, core network, slice) or at an aggregate (and centralized) level providing end-to-end or cross-domain analytics. We expect to see more evolution on the MDAF front in future 3GPP Releases as the industry fleshes out more use cases.

Non-RT and near-RT RIC

Outside the 5GC, the 5G RAN has seen an evolution in analytics. The most prominent in this domain are the near-real-time radio intelligent controller (near-RT RIC) and non-real-time RIC (non-RT RIC). The non-RT and near-RT RIC are part of O-RAN Alliance's work on Open RAN, which has sought to foster innovation on the RAN by opening interfaces across the RAN. These interfaces can provide visibility into radio network telemetry while allowing for programmatic control of radio parameters and configuration. O-RAN Alliance hopes to foster an ecosystem or even marketplace of applications hosted on the non-RT RIC in the form of rApps, and near-RT RIC in the form of xApps.

Analytics from the RICs can be consumed by NWDAF and incorporated into higher-order analytics. However, due to the shorter timescales (in particular, the near-RT RIC) on which the RICs operate, RIC analytics will stay in the RAN domain for rapid decision making while feeding into other DAFs (MDAF, NWDAF) for aggregate analysis, reporting, and longer timescale decision making.

[7] 3GPP Specifications TS 23.288, TS 23.501, TS 23.502, TS 29.510, TS 29.520, and TS 33.501

Overcoming Challenges in Achieving Intent-Driven Networks

While promising, to achieve E2E intent will require overcoming multiple challenges in the market. We've already pointed out that many of today's intent implementations by vendors are limited because they are vendor-proprietary and domain-specific. CSPs need to ensure they take a broader approach as lay the foundations to support E2E intent. We encourage CSPs to:

- **Pull together a complete E2E inventory** representing that single source of truth critical to the correct operation of intent frameworks. This needs to itemize and track all resources in every domain a particular business service might span. In the case of a 5G end-to-end network slice, this would include the complete path from the UE through the RAN, transport network, mobile core, backbone network, data center network, and finally, the servers that host applications, even if these servers reside in a hyperscaler public cloud.
- **Drive towards comprehensive telemetry and push for automation APIs** from all participating devices in the network. CSPs must close gaps in the control and visibility of third-party network elements, encourage vendors to expose necessary statistics on network elements, and invest in infrastructure that can consume and analyze large streams of real-time data from network elements.
- **Upgrade legacy orchestration systems** that do not support intent frameworks. Some networks, including 5G, are based on modern architecture but are still coupled to legacy OSS/BSS systems that do not support intent or policy controls. In a 5G end-to-end scenario, an advanced orchestration platform will be needed to support intent systems that encompass high-level intent, sub-intents, and policies across multiple interconnected domains.
- **Invest in intelligent assurance systems** that complement E2E orchestration systems to support the intent fulfillment-assurance cycle across all domains. These assurance systems will flexibility to support different vendor analytics and telemetry models while having sufficient intelligence around E2E service models. These systems will also require the sophistication to understand the impact of underlying performance and fault events on E2E service SLAs/SLOs.

Intent is more of a journey than an immediately achievable end goal. We should not expect a Big Bang event where an entire E2E 5G network is suddenly put under intent-driven controls. Instead, we'll see intent gradually show up within a domain, where complexity can be controlled (e.g., 5G RAN), before graduating to E2E systems.

Laying the Intent-Driven Foundation for Tomorrow's Networks Today

Intent-driven frameworks have evolved and gained traction. Vendors and SDOs acknowledge that intent-driven automation is the path forward for managing today's and tomorrow's NGNs. While intent-driven networking is the goal that everyone seeks, we're all on a journey, with multiple vendor-proprietary implementations being built and with standards and frameworks still in formation.

Even as these standards and frameworks are being developed, we know that intent requires investment in and modernization of E2E orchestration paired with E2E assurance. Likewise, we will need to build out data lakes fed with telemetry and analytics, mature automation, federated cross-domain inventory, and in-house AI/ML competency. This must happen in parallel with ongoing virtualization, containerization, and transition to a cloud-native infrastructure.

As intent-driven networking matures, CSPs can capture benefits if they've laid the right foundations. CSPs must determine which elements of the capabilities we've discussed can be performed in-house, and which will require partners. CSPs should seek partners who demonstrate a strong understanding of these intent principles and possess critical components for building successful intent-driven next-generation networks.

The move toward intent-driven systems is inevitable with the arrival of 5G and other NGNs, and the time to accelerate the modernization and transformation of the CSP network is now. CSPs must pick and adopt the right building blocks on the road to intent-driven networking today. We hope our discussion and exploration will facilitate CSPs initiating conversations with their networking vendors, ISVs, and systems integration partners around intent, and help put CSPs on the path to rich monetization opportunities with their NGNs.

Feedback and discussion are always welcome. You can reach the AvidThink research team at **research@avidthink.com**.

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