



ADDRESSING THE 5G GAP



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Trivialized APIs for Next-Gen Application Development on 5G Networks

Introduction

5G is the next generation of wireless technology and presents a powerful business opportunity. A vast majority of Fortune 500 executives are evaluating 5G use cases within their businesses, as creating next-generation applications that take full advantage of 5G's capabilities is vital to their digital transformation initiatives. With 5G being the next evolution, many such executives are relying on consulting and system integration firms to help them craft strategy and implementation plans around 5G.

In order to monetize the private and public 5G deployments, applications need to be built or refactored to leverage the unique network exposure capabilities and the openness of the various elements within the 5G system (RAN, Edge, Core).

This presents unique challenges for application developers, making it difficult to take full advantage of its capabilities. Although the 3rd Generation Partnership Project (3GPP) standards have defined Network Exposure Functions (NEFs), which can be utilized by Application Functions (AF), the complexity of the interfaces exposed are non-trivial. Application developers need to have in-depth knowledge of network behaviours, to utilize these standardized interfaces in their domains. Furthermore, all Network Equipment Providers (NEPs) differentiate their capabilities, by providing proprietary network interfaces which locks in the application to a particular set of Network Elements (NEs).

This drives the need for a network appliance that can lower costs, reduce complexities and accelerate timelines for deploying next-generation applications on advanced networks such as 5G. This appliance can enable applications to utilize these exposed network capabilities as trivialized APIs, requiring minimalistic knowledge/insights into the network operations and management.

Shabodi's Application Enablement Platform (AEP) provides a powerful solution to these challenges—it is a simple and effective network layer API, enabling abstraction and orchestration capability. Shabodi's AEP is a CAPIF-compliant network appliance that exposes network capabilities to developers as Restful APIs. These simple APIs abstract the complexity of underlying 5G network infrastructure while taking full advantage of its capabilities, enabling next-generation AI, MEC, AR/VR/XR and IoT applications to be **enhanced** network aware.

Industry Insight

5G is not just another G, but a foundation for a brand-new economy. What 4G/LTE was to the consumer, 5G is to the enterprise.

A lion's share of the use-cases within 5G will be applications which interact with the network, instead of simply utilizing the network, and can include Industrial 4.0 and next-generation applications, within (but not limited to) the following verticals:

- Manufacturing
- Transportation
- Ports & Logistics
- Energy, Oil, & Gas
- Mining
- Government
- Healthcare
- Sports, Media, & Entertainment
- Financial Services
- Gaming



Challenges of Implementation

As 5G gains momentum, new software development paradigms need to be enabled for developers to interact with NEs about the bespoke requirements and enhance the performance/utilization of their software. While the NEPs are exposing their services to software developers, the APIs are extremely complex and require the developers to be masters of both domains—the Network and the Application. This requires a new set of skills and domain knowledge which will make the application development extremely complex and expensive. Network developers will need time to specialize in application domains and complexities—similarly, application developers will be challenged to master network intricacies. Both of these dynamics will add unnecessary costs and delays, validating the need for Shabodi's AEP.

Problems and Solutions

5G allows applications to interact directly with network resources; in contrast, previous network generations only allowed applications to be network aware. With 5G, applications can tailor and leverage network capabilities to their needs (such as low latency, bandwidth, etc.) instead of blindly depending on pre-configured network setups.

5G adds complexity and a knowledge gap to existing telecommunications technologies because developers need training in network architecture, access, and manipulation to harness the power of 5G. Enterprises may have to make difficult trade-offs, re-skilling in-house developers to understand advanced network constructs (5G), at the expense of other initiatives. Developers and their time are an increasingly critical and limited resource.

Lack of trivialized application domain APIs means enterprises will struggle to deploy high-end 5G-enabled applications and, as a result, most of their 5G applications initiatives may result in lackluster and delayed ROI timelines.

Notable challenges when deploying 5G within an enterprise, and potential solutions:

Problems	Solutions
Applications need to utilize the network, requiring the hiring of developer subject matter experts (SMEs) and/or reskilling existing developer workforce.	Shabodi's AEP addresses this by simplifying and accelerating 5G application development, accelerating deployment and ROI timelines.
In a multi-NEP environment, where NEs are provided by multiple providers, the optional and proprietary interfaces provided by NEPs create complexities for application developers.	Shabodi provides a universal AEP framework guaranteeing interoperability across a myriad of NEP- specific and multi-NEP environments.
In a multi-site deployment (across countries and even NEPs), where a set of application utilization parameters need to be based from one GPRS Tunneling Protocol (GTP) tunnel to another over the backhaul network—the two network domains are independent and do not pass the application NEF executions.	Shabodi's solution discovers all NE function APIs, and outputs simplified APIs for application developers to build applications, regardless of vendor.

The 5G Standards Are Just a Starting Point

The NEPs expose network interfaces based on the standards defined for the NEFs. Beyond what the 5G standard bodies advise, NEPs differentiate themselves by providing additional services as optional or proprietary interfaces. Furthermore, application developers may not have complete insights into the network configurations and deployment constructs. Hence, there is a disconnect between how application developers consume services and how network operators and providers expose the network.



3GPP standards define an API orchestration (between applications and network elements) under specification 23.222 (CAPIF framework). This specification is critical to enable next-generation applications, to protect the network elements from overwhelming application requests, and potential security impacts. 3GPP has defined the new 5G API interface platform to address new 5G service scenarios. They have also defined the framework that supports developers, to create new 5G services.

This standard exposes the following capabilities:

- Support 5G service-based architecture and expose their network functions
- Guarantee 5G system (RAN, Edge, and Core) stability with rate limitations
- Exposure of Restful APIs
- Single API gateway function for all Core, whereas the Edge and the RAN are beyond its scope
- Exposure of core network internal capabilities for analytics

In order for the NEP to be NEF compliant, only the mandatory set of APIs need to be exposed. As stated earlier, NEPs differentiate themselves by providing additional or streamlined services as proprietary Network APIs. **Therefore, a vast majority of the interfaces are proprietary or optional, making the framework fall short in defining simplified application interfaces for application developers to consume.** This creates a challenge for developers to build applications that can take advantage of the lower latency, higher bandwidth capabilities offered by 5G.

Some Service Providers (SP) have begun to define these capabilities as part of their Service Delivery Platform (SDP) strategies. Application developers within large enterprises must factor working with different SPs and NEPs (for SP-based and Private 5G deployments) - each with its own complexity, interfaces, parameters, protocols, etc.

Shabodi's Solution



Shabodi is the first to market with a patent-pending AEP that accelerates and simplifies deployment of 5G applications, irrespective of the underlying network. In doing so, Shabodi provides RESTful APIs, ensuring enterprises do not have to constantly rewrite/refactor their applications every time there is an upgrade or evolution to their network.

Shabodi's Application Enablement Platform (AEP) is a SA6 CAPIF (23.222) compliant virtual network appliance that exposes the network capabilities to developers by using easy-to-use RESTful APIs, abstracting the complexity of the underlying network infrastructure.

This enables the application developer to go beyond legacy network aware applications and accelerate development of 5G applications that leverage:

- The orchestration of Multi-vendor Network Components
- Network configurations, and policies
- Supporting interworking between different systems and networks etc.

The value in leveraging Shabodi's Application Enablement Platform (AEP) is the ability to take a trivialized API on the northbound of an application, mapping and orchestrating it onto a discovered API from the network in a secure fashion.

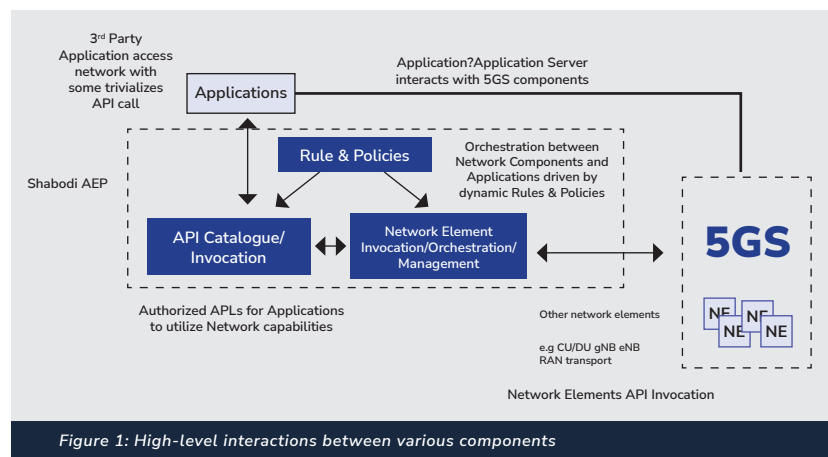
As a trusted virtual network element, Shabodi's AEP can execute a request on behalf of an application function. This provides application developers the ability to control, influence, and manipulate the parameters of a network within the 3GPP specs, through the user and data planes. This also enables applications to dynamically (in near real-time) adjust or change QFIs, Network Slices, Traffic Flow, Network Authentication, KPIs, and Service Level Agreements (SLAs) management.

Shabodi's Application Enablement Platform (AEP)

Shabodi's AEP wipes out the need to hard-code applications on the network by providing a simple API interface for developers to reconfigure applications on a 5G network—saving them time, money and resources.

How it Works

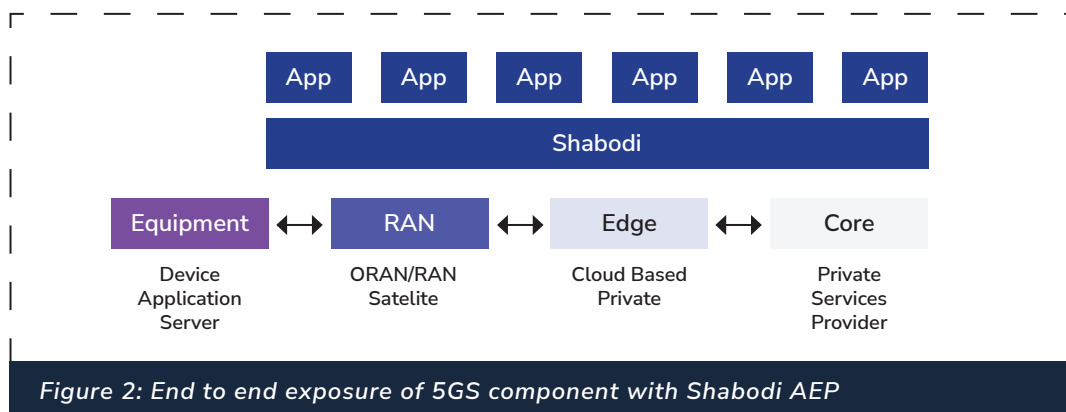
Figures below capture the high-level interactions and APIs exposures/ingestion to/from application and networks. Applications invoke the published APIs (REST/microservices etc.) from Shabodi's AEP. These APIs are enabled with complete life-cycle management (access control, authorization, publishing, deprecation, upgrade, versioning etc.). The authentication of the application APIs leverages comprehensive security protocols from JWT tokens, OAuth2, shared secrets, certificates etc., and are mapped to the session with the AEP platform. This is shown in Figure 1.



The authenticated APIs are accessed by applications to invoke the network services and capabilities exposed within the environment. The request from the invoked application API on Shabodi is orchestrated (via comprehensive set of Rules & Policies), to derive appropriate network parameters, and orchestrate the execution on the Network

Elements (normalized network capabilities within the Shabodi AEP, which represents the standardized NEF and proprietary NE APIs).

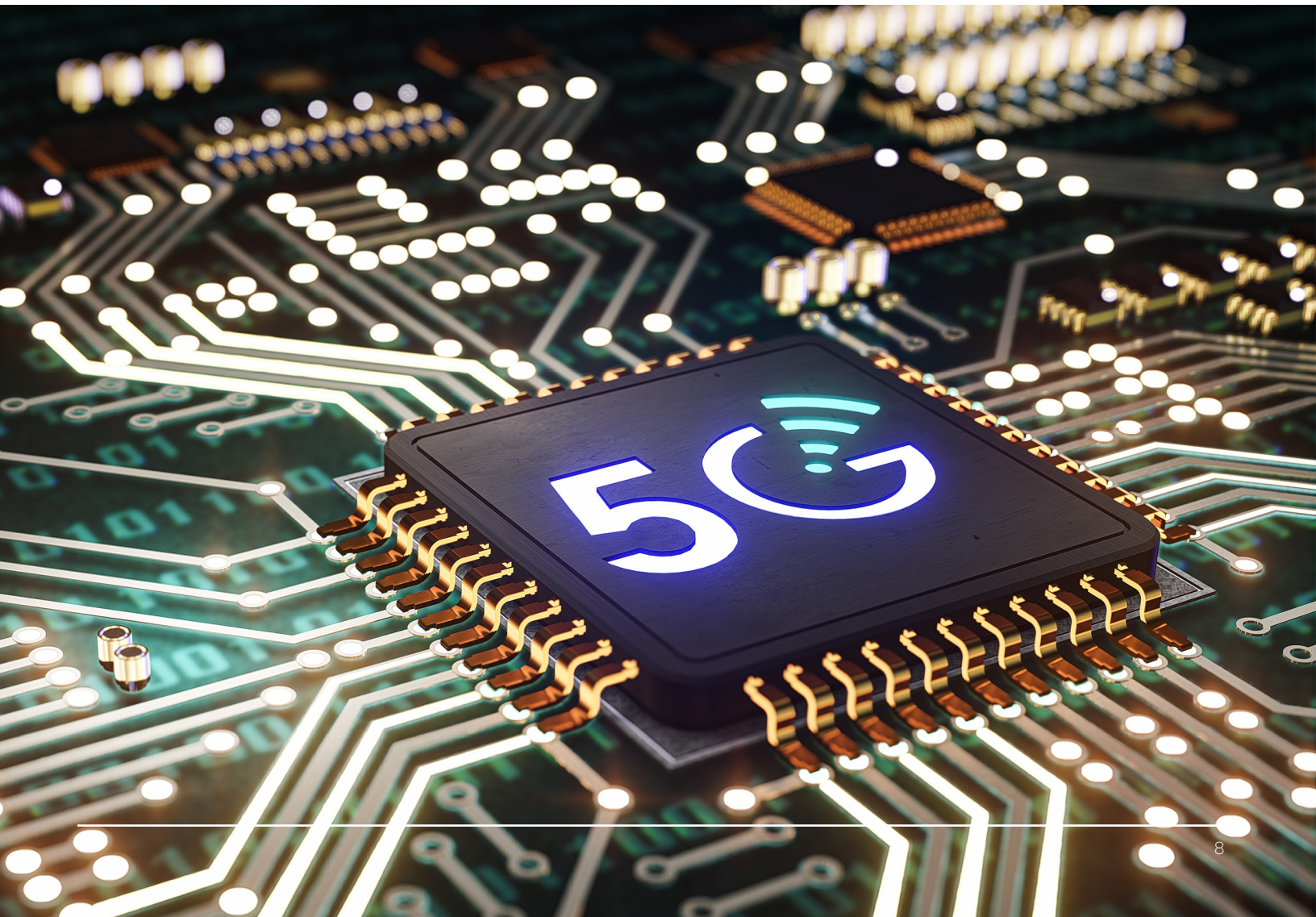
As seen in Figure 2, Shabodi trivializes the complexity by directly interfacing with RAN, Edge, and Core. All network interfaces that are required to provide end to end orchestration, are ingested by the Shabodi AEP, normalized within the platform, and exposed to be consumed by the applications in a trivialized fashion.



Enabling Next-Gen Applications

Shabodi changes the paradigm of application development and network utilization. Prior to Shabodi, applications could only integrate with pre-defined network services (as defined within the management plane via OSS/BSS or configuration tools), and influence them with vendor specific interfaces at the RAN, Edge, or Core. There was no flexibility in changing these preconceived configurations to be enhanced/modified by applications based on their runtime requirements. This led to over-engineering and oversubscription of valuable network resources.

Furthermore, the hardcoded configurations made the applications utilize the network as a pipe, and not an environment that could be utilized for their bespoke use. With Shabodi, an end to end orchestration and influence in a multi-network configuration, multi-component network vendor environment is feasible, enabling next-generation applications to go beyond being just “network aware”.



Shabodi's Benefits

- **Trivialized Application APIs**- Application developers can modify network services for their bespoke needs by utilizing simple REST APIs to invoke complex network services.
- **Network Domain Protection**- As a trusted network element, Shabodi protects the network from undesirable utilization and enables NE developers to continue building next-generation applications without compromising the network.
- **Application Portability**- Build once, deploy to any Shabodi-enabled Private 5G network, ensuring applications never need refactoring.
- **Bespoke Implementation of Apps**- Shabodi allows for custom application integration on top of each individual component of the network: RAN, Edge, and Core.
- **Dynamic Routing**- Shabodi's platform dynamically determines the best network path for your application to succeed using artificial intelligence and machine learning components that actively monitor and learn about your network's ideal performance.
- **Dynamic Manipulation of Network Resources**- Applications leveraging Shabodi's AEP platform can dynamically modify network behaviour when deploying applications on a 5G network, empowering applications to request the priority, parameter, latency, speed, and bandwidth it requires.
- **Application Change Proofing**- Shabodi automatically handles discovery and manifestation of network or policy changes, ensuring your applications never need manual refactoring.
- **Multisite Interconnect**- Shabodi abstracts multiple network hardware providers and vendors, ensuring enterprises can seamlessly interconnect applications between multiple sites, linked over vast distances across multiple carrier networks.
- **Open Standards**- Shabodi's application APIs are built using the open standard CAPIF framework, meaning no vendor lock-in.
- **5G NEP Vendor Agnostic**- Shabodi's platform discovers all Network Element function APIs, and outputs simplified APIs for application developers to build next-generation applications (regardless of vendor).

Unlocking 5G

The reality is that a 5G network is only as powerful as its utilization. The complexities of monetizing and leveraging a 5G investment can be daunting. Developers need to learn **new domain knowledge** and development skills, **extend** CAPIF beyond the NEFs and Core to any network API within 5G, designing and building **interoperability** within different carriers and equipment providers using proprietary options.

5G has redefined the network: from providing simple connectivity infrastructure, to becoming a programmable platform used to create new applications based on collaboration.

As 5G technology prompts Service Providers and Network Equipment Providers to re-evaluate the purpose of their network services, enterprises must be prepared and be agile in their development of applications to utilize

these 5G deployments. The enterprises that can reduce technological friction on a 5G network with its application deployment will have the opportunity to become industry leaders.

Shabodi's AEP does the heavy lifting to dynamically modify the network, enabling developers to be more creative in developing the next generation of innovation. It also enables the CIO, CTO, CISO, product team, architects, and developers to work together in a more cohesive manner.

Shabodi acts as a bridge between the network and application domains, by offering a developer friendly platform, that gives enterprises the power to monetize their 5G deployments, accelerate ROI, and unlock the full potential of 5G networks by building and deploying next-generation, Industry 4.0 applications.



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Learn more at shabodi.com

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