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5G NEW RADIO STAND-ALONE CALL LOG ANALYSING AND DEBUGGING

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ABSTRACT

The most recent 5G network architecture, known as 5G SA (Stand Alone), was created to fully utilize the possibilities of 5G technology without relying on existing 4G infrastructure. It enables quicker data transmission rates, more dependable, and stable communication between devices, as well as increased network performance. With the help of 5G SA, network providers may provide cutting-edge services like network slicing, which enables the development of several virtual networks on a single physical infrastructure, each with a distinct set of capabilities and performance needs. As a result, operators can provide tailored services to various customer segments, including individuals, businesses, and Internet of Things (IoT) devices. Additionally, 5G SA supports ultra-reliable low-latency communication (URLLC), which enables mission-critical applications like autonomous vehicles, smart factories, and remote surgery.

INTRODUCTION TO 5G SA(STAND ALONE)

The fifth generation of mobile networks, commonly known as 5G, is the latest evolution of wireless communication technology. 5G SA, or 5G Standalone, is a new network architecture that operates independently of previous network generations. It is a complete overhaul of the previous network infrastructure and is designed to offer faster data speeds, lower latency, and higher reliability compared to previous generations.

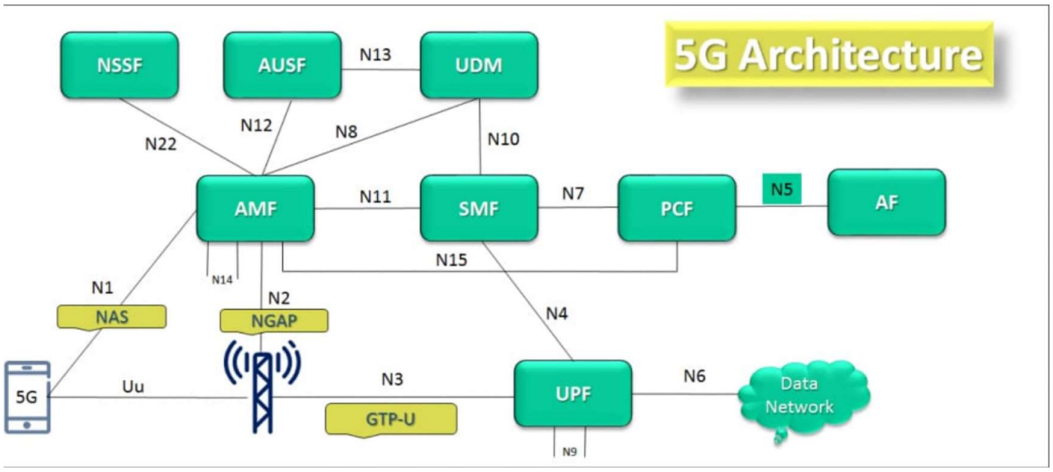
One of the main advantages of 5G SA is its ability to support massive machine-type communications (mMTC), which will be essential for enabling the Internet of Things (IoT) and smart cities. Additionally, 5G SA offers improved network slicing capabilities, which allow service providers to create dedicated network slices for specific applications or customers.

Another important aspect of 5G SA is its ability to support ultra-reliable low-latency communications (URLLC), which are critical for applications such as autonomous vehicles, industrial automation, and remote surgery. With its advanced features and capabilities, 5G SA is expected to revolutionize the way we use wireless communication technology and enable a wide range of new applications and use cases that were not possible with previous network generations.

However, the deployment of 5G SA is not without its challenges, particularly in densely populated urban environments where high traffic density and interference can impact network performance. In this paper, we will analyze the performance of 5G SA networks in urban environments and propose solutions to mitigate the effects of interference and improve network performance.

5G SA Architecture & Network Function Overview

The 3GPP-standard 5G core network architecture offers support for higher throughput demands, lower latency, and more dependability in accordance with the demands of diverse applications and services that 5G must support. According to 3GPP specifications, the new 5G core makes use of a cloud-aligned, service-based architecture (SBA) that covers all 5G interactions and services, including authentication, security, session management, and traffic aggregation from end devices. The 5G core emphasises NFV even more as an integrated design idea with software functionalities that may be put in the network that are virtualized. The bus-based 5G core network architecture is depicted in Figure 2. The 3GPP Technical Specification 23.501 outlines the 5G core network architecture.



The primary Network Functions (NFs) and their capabilities as they are defined in the standards process today are as below:

i. Authentication Server Function (AUSF):

This acts as an authentication server. It contains mainly the EAP authentication server functionality and acts as storage for keys and provides keying material to the requester NF.

ii. Access and Mobility Management Function (AMF)

It terminates NAS signals, protects NAS ciphering & integrity, manages registration, connections, mobility, access authentication and authorization, and manages security context. The Network Slice Selection Function (NSSF) and the RAN CP interface termination point (N2) are also included in the AMF.

iii. Session Management Function (SMF):

It performs DHCP operations, UE IP address allocation and management, termination of NAS signals related to session management, DL data notification, and traffic steering configuration for UPF for optimal traffic routing. It also manages sessions (session setup, modification, and release).

iv. User Plane Function (UPF):

It performs packet forwarding and routing, packet inspection, QoS management, serves as an external PDU session point of interface to the Data Network (DN), and operates as an anchor point for intra- and inter-RAT mobility.

vi. NF Repository Function (NRF):

Discovering instances of network functions is done via the network repository function (NRF). It offers the found NF instances when an NF instance makes an NF discovery request. It is absent from 4G. It manages and supports the following: a. Service-Based Interfaces, Management & Maintenance profiles of Network Function (NF) instances and the services they support inside the network

The NF Repository Function (NRF) in the SBA facilitates service discovery amongst different network functions. It keeps track of profiles for network function instances and their supported services, including endpoint details such IP addresses, function IDs, function types, network slice identifiers, capacity information, and supported services. It represents a significant "pivot" for the SBA in this regard.

An major part of the creation of a new session is played by the NRF. Here, the AMF starts the SMF discovery and selection process when it receives a request from the UE to start a data connection. The right SMF is found and chosen with the help of the NRF. The identical procedure is carried out in a network slice context: the AMF asks the NRF to pick

Through service-based interfaces (using HTTP 2.0 transport), control-plane processes converse with one another over the NRF. These self-contained software modules may be seen as micro services and are reusable independently of one another. The network function (NF) has two ways to interact with other NFs: either it can subscribe to a producer and be notified when certain conditions arise, such as when a subscriber's state changes to inactive mode, or it can request information about subscriber policies from a producer NF (see top of Figure 2). has two ways to communicate: either a consumer NF may ask a producer NF for a response, such

as information on subscriber policies, or it can subscribe to a producer and get notifications as needed, such as when a subscriber's state shifts to inactive mode.

vii. Policy Control Function (PCF):

It implements a uniform policy framework, provides CP functions with policy rules, and provides access to subscription data for policy choices in UDR. Incorporating network slicing, roaming, and mobility management, this offers a policy framework. It resembles the 4G Policy and Charging Rules Function (PCRF), which is already in place.

viii. Unified Data Management (UDM):

It maintains subscriber information and profiles, generates authentication and key agreement (AKA) credentials, handles user identification, authorises access, and manages subscriptions.

ix. Application Functions (AF):

Similar to an application server that can communicate with other control-plane NFs is the application function (AF). For various application services, AFs can exist and be either owned by the network operator or by dependable outside parties. For instance, the AF of a provider of over-the-top applications might have an impact on routing by directing traffic to the provider's external edge servers. While untrusted or third-party AFs would access the Network Functions through the NEF, the AF can access services that the operator deems to be trusted directly.

x. Data Network (DN):

This is the external data network that allows access to operator services, third-party services, etc.

Other authorised network functions can access their services thanks to this enhanced representation of the 5G Core Architecture in the control plane's network functions, such as the Access Management Function (AMF). Diameter-like protocols are replaced with HTTP-based APIs for communication with these nodes. With the introduction of stateless functions, interfaces based on APIs, and a movement towards the software world, this constitutes a significant change in the telecom industry. The general concept and its possible advantages include: a. Flexible and adaptable architecture

Application Programming Interfaces (APIs) are used to facilitate integration with third-party applications.

c. User equipment (UE) with numerous slices, where a single UE is connected to several services distributed among several slices with improved access and mobility signals.

d. Increased QoS

IMPLEMENTATION

The AMARI Callbox Ultimate does not have a built-in graphical card however you can remotely connect to the callbox by using one of the Ethernet ports.

A 3GPP-compatible eNodeB, gNodeB, EPC, and 5GC called AMARI Callbox Ultimate

enables testing of NR, LTE, LTE-M, and NB-IoT devices' functionality and performance. For VoLTE and eMBMS testing, it also comes with an integrated IMS server and an eMBMS gateway.

A complete solution that uses the Fedora 30 operating system is Callbox Ultimate. It includes all of the software, licences, and four PCIe SDR cards needed to simulate your 4G or 5G network.
The initial setup and configuration procedures for your Amarisoft Callbox are covered in this guide. Please refer to the application notes and other papers located under extranet.amarisoft.com or within the /root/components>/doc/ folders of your Callbox for advanced setups and testing.

In relation to 5G networks, Amarisoft today announced its partnership with AMD. The AMD RyzenTM-powered AMARI Callbox Extreme was just released by Amarisoft. This new Callbox completes the current series in terms of performance in mmwave and sub-6 GHz bands, enabling customers to fully use the capabilities of 5G technology. Its maximum downlink speeds are 9.5 Gbps. It supports NR-DC with up to 10 carriers in FR2 MIMO 22 or 6 carriers in sub-6 GHz MIMO 44, as well as 4G, 5G NSA, and SA. On the vRAN side, Amarisoft can offer 42 NR SA cells in a 100 MHz MIMO 44 configuration with an aggregate throughput of 61 Gbps in DL and 3.1 Gbps in UL running on 112 cores using its full software solution, which includes low PHY, high PHY, and protocol stack, running on a dual socket platform powered by AMD EPYCTM 7713 processors. The mobile industry now has access to a high-performance 5G solution that is The mobile industry now has access to a high-performance 5G solution that is both economical and of the highest calibre thanks to Amarisoft's dedication to complete software RAN and AMD EPYC processors.

The large core count and effective memory management of the sophisticated AMD CPU architecture offer a fresh view on the possibilities and capabilities of the Amarisoft complete software RAN solution. Franck added that no hardware acceleration card was used.

CODE:
INTRODUCTION TO WIRESHARK

An effective and well-liked open-source network protocol analyzer is Wireshark. It offers a full set of instruments for recording, examining, and debugging network data. Users of Wireshark can acquire profound insights into network behaviour, traffic patterns, and protocol usage.

An introduction to Wireshark is given below:
The main application of Wireshark is network packet analysis. Users may use it to either analyse previously collected packet traces or capture packets from a network interface. It aids in figuring out how network protocols work, identifying network problems, and guaranteeing proper network performance.

Wireshark's ability to record live network traffic allows users to view the packets as they move through the network in real time. Ethernet, Wi-Fi, and virtual interfaces are just a few of the many network interfaces it offers.
Protocol analysis: Wireshark translates and decodes a variety of network protocols, giving precise details on packet payloads, headers, and other protocol-specific data. It allows users to comprehend the structure and content of network packets by supporting protocol dissection at various OSI model layers.

Search and filter: Wireshark has a robust filtering feature that lets you zero in on certain packets or interesting protocols. Based on parameters like IP addresses, port numbers, protocol kinds, and more, users may develop filters. Additionally, it offers search capabilities for locating certain packet data or patterns inside collected traces.

Display and Visualisation: To visualise network statistics, packet timing, and flow data, Wireshark offers customizable views and graphs. Users may create graphs and charts to examine the performance, behaviour, and anomalies of the network.

CONCLUSION:
Therefore, 5G NR (New Radio) Standalone (SA) is a significant development in wireless communication technology. Here are some important things to think about:

Greater Speed and Capacity: Compared to earlier generations, 5G NR SA delivers much greater data rates, enabling quicker download and upload speeds. It has the capacity to provide peak data speeds of up to 20 Gbps, enabling applications like virtual reality, augmented reality, and ultra-HD video streaming that need a lot of bandwidth. Furthermore, 5G NR SA increases network capacity to support a huge number of connected devices at once.

Lower Latency: 5G NR SA greatly lowers network latency, or the time it takes for data to be transmitted and received. For real-time applications like driverless cars, remote surgery, and industrial automation, this enhancement is essential.
big Internet of Things (IoT) Connectivity: 5G NR SA is built to facilitate big machine-type communications, enabling a huge number of devices to connect to the network at once. For

Internet of Things (IoT) applications, where extensive deployments of sensors and devices need seamless connection, energy efficiency, and optimised network resources, this is especially advantageous.

Network Slicing: Network slicing, which permits the construction of several virtual networks across a common physical infrastructure, is a notion that 5G NR SA introduces. Network slicing enables operators to provide customised connectivity, latency, and security needs for certain use cases or sectors. This adaptability is essential for enabling a variety of applications and guaranteeing effective resource management.