Started on	Thursday, 26 October 2023, 11:47 AM
State	Finished
Completed on	Thursday, 26 October 2023, 11:51 AM
Time taken	3 mins 49 secs
Grade	**8.00** out of 8.00 (**100**%)

Question **1**

Correct

Mark 1.00 out of 1.00

Do the matching options:

So, Edge Computing reduces the distance between Users (Applications) and Services (Data). But the question remains: "Why has Edge Computing become such a popular technology trend during the past years?"

In mobile networks, Applications (Apps) run in smartphones, whereas Services run in the Operator´s Core Network (IMS Services) or in Internet (commonly in Public clouds). Apps and Services are therefore very 'far away' from each other as perceived from a time point of view (e.g., typically more than 50-100 ms). This is because exchanged data have to travel through a set of networking entities and devices (e.g., aggregation points, IP routers, Peering routers, Interconnection hubs). It is not uncommon that the links to these devices can get congested, and therefore it is impossible to guarantee any end-to-end Quality of Service (QoS) or throughput.

In such an environment Edge Computing plays a key role as the enabling technology to shorten the distance between Users (Apps) and Services (Data) and enable guaranteed Latencies and Throughputs, as required by services and applications. These requirements have become apparent especially with the digitization of Verticals such as Industry 4.0, Collaborative and Automated Driving, E-Health etc.[6]

Peering Routers	Used at network interconnection points. Congestion can occur during high-demand data transfer between networks.
Interconnection Hubs	Physical locations for network providers to exchange data. Congestion at interconnection hubs can result in delays and c
IP Routers	Manage data packet routing in IP networks. Congestion in IP routers can lead to delays and packet loss.
Aggregation Points	Combine data streams, often in mobile networks. They can become congested with high data volumes.

Your answer is correct.

The correct answer is:
Peering Routers → Used at network interconnection points. Congestion can occur during high-demand data transfer between networks.,

Interconnection Hubs → Physical locations for network providers to exchange data. Congestion at interconnection hubs can result in delays and quality of service issues.,

IP Routers → Manage data packet routing in IP networks. Congestion in IP routers can lead to delays and packet loss.,

Aggregation Points → Combine data streams, often in mobile networks. They can become congested with high data volumes.

Question **2**

Correct

Mark 1.00 out of 1.00

1.2 Why is Edge Computing critical for 5G?

The 5G Network is the most recent Mobile Network generation defined by 3GPP. Looking back at the evolution of Mobile Networks, before the introduction of a new generations it has always been a problem to predict which use cases would have been the ones mostly valued by Users:

- 3G Networks were designed mainly for Voice (Circuit Switched) and limited Internet browsing. However, Smartphones appearance in 2007 revealed Apps as the main use case: people used to spend 90% of their mobile usage time with Apps[7].

- 4G Networks were designed for Data services, modelling Voice service as Data (VoLTE), while most of the traffic in 4G Networks is Video (Video will represent 82% of all IP traffic in 2021)[8].

If the Telco Industry would have known that Video was to account for 80% of traffic, most probably the design of 4G Networks would have been different, e.g., introducing Content Delivery Network (CDN) in the architecture.

The reality is that it is impossible to predict how users are going to drive the usage of newly introduced mobile networks. Therefore, for 5G Networks, 3GPP has taken a Service Oriented approach, introducing new key concepts, such as Network Slicing, or a Service Bus Architecture for Microservices, to offer the possibility to create a Virtual Network for a specific Service to deliver the best user experience to customers.

3G Networks were used	to spend 90% of their mobile usage time with Apps	✔
4G Networks were used	to spend 82% of their mobile usage time with Video IP traffic	✔
4G Networks were designed	for Data services, modelling Voice service as Data (VoLTE)	✔
3G Networks were designed	for Voice (Circuit Switched) and limited Internet browsing	✔

Your answer is correct.

The correct answer is:
3G Networks were used → to spend 90% of their mobile usage time with Apps,

4G Networks were used → to spend 82% of their mobile usage time with Video IP traffic,

4G Networks were designed → for Data services, modelling Voice service as Data (VoLTE),

3G Networks were designed → for Voice (Circuit Switched) and limited Internet browsing

Question **3**

Correct

Mark 1.00 out of 1.00

If the Telco Industry would have known that Video was to account for 80% of traffic, most probably the design of 4G Networks would have been different, e.g., introducing Content Delivery Network (CDN) in the architecture.

The reality is that it is impossible to predict how users are going to drive the usage of newly introduced mobile networks. Therefore, for 5G Networks, 3GPP has taken a Service Oriented approach, introducing new key concepts, such as Network Slicing, or a Service Bus Architecture for Microservices, to offer the possibility to create a Virtual Network for a specific Service to deliver the best user experience to customers.

If telco industry could know that video is the dominant traffic, 4G Networks would have implemented

Content Delivery Network (CDN) ✔

Due to unpredictability in dominant application and traffic moving forward, 5G Networks implemented

Service Oriented approach, introducing new key concepts, such as Network Slicing, or a Service Bus Architecture for Micro ✔

Your answer is correct.

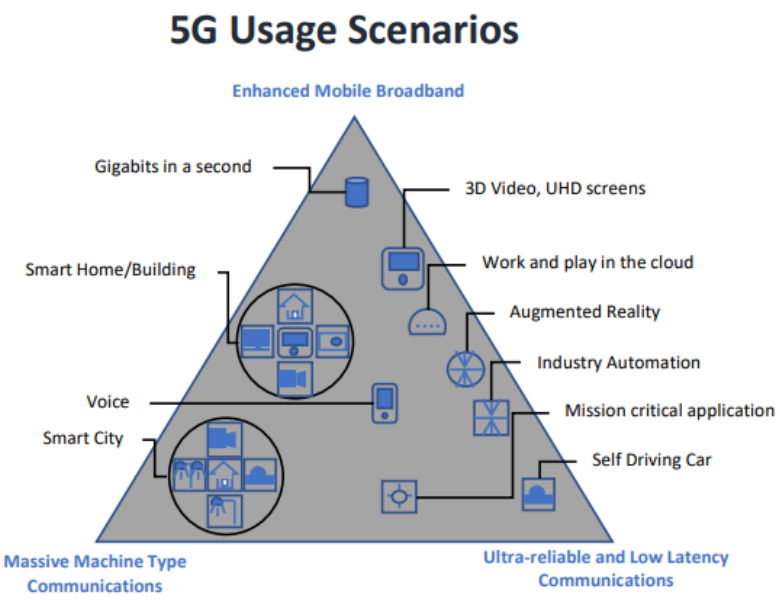
The correct answer is:
If telco industry could know that video is the dominant traffic, 4G Networks would have implemented → Content Delivery Network (CDN),

Due to unpredictability in dominant application and traffic moving forward, 5G Networks implemented → Service Oriented approach, introducing new key concepts, such as Network Slicing, or a Service Bus Architecture for Microservices

Question **4**

Correct

Mark 1.00 out of 1.00



5G enables an 1000X increase of devices connected to the Network, moving from 1K devices per Km2 in 4G to 1M devices in 5G	Massive Machine Type Communications (mMTC) ✔
aims to service more densely populated metropolitan centers with downlink speeds approaching 1 Gbps (gigabits-per second) indoors, and 300 Mbps (megabits-per-second) outdoors.	Enhanced Mobile Broadband (eMBB) ✔
addresses critical communications where bandwidth is not quite as important as speed - specifically, an end-to-end (E2E) latency of 1 ms or less.	Ultra-Reliable and Low Latency Communications (URLLC) ✔

Your answer is correct.

The correct answer is:
5G enables an 1000X increase of devices connected to the Network, moving from 1K devices per Km2 in 4G to 1M devices in 5G → Massive Machine Type Communications (mMTC),

aims to service more densely populated metropolitan centers with downlink speeds approaching 1 Gbps (gigabits-per second) indoors, and 300 Mbps (megabits-per-second) outdoors. → Enhanced Mobile Broadband (eMBB),

addresses critical communications where bandwidth is not quite as important as speed - specifically, an end-to-end (E2E) latency of 1 ms or less. → Ultra-Reliable and Low Latency Communications (URLLC)

Question **5**

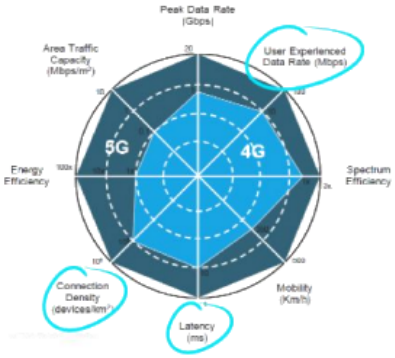
Correct

Mark 1.00 out of 1.00

Need of Edge Computing for various 5G Usage Scenarios.

In order to deliver the above mentioned above value proposition, Edge Computing plays a fundamental role, as Compute resources are critical to enable those three capabilities to the Network, so to be able to finally deliver a satisfactory E2E experience.

Figure 5 elaborates on what the main enhancements to some key system capabilities are, when moving from a 4G network to a 5G one.



eMBB: increasing Data transfer in Radio interface is not enough. Content needs to be closer to customers in order to sustain high data transfers rate with no congestion.
URLLC: reducing Latency in Radio interface is not enough. We need to move Services closer to customers in order to deliver a reduced and guaranteed E2E Latency.
mMTC: increasing the number of connected devices to the network needs to be accompanied by processing the signalling and data from these devices at the edge of the network to digest the volumes of information generated by a huge number of Things connected to the network.

processing the signaling and data from these devices at the edge of the network to digest the volumes of information generated by a huge number of Things connected to the network.

Massive Machine Type Communications (mMTC) ✔

We need to move Services closer to customers in order to deliver a reduced and guaranteed E2E Latency.

Ultra-Reliable and Low Latency Communications (URLLC) ✔

Content needs to be closer to customers in order to sustain high data transfers rate with no congestion.

Enhanced Mobile Broadband (eMBB) ✔

Your answer is correct.

The correct answer is:
processing the signaling and data from these devices at the edge of the network to digest the volumes of information generated by a huge number of Things connected to the network. → Massive Machine Type Communications (mMTC),

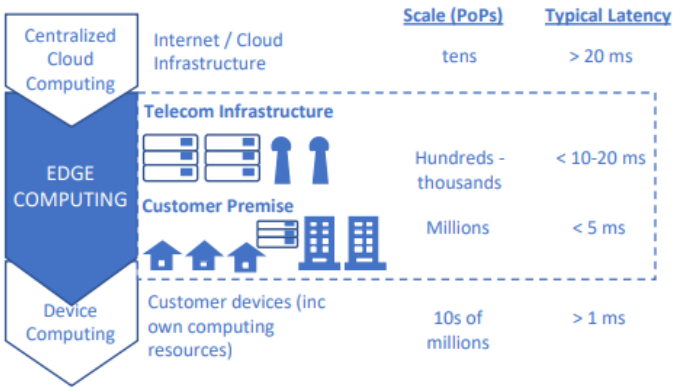
We need to move Services closer to customers in order to deliver a reduced and guaranteed E2E Latency. → Ultra-Reliable and Low Latency Communications (URLLC),

Content needs to be closer to customers in order to sustain high data transfers rate with no congestion. → Enhanced Mobile Broadband (eMBB)

Question **6**

Correct

Mark 1.00 out of 1.00



Customer device (inc own computing resources)	latency > 1 ms ✔
Internet / Cloud Infrastructure	latency > 20 ms ✔
Customer Premise	latency < 5 ms ✔
Telecom Infrastructure	latency < 10-20 ms ✔

Your answer is correct.

The correct answer is:
Customer device (inc own computing resources) → latency > 1 ms,

Internet / Cloud Infrastructure → latency > 20 ms,

Customer Premise → latency < 5 ms,

Telecom Infrastructure → latency < 10-20 ms

Question **7**

Correct

Mark 1.00 out of 1.00

Which of the following best describes the impact of Edge Computing?

1.1 What is Edge Computing

There are many definitions for the term Edge Computing. The Linux Foundation has created an Open Glossary and under Edge Computing [3] one can read the following definition:

The delivery of computing capabilities to the logical extremes of a network in order to improve the performance, operating cost and reliability of applications and services. By shortening the distance between devices and the cloud resources that serve them, and also reducing network hops, edge computing mitigates the latency and bandwidth constraints of today's Internet, ushering in new classes of applications. In practical terms, this means distributing new resources and software stacks along the path between today's centralized data centers and the increasingly large number of devices in the field, concentrated, in particular, but not exclusively, in close proximity to the last mile network, on both the infrastructure and device sides.

So, Edge Computing reduces the distance between Users (Applications) and Services (Data). But the question remains: "Why has Edge Computing become such a popular technology trend during the past years?"

- a. It increases the distance between Users (Applications) and Services (Data).
- b. It has no effect on the distance between Users (Applications) and Services (Data).
- c. It completely eliminates the need for Users (Applications) to access Services (Data).
- d. It reduces the distance between Users (Applications) and Services (Data). ✔

Your answer is correct.

The correct answer is:
It reduces the distance between Users (Applications) and Services (Data).

Question **8**

Correct

Mark 1.00 out of 1.00

Mobile and sensor-based content, Web-based unstructured content, DBMS-based structured content are:

So, Edge Computing reduces the distance between Users (Applications) and Services (Data). But the question remains: "Why has Edge Computing become such a popular technology trend during the past years?"

We can explain this explosion of interest by looking at Big Data and AI evolution.

BIG DATA PHASE 1		BIG DATA PHASE 2		BIG DATA PHASE 3	
Period: 1970-2000	DBMS-based, structured content: • RDBMS & data warehousing • Extract Transfer Load • Online Analytical Processing • Dashboards & scoreboards • Data mining & Statistical analysis	Period: 2000-2010	Web-based, unstructured content • Information retrieval and extraction • Opinion mining • Question answering • Web analytics and web intelligence • Social media analytics • Social network analysis • Spatial-temporal analysis	Period: 2010-Present	Mobile and sensor-based content • Location-aware analysis • Person-centered analysis • Context-relevant analysis • Mobile visualization • Human-Computer Interaction

Figure 2: Big Data major phases from the Enterprise Big Data Professional Guide[4]

While the beginning of Big Data can be set in the 90s, it is really in the last decade that Data explosion took place.
The application of AI to Big Data increased the need for larger Data sets to train inference models. Public cloud has played an instrumental role in this space, but the more the data set grows, the more difficult is to move the data.

That´s why Dave McCrory in 2010 introduced the concept of "Data Gravity"[5]. The idea is that data and applications are attracted to each other, similar to the attraction between objects as explained by the Law of Gravity.

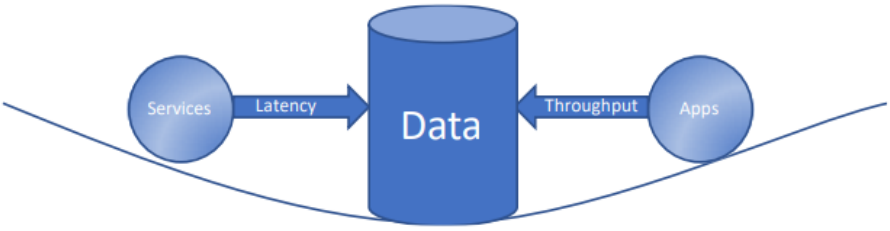


Figure 3: The Data Gravity concept introduced in 2010 by Dave McCrory

- a. Big Data Phase 2, 3, 1
- b. Big Data Phase 1, 2, 3
- c. Big Data Phase 3, 2, 1 ✔
- d. Big Data Phase 1, 3, 2

Your answer is correct.

The correct answer is:
Big Data Phase 3, 2, 1

◄ 05. 5G NR Evolution

Jump to...

Started on	Sunday, 29 October 2023, 4:05 PM
State	Finished
Completed on	Sunday, 29 October 2023, 4:11 PM
Time taken	5 mins 45 secs
Grade	**17.00** out of 17.00 (**100**%)

Question **1**

Correct

Mark 6.00 out of 6.00

Match the process that occurs when a user connects to the internet via a 5G network.

Continuously monitors the user's mobility and manages handovers within the coverage area.	Mobility Management ✔
The establishment of communication sessions for user data traffic.	Session Establishment ✔
Setting up security keys to secure the connection between the user's device and the network.	Security Key Setup ✔
The process of identifying the user's device and assigning a temporary identity.	User Registration ✔
Managing the routing of user data traffic between the base station and external networks.	Traffic Routing ✔
Involves verifying the user's identity using authentication protocols.	User Authentication ✔

Your answer is correct.

The correct answer is:
Continuously monitors the user's mobility and manages handovers within the coverage area. → Mobility Management,

The establishment of communication sessions for user data traffic. → Session Establishment,

Setting up security keys to secure the connection between the user's device and the network. → Security Key Setup,

The process of identifying the user's device and assigning a temporary identity. → User Registration,

Managing the routing of user data traffic between the base station and external networks. → Traffic Routing,

Involves verifying the user's identity using authentication protocols. → User Authentication

Question **2**

Correct

Mark 11.00 out of 11.00

Match the 5G Core module's functionality with the particular module's name

Provides real-time data analytics and insights for network optimization.	Network Data Analytics Function (NWDAF) ✔
Handles the establishment and management of communication sessions.	Session Management Function (SMF) ✔
Offers data and application services within the 5G network.	Application Function (AF) ✔
Provides authentication and authorization services for the network.	Authentication Server Function (AUSF) ✔
Exposes network capabilities and services to external applications.	Network Exposure Function (NEF) ✔
Serves as a repository for information about network services and functions.	Network Repository Function (NRF) ✔
Responsible for managing the user's mobility, including handovers within the network.	Access and Mobility Management Function (AMF) ✔
Manages and controls the quality of service (QoS) and policy enforcement.	Policy Control Function (PCF) ✔
Manages the forwarding of user data packets and performs data plane functions.	User Plane Function (UPF) ✔
Manages subscriber data and user profiles.	Unified Data Management (UDM) ✔
Responsible for selecting the appropriate network slice based on user requirements.	Network Slice Selection Function (NSSF) ✔

Your answer is correct.

The correct answer is:
Provides real-time data analytics and insights for network optimization. → Network Data Analytics Function (NWDAF),

Handles the establishment and management of communication sessions. → Session Management Function (SMF),

Offers data and application services within the 5G network. → Application Function (AF),

Provides authentication and authorization services for the network. → Authentication Server Function (AUSF),

Exposes network capabilities and services to external applications. → Network Exposure Function (NEF),

Serves as a repository for information about network services and functions. → Network Repository Function (NRF),

Responsible for managing the user's mobility, including handovers within the network. → Access and Mobility Management Function (AMF),

Manages and controls the quality of service (QoS) and policy enforcement. → Policy Control Function (PCF),

Manages the forwarding of user data packets and performs data plane functions. → User Plane Function (UPF),

Manages subscriber data and user profiles. → Unified Data Management (UDM),

Responsible for selecting the appropriate network slice based on user requirements. → Network Slice Selection Function (NSSF)

◄ Early Open Quiz -01 (Edge Computing)

Jump to...

Started on	Friday, 3 November 2023, 5:44 PM
State	Finished
Completed on	Friday, 3 November 2023, 6:03 PM
Time taken	19 mins 24 secs
Grade	**3.00** out of 3.00 (**100**%)

Question **1**

Correct

Mark 1.00 out of 1.00

Match the following Call flow Options

📡 Objective: Sync UE with the gNB's timing. 📍 Actions:UE performs cell search. Captures PSS and SSS to identify the cell.	Downlink Synchronization ✔
📶 Objective: Align UE's transmission timing with gNB. 📍 Actions:UE initiates RACH process. Transmits a randomly chosen preamble. gNB responds with a timing adjustment.	Uplink Synchronization ✔
📡 Objective: Set up a radio resource control connection. 📍 Actions:UE sends an RRCSetupRequest message. gNB responds with RRCSetup, providing configuration info.	RRC Establishment ✔
📝 Objective: Register UE with the 5G network. 📍 Actions:UE sends a Registration Request to the AMF. Includes security credentials and network capability.	Registration Request ✔
🔐 Objective: Verify UE's identity for secure communication. 📍 Actions:AMF sends an authentication challenge. UE responds with a computed authentication response.	Authentication Process ✔
🛡️ Objective: Establish security keys for secure communication. 📍 Actions:AMF sends a Security Mode Command. UE acknowledges with Security Mode Complete message.	Security Process ✔
✅ Objective: Finalize UE's registration with the 5G network. 📍 Actions:AMF sends Registration Accept with 5G-GUTI and configuration info. UE is now successfully registered.	Registration Accept ✔
📶 Objective: Configure UE for data transmission. 📍 Actions:gNB sends RRCReconfiguration with necessary configuration info.	RRC Reconfiguration ✔
🌐 Objective: Initiate a data session for UE. 📍 Actions:UE sends a PDU Session Establishment Request to the SMF. Request includes data session requirements like SSC Mode, PCO, DNN, etc.	PDU Session Establishment Request ✔
🎉 Objective: Confirm the establishment of the data session. 📍 Actions:SMF sends PDU Session Establishment Accept. UE is now ready for data transmission over the established PDU session.	PDU Session Establishment Accept ✔

Your answer is correct.

The correct answer is:
📡 Objective: Sync UE with the gNB's timing.
📍 Actions:UE performs cell search.
Captures PSS and SSS to identify the cell. → Downlink Synchronization,

📶 Objective: Align UE's transmission timing with gNB.
📍 Actions:UE initiates RACH process.
Transmits a randomly chosen preamble.
gNB responds with a timing adjustment. → Uplink Synchronization,

📡 Objective: Set up a radio resource control connection.
📍 Actions:UE sends an RRCSetupRequest message.
gNB responds with RRCSetup, providing configuration info. → RRC Establishment,

📝 Objective: Register UE with the 5G network.
📍 Actions:UE sends a Registration Request to the AMF.
Includes security credentials and network capability. → Registration Request,

🔐 Objective: Verify UE's identity for secure communication.
📍 Actions:AMF sends an authentication challenge.
UE responds with a computed authentication response. → Authentication Process,

🛡️ Objective: Establish security keys for secure communication.
📍 Actions:AMF sends a Security Mode Command.
UE acknowledges with Security Mode Complete message. → Security Process,

✅ Objective: Finalize UE's registration with the 5G network.
📍 Actions:AMF sends Registration Accept with 5G-GUTI and configuration info.
UE is now successfully registered. → Registration Accept,

📶 Objective: Configure UE for data transmission.
📍 Actions:gNB sends RRCReconfiguration with necessary configuration info. → RRC Reconfiguration,

🌐 Objective: Initiate a data session for UE.
📍 Actions:UE sends a PDU Session Establishment Request to the SMF.
Request includes data session requirements like SSC Mode, PCO, DNN, etc. → PDU Session Establishment Request,

🎉 Objective: Confirm the establishment of the data session.
📍 Actions:SMF sends PDU Session Establishment Accept.
UE is now ready for data transmission over the established PDU session. → PDU Session Establishment Accept

Question **2**

Correct

Mark 1.00 out of 1.00

Arrange the following Call Flow Options

Step 01:	Downlink Synchronization	✔
Step 02:	Uplink Synchronization	✔
Step 03:	RRC Establishment	✔
Step 04:	Registration Request	✔
Step 05:	Authentication Process	✔
Step 06:	Security Process	✔
Step 07:	Registration Accept	✔
Step 08:	RRC Reconfiguration	✔
Step 09:	PDU Session Establishment Request	✔
Step 10:	PDU Session Establishment Accept	✔

Your answer is correct.

The correct answer is:
Step 01: → Downlink Synchronization,

Step 02: → Uplink Synchronization,

Step 03: → RRC Establishment,

Step 04: → Registration Request,

Step 05: → Authentication Process,

Step 06: → Security Process,

Step 07: → Registration Accept,

Step 08: → RRC Reconfiguration,

Step 09: → PDU Session Establishment Request,

Step 10: → PDU Session Establishment Accept

Question **3**

Correct

Mark 1.00 out of 1.00

Match the Following Call Flow Options

Downlink Synchronization	Sync UE with the gNB's timing ✔
Uplink Synchronization	Align UE's transmission timing with gNB. ✔
RRC Establishment	Set up a radio resource control connection. ✔
Registration Request	Register UE with the 5G network. ✔
Authentication Process	Verify UE's identity for secure communication. ✔
Security Process	Establish security keys for secure communication. ✔
Registration Accept	Finalize UE's registration with the 5G network. ✔
RRC Reconfiguration	Configure UE for data transmission. ✔
PDU Session Establishment Request	Initiate a data session for UE. ✔
PDU Session Establishment Accept	Confirm the establishment of the data session. ✔

Your answer is correct.

The correct answer is:
Downlink Synchronization → Sync UE with the gNB's timing,

Uplink Synchronization → Align UE's transmission timing with gNB.,

RRC Establishment → Set up a radio resource control connection.,

Registration Request → Register UE with the 5G network.,

Authentication Process → Verify UE's identity for secure communication.,

Security Process → Establish security keys for secure communication.,

Registration Accept → Finalize UE's registration with the 5G network.,

RRC Reconfiguration → Configure UE for data transmission.,

PDU Session Establishment Request → Initiate a data session for UE.,

PDU Session Establishment Accept → Confirm the establishment of the data session.

◄ Early Open Quiz -02 (5G Core)

Jump to...

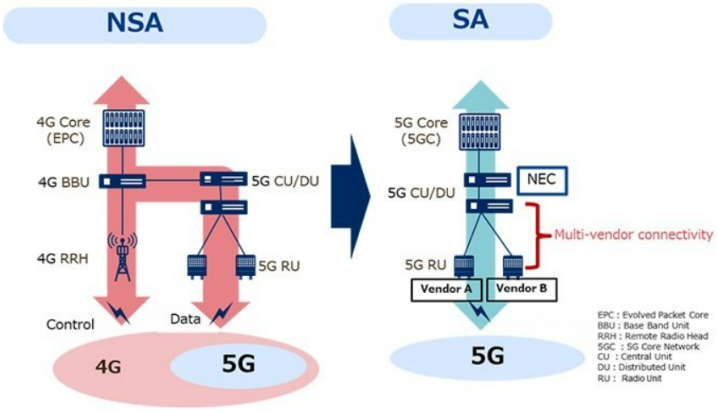
Early Open Quiz -04 (NSA vs SA deployment) ►

Started on	Sunday, 5 November 2023, 9:51 AM
State	Finished
Completed on	Sunday, 5 November 2023, 9:51 AM
Time taken	35 secs
Grade	**1.00** out of 1.00 (**100**%)

Question **1**

Correct

Mark 1.00 out of 1.00



What is the main difference between the NSA system and the SA system in 5G networks?

- a. NSA uses 4G cores and 5G base stations, while SA uses 5G cores and 5G base stations. ✔
- b. NSA uses 5G cores and 5G base stations, while SA uses 4G cores and 5G base stations.
- c. NSA uses 5G cores and 4G base stations, while SA uses 5G cores and 5G base stations.
- d. NSA and SA systems are identical in terms of their core and base station configurations.

Your answer is correct.

The correct answer is:
NSA uses 4G cores and 5G base stations, while SA uses 5G cores and 5G base stations.

◄ Early Open Quiz -03 (Call Flow)

Jump to...

Early Open Quiz -05 (PNF VNF CNF) ►

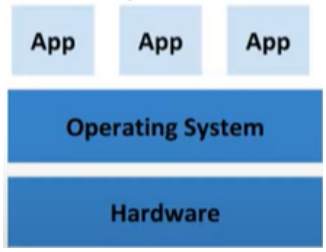
Started on	Sunday, 5 November 2023, 9:52 AM
State	Finished
Completed on	Sunday, 5 November 2023, 9:52 AM
Time taken	33 secs
Grade	**1.00** out of 1.00 (**100**%)

Question **1**

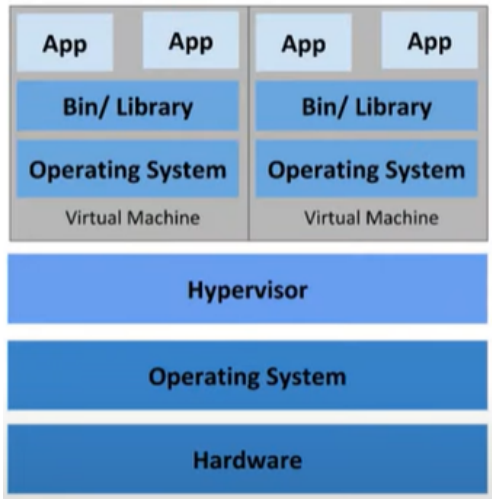
Correct

Mark 1.00 out of 1.00

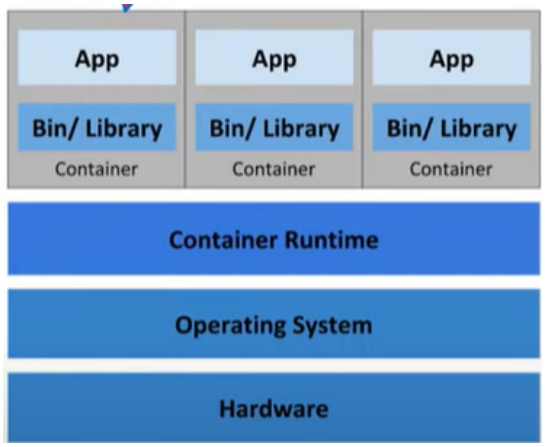
Match the followings



Traditional Deployment using PNF (Physical Network Functions) ✔



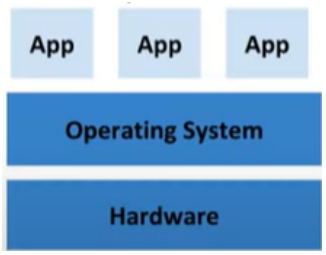
Virtualized Deployment using VNF (Virtual Network Functions) ✔



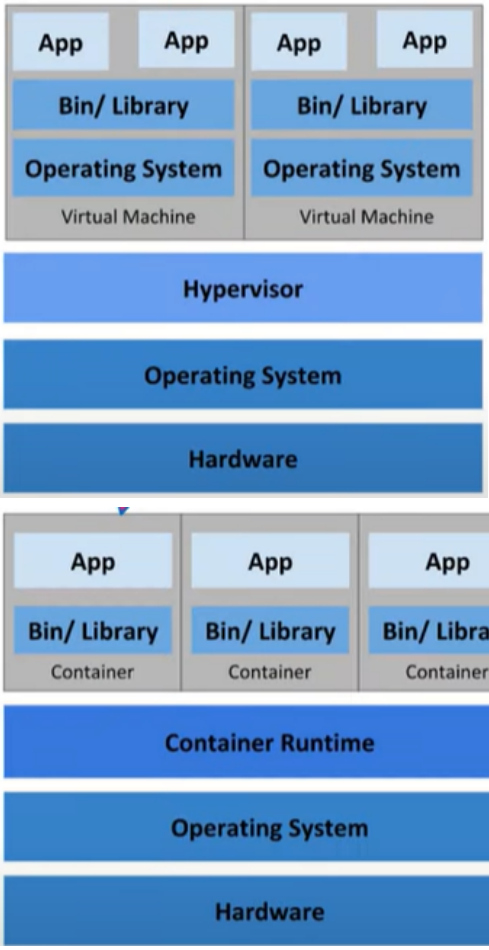
Container Deployment using CNF (Container Network Functions) ✔

Your answer is correct.

The correct answer is:



→ Traditional Deployment using PNF (Physical Network Functions),



→ Virtualized Deployment using VNF (Virtual Network Functions),

→ Container Deployment using CNF (Container Network Functions)

◄ Early Open Quiz -04 (NSA vs SA deployment)

Jump to...

Early Open Quiz -06 (Edge Computing) ►

Started on	Monday, 6 November 2023, 10:55 PM
State	Finished
Completed on	Monday, 6 November 2023, 10:56 PM
Time taken	34 secs
Grade	**2.00** out of 2.00 (**100**%)

Question **1**

Correct

Mark 1.00 out of 1.00

Match the followings:

A footprint-flexible, efficient, automated infrastructure providing high reliability, deployed on-premise or in the CSP network, hosting telco workloads and 3rd party/over the top applications with limited local management system.	Infrastructure ✔
Providing smart 3rd party/over the top workload placement and topology discovery, controlling where applications are deployed and how they're configured.	Orchestration ✔
Exposing APIs for the edge and at the edge for telco applications, facilitating interaction with the telecom network and improving use cases.	Exposure ✔
Routing data to the nearest edge location where the application is hosted to enhance the customer experience.	Traffic routing ✔
Enabling termination at distributed sites through the deployment of a 3GPP-compliant, low footprint Packet Core user plane functions.	User plane ✔

Your answer is correct.

The correct answer is:
A footprint-flexible, efficient, automated infrastructure providing high reliability, deployed on-premise or in the CSP network, hosting telco workloads and 3rd party/over the top applications with limited local management system. → Infrastructure,

Providing smart 3rd party/over the top workload placement and topology discovery, controlling where applications are deployed and how they're configured. → Orchestration,

Exposing APIs for the edge and at the edge for telco applications, facilitating interaction with the telecom network and improving use cases. → Exposure,

Routing data to the nearest edge location where the application is hosted to enhance the customer experience. → Traffic routing,

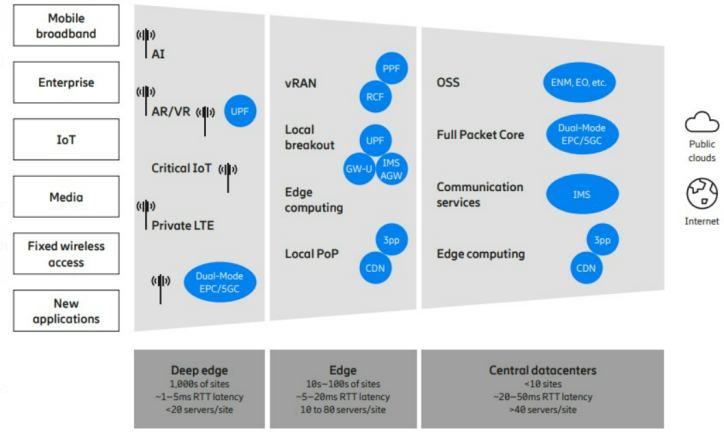
Enabling termination at distributed sites through the deployment of a 3GPP-compliant, low footprint Packet Core user plane functions. → User plane

Question **2**

Correct

Mark 1.00 out of 1.00

Where will you keep your heavy compute intensive application?



a. Edge

b. Public Cloud

c. Central Datacenter

d. Deep Edge ✔

Your answer is correct.

The correct answer is:
Deep Edge

◄ Early Open Quiz -05 (PNF VNF CNF)

Jump to...

Early Open Quiz -07 (Call Flow) ►

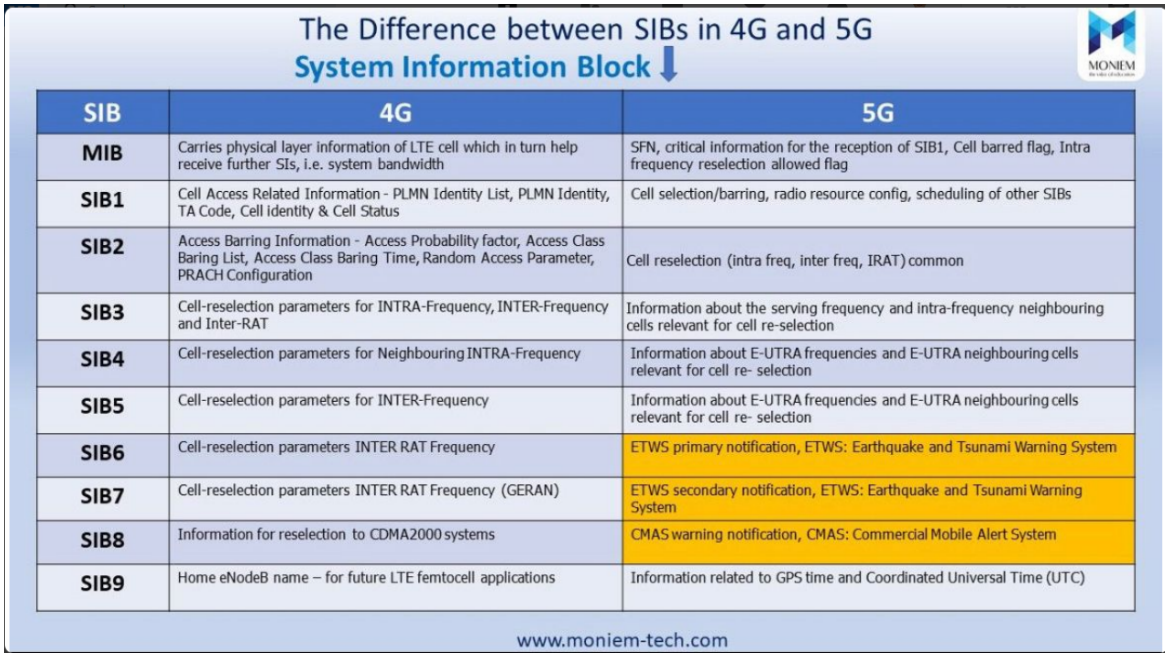
Started on	Monday, 6 November 2023, 10:56 PM
State	Finished
Completed on	Monday, 6 November 2023, 10:57 PM
Time taken	38 secs
Grade	**2.00** out of 2.00 (**100**%)

Question **1**

Correct

Mark 1.00 out of 1.00

Match the followings:



SIB	4G	5G
MIB	Carries physical layer information of LTE cell which in turn help receive further SIs, i.e. system bandwidth	SFN, critical information for the reception of SIB1, Cell barred flag, Intra frequency reselection allowed flag
SIB1	Cell Access Related Information - PLMN Identity List, PLMN Identity, TA Code, Cell identity & Cell Status	Cell selection/barring, radio resource config, scheduling of other SIBs
SIB2	Access Barring Information - Access Probability factor, Access Class Baring List, Access Class Baring Time, Random Access Parameter, PRACH Configuration	Cell reselection (intra freq, inter freq, IRAT) common
SIB3	Cell-reselection parameters for INTRA-Frequency, INTER-Frequency and Inter-RAT	Information about the serving frequency and intra-frequency neighbouring cells relevant for cell re-selection
SIB4	Cell-reselection parameters for Neighbouring INTRA-Frequency	Information about E-UTRA frequencies and E-UTRA neighbouring cells relevant for cell re- selection
SIB5	Cell-reselection parameters for INTER-Frequency	Information about E-UTRA frequencies and E-UTRA neighbouring cells relevant for cell re- selection
SIB6	Cell-reselection parameters INTER RAT Frequency	ETWS primary notification, ETWS: Earthquake and Tsunami Warning System
SIB7	Cell-reselection parameters INTER RAT Frequency (GERAN)	ETWS secondary notification, ETWS: Earthquake and Tsunami Warning System
SIB8	Information for reselection to CDMA2000 systems	CMAS warning notification, CMAS: Commercial Mobile Alert System
SIB9	Home eNodeB name – for future LTE femtocell applications	Information related to GPS time and Coordinated Universal Time (UTC)

Initial Registration	MIB and SIB1	✔
Cell Reselection	SIB2 - SIB5	✔
Emergency Services	SIB6- SIB8	✔

Your answer is correct.

The correct answer is:
Initial Registration → MIB and SIB1,

Cell Reselection → SIB2 - SIB5,

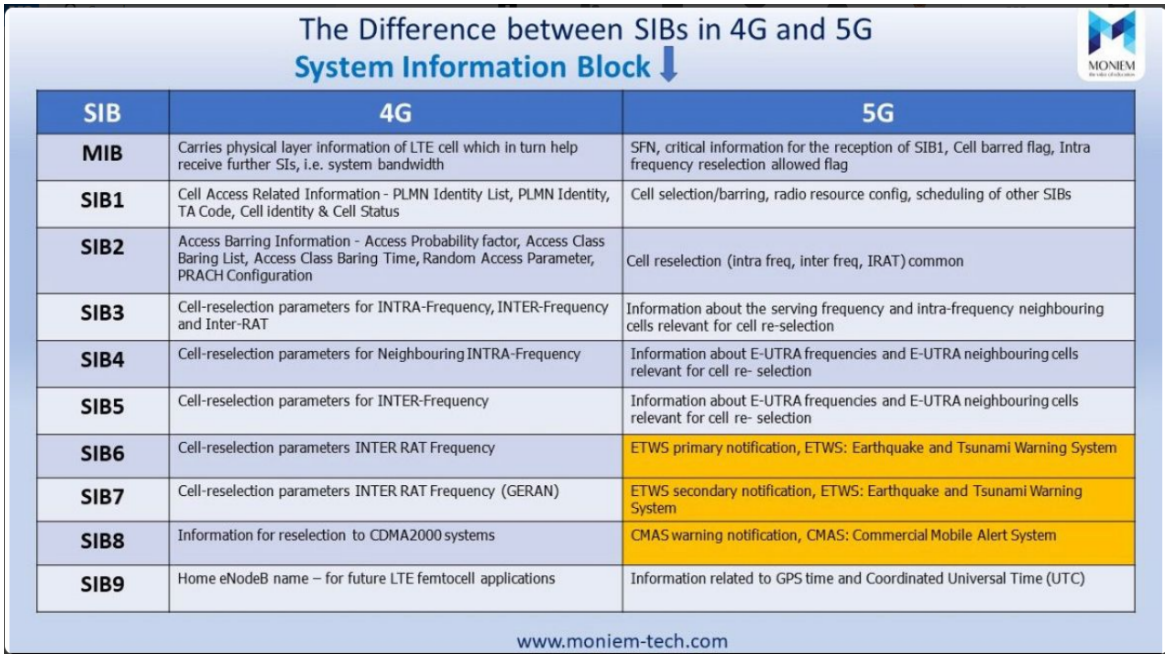
Emergency Services → SIB6- SIB8

Question **2**

Correct

Mark 1.00 out of 1.00

Match the followings:



The Difference between SIBs in 4G and 5G

System Information Block

SIB	4G	5G
MIB	Carries physical layer information of LTE cell which in turn help receive further SIs, i.e. system bandwidth	SFN, critical information for the reception of SIB1, Cell barred flag, Intra frequency reselection allowed flag
SIB1	Cell Access Related Information - PLMN Identity List, PLMN Identity, TA Code, Cell identity & Cell Status	Cell selection/barring, radio resource config, scheduling of other SIBs
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SIB9	Home eNodeB name – for future LTE femtocell applications	Information related to GPS time and Coordinated Universal Time (UTC)

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MIB and SIB1 — Initial Registration ✔

SIB2 - SIB5 — Cell Reselection ✔

SIB6- SIB8 — Emergency Services ✔

Your answer is correct.

The correct answer is:
MIB and SIB1 → Initial Registration,

SIB2 - SIB5 → Cell Reselection,

SIB6- SIB8 → Emergency Services

◄ Early Open Quiz -06 (Edge Computing)

Jump to...

Early Open Quiz -08 (Various frameworks) ►

Started on	Wednesday, 8 November 2023, 9:41 PM
State	Finished
Completed on	Wednesday, 8 November 2023, 9:43 PM
Time taken	2 mins 13 secs
Grade	**2.00** out of 2.00 (**100**%)

Question **1**

Correct

Mark 1.00 out of 1.00

2. Key Technologies for 5G on Edge Computing

As discussed in the previous chapter, Edge Computing can be seen as an open platform where the core capabilities of networks, computing, storage, and applications converge. It provides intelligent services at the network Edge near the source of the objects or data to meet the critical requirements of real-time services, data optimization, application intelligence, security and privacy protection of industry digitization. To address these requirements, the frameworks of virtualization, orchestration, networking and operations should be designed and adapted to the distributed nature of the Edge services and applications, the ephemerality of data generated and the scaling needs.

In this section, we introduce some key technologies into four areas: the virtualisation, the orchestration, the network control and operational frameworks. In the last sub-section, we introduce some typical Edge Apps and Services through the description of some Edge Connectivity scenarios.

Edge Computing can be seen as ✔	open platform
converges core capabilities are ✔	networks, computing, storage, and applications
provides ✔	intelligent services at the network Edge near the source of the objects or data
to meet the critical requirements ✔	real-time services, data optimization, application intelligence, security and privacy protection of industry digitization
To address these requirements the frameworks should be designed ✔	virtualization, orchestration, networking and operations
To address these requirements the frameworks should be adapted ✔	distributed nature of the Edge services and applications

Your answer is correct.

The correct answer is:
Edge Computing can be seen as → open platform,

converges core capabilities are → networks, computing, storage, and applications,

provides → intelligent services at the network Edge near the source of the objects or data,

to meet the critical requirements → real-time services, data optimization, application intelligence, security and privacy protection of industry digitization,

To address these requirements the frameworks should be designed → virtualization, orchestration, networking and operations,

To address these requirements the frameworks should be adapted → distributed nature of the Edge services and applications

Question **2**

Correct

Mark 1.00 out of 1.00

PUT THE AREAS IN ORDER MENTIONED:

Virtual Machines and Containerization	Resources Virtualization framework ✔
Lightweight virtualization	Resources Virtualization framework ✔
Kubernetes	Orchestration framework ✔
Open Source MANO (OSM) where MANO (Management and Network Orchestration)	Orchestration framework ✔
Open Network Automation Platform (ONAP)	Orchestration framework ✔
SDN for Edge Computing	Networking programmability framework ✔
Data plane programmability	Networking programmability framework ✔
FPGA as a Platform	Acceleration at the Edge ✔
Direct Memory Access on FPGA	Acceleration at the Edge ✔
Seamless Virtualized Acceleration Layer	Acceleration at the Edge ✔

Your answer is correct.

The correct answer is:
Virtual Machines and Containerization → Resources Virtualization framework,

Lightweight virtualization → Resources Virtualization framework,

Kubernetes → Orchestration framework,

Open Source MANO (OSM)
where MANO (Management and Network Orchestration) → Orchestration framework,

Open Network Automation Platform (ONAP) → Orchestration framework,

SDN for Edge Computing → Networking programmability framework,

Data plane programmability → Networking programmability framework,

FPGA as a Platform → Acceleration at the Edge,

Direct Memory Access on FPGA → Acceleration at the Edge,

Seamless Virtualized Acceleration Layer → Acceleration at the Edge

◄ Early Open Quiz -07 (Call Flow)

Jump to...

Early Open Quiz -09 (Resources Virtualization Hardware Acceleration) ►

Started on	Wednesday, 8 November 2023, 9:43 PM
State	Finished
Completed on	Wednesday, 8 November 2023, 9:45 PM
Time taken	1 min 51 secs
Grade	**10.00** out of 10.00 (**100**%)

Question **1**

Correct

Mark 1.00 out of 1.00

What is a container in the context of software development?

- a. A virtual machine that runs applications
- b. A lightweight package of software that includes code, libraries, and dependencies ✔
- c. . A microservices architecture pattern.
- d. A standard lightweight interface for interactions between services.

Your answer is correct.

The correct answer is:
A lightweight package of software that includes code, libraries, and dependencies

Question **2**

Correct

Mark 1.00 out of 1.00

What is a key advantage of containerization mentioned in the text?

- a. Improved service cohesion.
- b. Enhanced security by design ✔
- c. Increased use of quota management resources.
- d. Complex resource sharing with virtual machines.

Your answer is correct.

The correct answer is:
Enhanced security by design

Question **3**

Correct

Mark 1.00 out of 1.00

What distinguishes Edge Computing from Multi-Access Edge Computing (MEC)?

- a. Edge Computing focuses on stateful applications, while MEC uses stateless event-triggered functions.
- b. Edge Computing is an ETSI standard architecture, whereas MEC is a concept. ✔
- c. Edge Computing relies on virtualization, while MEC leverages containerization.
- d. Edge Computing is ideal for all use-cases, while MEC is specific to broadcasting and CDN scenarios.

Your answer is correct.

The correct answer is:
Edge Computing is an ETSI standard architecture, whereas MEC is a concept.

Question **4**

Correct

Mark 1.00 out of 1.00

What is the primary challenge in achieving high bandwidth and low latency for Edge Computing?

- a. Security vulnerabilities
- b. Data processing limitations ✔
- c. Hardware compatibility
- d. Network congestion

Your answer is correct.

The correct answer is:
Data processing limitations

Question **5**

Correct

Mark 1.00 out of 1.00

What technology is mentioned as a breakthrough for performing networking and security functions in Edge Computing locations?

- a. 5G connectivity
- b. Artificial Intelligence
- c. Quantum computing
- d. NFV (Network Functions Virtualization) ✔

Your answer is correct.

The correct answer is:
NFV (Network Functions Virtualization)

Question **6**

Correct

Mark 1.00 out of 1.00

How does using an FPGA for data processing affect latency in comparison to CPU-based software solutions?

- a. FPGA increases latency significantly
- b. FPGA increases latency slightly
- c. FPGA has no impact on latency
- d. FPGA reduces latency to a few microseconds ✔

Your answer is correct.

The correct answer is:
FPGA reduces latency to a few microseconds

Question **7**

Correct

Mark 1.00 out of 1.00

In terms of cybersecurity, what is a significant advantage of offloading data processing to an FPGA?

- a. Enhanced firewall protection
- b. Separation of networking from computation ✔
- c. Improved network bandwidth
- d. Lower operational costs

Your answer is correct.

The correct answer is:
Separation of networking from computation

Question **8**

Correct

Mark 1.00 out of 1.00

Why are FPGA-based SmartNICs considered futureproof in Edge Computing?

- a. They are fully reprogrammable for emerging functionalities ✔
- b. They are low-cost solutions
- c. They require frequent hardware upgrades
- d. They offer general-purpose functionality

Your answer is correct.

The correct answer is:
They are fully reprogrammable for emerging functionalities

Question **9**

Correct

Mark 1.00 out of 1.00

What role does DPDK (Data Plane Development Kit) play in enhancing NIC performance in conjunction with FPGA-based DMA functionality?

- a. It improves server security.
- b. It enhances software flexibility.
- c. It reduces CPU core requirements. ✔
- d. It increases memory utilization.

Your answer is correct.

The correct answer is:
It reduces CPU core requirements.

Question **10**

Correct

Mark 1.00 out of 1.00

How do DPDK APIs contribute to the virtualized acceleration layer?

- a. By requiring specific FPGA code
- b. By controlling FPGA hardware separately
- c. By enabling hardware agnosticism ✔
- d. By limiting SmartNIC functionality

Your answer is correct.

The correct answer is:
By enabling hardware agnosticism

◄ Early Open Quiz -08 (Various frameworks)

Jump to...

Early Open Quiz -10 (ETSI NFV) ►

Started on	Wednesday, 8 November 2023, 10:47 PM
State	Finished
Completed on	Wednesday, 8 November 2023, 10:54 PM
Time taken	7 mins 9 secs
Grade	**10.00** out of 10.00 (**100**%)

Question **1**

Correct

Mark 1.00 out of 1.00

Which component is responsible for managing the virtualized resources in NFV for 5G?

- a. NFV Orchestration (NFVO)
- b. Network Service Catalog
- c. Virtualized Infrastructure Manager (VIM) ✔
- d. VNF Manager (VNFM)

Your answer is correct.

The correct answer is:
Virtualized Infrastructure Manager (VIM)

Question **2**

Correct

Mark 1.00 out of 1.00

What is the role of NFV Orchestration (NFVO) in 5G networks?

- a. Coordinating the lifecycle of VNFs to create Network Services ✔
- b. Configuring Network Hardware
- c. Handling Network Security
- d. Managing Network Functions

Your answer is correct.

The correct answer is:
Coordinating the lifecycle of VNFs to create Network Services

Question **3**

Correct

Mark 1.00 out of 1.00

Which component is responsible for coordinating the instantiation, scaling, and termination of Network Services in NFV Orchestration (NFVO)?

- a. VNF Manager (VNFM)
- b. NFV Orchestrator (NFVO) ✔
- c. Network Service Catalog
- d. NFV Infrastructure (NFVI)

Your answer is correct.

The correct answer is:
NFV Orchestrator (NFVO)

Question **4**

Correct

Mark 1.00 out of 1.00

What does NFVI stand for in 5G NFV?

- a. Network Function Visualization Infrastructure
- b. Network Function Verification and Inspection
- c. Network Function Virtualization Interface
- d. Network Functions Virtualization Infrastructure ✔

Your answer is correct.

The correct answer is:
Network Functions Virtualization Infrastructure

Question **5**

Correct

Mark 1.00 out of 1.00

What is the primary purpose of Business Support Systems (BSS) in the telecommunications industry?

- a. Managing network infrastructure and resources
- b. Ensuring data security and privacy in telecommunications
- c. Handling customer-related operations and revenue management ✔
- d. Monitoring network performance and troubleshooting issues

Your answer is correct.

The correct answer is:
Handling customer-related operations and revenue management

Question **6**

Correct

Mark 1.00 out of 1.00

What is the main function of Operations Support Systems (OSS) in the telecommunications industry?

- a. Monitoring and managing network infrastructure and services ✔
- b. Handling regulatory compliance and data privacy
- c. Providing customer support and service maintenance
- d. Managing customer-related operations and billing

Your answer is correct.

The correct answer is:
Monitoring and managing network infrastructure and services

Question **7**

Correct

Mark 1.00 out of 1.00

What is the primary role of the LCM Proxy in the context of network services?

- a. Handling customer service inquiries and support requests
- b. Coordinating the lifecycle management of network functions or services ✔
- c. Managing customer billing and revenue generation
- d. Ensuring data security and privacy in telecommunications

Your answer is correct.

The correct answer is:
Coordinating the lifecycle management of network functions or services

Question **8**

Correct

Mark 1.00 out of 1.00

What is the main purpose of a Customer Self-Service Portal (CSSP) in the telecommunications industry?

- a. Providing customers with tools to manage their own accounts and services ✔
- b. Coordinating the lifecycle management of network functions
- c. Managing network infrastructure and services
- d. Ensuring regulatory compliance and data privacy in telecommunications

Your answer is correct.

The correct answer is:
Providing customers with tools to manage their own accounts and services

Question **9**

Correct

Mark 1.00 out of 1.00

Match the following roles:

CSP	Provides tools for customers to manage their own accounts and services. ✔
SCP	Handles call control and service logic, such as call routing and feature management. ✔
BSS	Handles customer-related operations, billing, and revenue management. ✔
OSS	Manages and monitors network infrastructure and services. ✔
MANO	Manages and orchestrates the management and orchestration of NFV infrastructure. ✔
VNFM	Coordinates the lifecycle management of virtual network functions (VNFs). ✔
NFVO	Orchestrates the lifecycle of VNFs to create Network Services. ✔
VIM	Manages virtualized resources. ✔

Your answer is correct.

The correct answer is:
CSP → Provides tools for customers to manage their own accounts and services.,

SCP → Handles call control and service logic, such as call routing and feature management.,

BSS → Handles customer-related operations, billing, and revenue management.,

OSS → Manages and monitors network infrastructure and services.,

MANO → Manages and orchestrates the management and orchestration of NFV infrastructure.,

VNFM → Coordinates the lifecycle management of virtual network functions (VNFs).,

NFVO → Orchestrates the lifecycle of VNFs to create Network Services.,

VIM → Manages virtualized resources.

Question **10**

Correct

Mark 1.00 out of 1.00

Match the following roles:

Provides tools for customers to manage their own accounts and services.	CSP ✔
Handles call control and service logic, such as call routing and feature management.	SCP ✔
Handles customer-related operations, billing, and revenue management.	BSS ✔
Manages and monitors network infrastructure and services.	OSS ✔
Manages and orchestrates the management and orchestration of NFV infrastructure.	MANO ✔
Coordinates the lifecycle management of virtual network functions (VNFs).	VNFM ✔
Orchestrates the lifecycle of VNFs to create Network Services.	NFVO ✔
Manages virtualized resources.	VIM ✔

Your answer is correct.

The correct answer is:
Provides tools for customers to manage their own accounts and services. → CSP,

Handles call control and service logic, such as call routing and feature management. → SCP,

Handles customer-related operations, billing, and revenue management. → BSS,

Manages and monitors network infrastructure and services. → OSS,

Manages and orchestrates the management and orchestration of NFV infrastructure. → MANO,

Coordinates the lifecycle management of virtual network functions (VNFs). → VNFM,

Orchestrates the lifecycle of VNFs to create Network Services. → NFVO,

Manages virtualized resources. → VIM

◄ Early Open Quiz -09 (Resources Virtualization Hardware Acceleration)

Jump to...

Early Open Quiz -11 (Orchestration and Networking Framework) ►

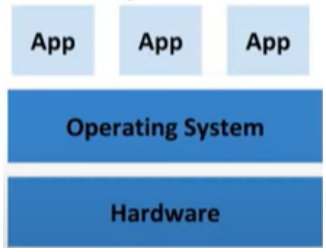
Started on	Wednesday, 8 November 2023, 10:54 PM
State	Finished
Completed on	Wednesday, 8 November 2023, 10:56 PM
Time taken	2 mins 39 secs
Grade	**10.00** out of 10.00 (**100**%)

Question **1**

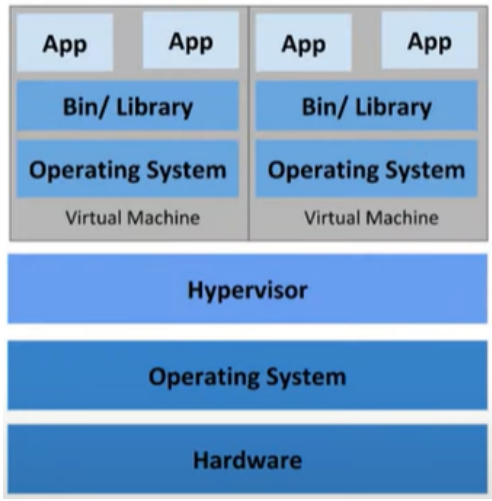
Correct

Mark 1.00 out of 1.00

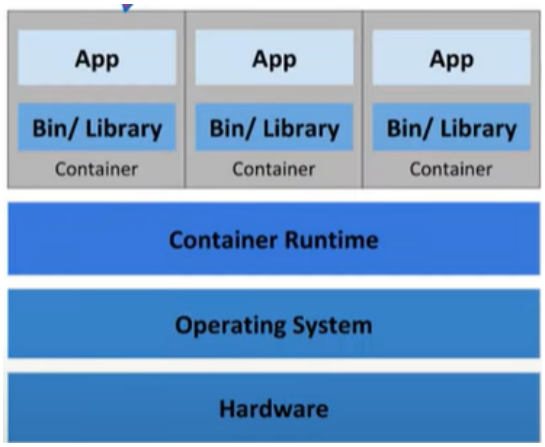
Match the followings



Traditional Deployment using PNF (Physical Network Functions) ✔



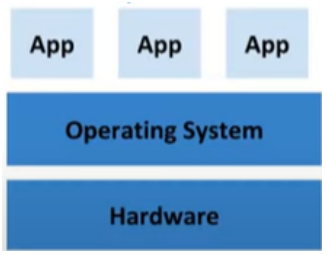
Virtualized Deployment using VNF (Virtual Network Functions) ✔



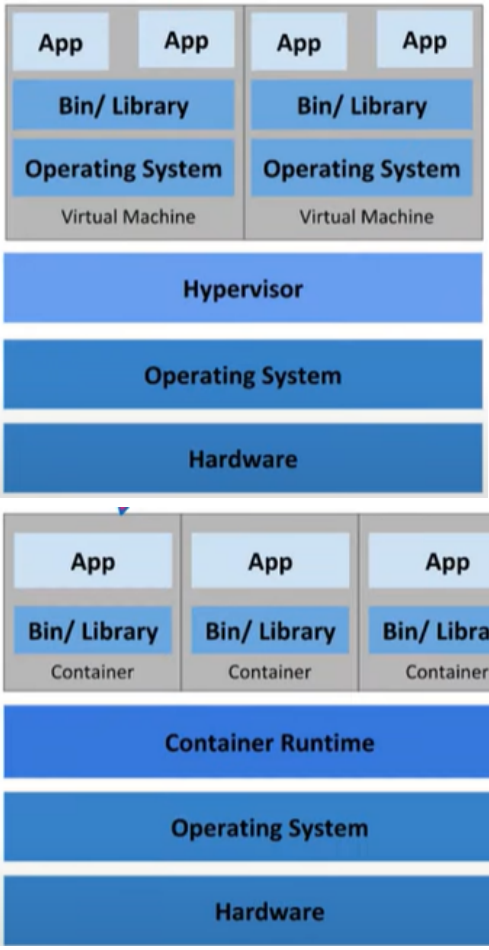
Container Deployment using CNF (Container Network Functions) ✔

Your answer is correct.

The correct answer is:



→ Traditional Deployment using PNF (Physical Network Functions),



→ Virtualized Deployment using VNF (Virtual Network Functions),

→ Container Deployment using CNF (Container Network Functions)

Question **2**

Correct

Mark 1.00 out of 1.00

What is the primary role of Kubernetes in container orchestration?

- a. Acting as an intelligent, intent-based orchestration engine ✔
- b. Treating it as a "dumb" NFV Infrastructure
- c. Managing physical hardware resourcesAnswer:
- d. Providing a low-effort way to integrate with existing NFV Infrastructure

Your answer is correct.

The correct answer is:
Acting as an intelligent, intent-based orchestration engine

Question **3**

Correct

Mark 1.00 out of 1.00

What advantage does Kubernetes offer when managing Container Network Functions (CNFs)?

a. It treats CNFs as just one more NFVI.

b. It can orchestrate not only containers but also various resources in NFVIs ✔

c. It replaces traditional NFV infrastructure with ease

d. It simplifies the deployment of legacy orchestration solutions.

Your answer is correct.

The correct answer is:
It can orchestrate not only containers but also various resources in NFVIs

Question **4**

Correct

Mark 1.00 out of 1.00

What is k3s?

a. An intent-based orchestration engine for Kubernetes.

b. A lightweight Kubernetes solution suitable for edge environments. ✔

c. A mainstream Kubernetes option for large-scale deployments.

d. A traditional orchestration framework for Kubernetes.

Your answer is correct.

The correct answer is:
A lightweight Kubernetes solution suitable for edge environments.

Question **5**

Correct

Mark 1.00 out of 1.00

What roles do kube-apiserver, kube-manager, kube-scheduler, kubelet, and kube-proxy play in managing Kubernetes clusters?

a. They are management and network orchestration tools

b. They are components responsible for different aspects of cluster coordination, health checking, scheduling, monitoring, and network proxy functionalities. ✔

c. They are various Kubernetes distributions.

d. They are Kubernetes-native patterns for network services.

Your answer is correct.

The correct answer is:
They are components responsible for different aspects of cluster coordination, health checking, scheduling, monitoring, and network proxy functionalities.

Question **6**

Correct

Mark 1.00 out of 1.00

What is the primary objective of Open Source MANO (OSM)?

- a. Providing a containerized network stack
- b. Delivering a production-quality MANO stack for NFV ✔
- c. Hosting physical network functions (PNFs)
- d. Managing cloud-native applications

Your answer is correct.

The correct answer is:
Delivering a production-quality MANO stack for NFV

Question **7**

Correct

Mark 1.00 out of 1.00

In OSM Release EIGHT, what does it allow within the same Network Service?

- a. Combining physical network functions with cloud-native applications
- b. Combining cloud-native applications with traditional virtual and physical network functions (VNFs and PNFs) ✔
- c. Supporting only OpenStack-based VIMs
- d. Integrating various SDN frameworks

Your answer is correct.

The correct answer is:
Combining cloud-native applications with traditional virtual and physical network functions (VNFs and PNFs)

Question **8**

Correct

Mark 1.00 out of 1.00

What is the primary objective of the Open Network Automation Platform (ONAP)?

- a. Supporting cloud-native applications
- b. Enabling telco networks to become increasingly autonomous ✔
- c. Hosting telecommunication networks
- d. Managing network security

Your answer is correct.

The correct answer is:
Enabling telco networks to become increasingly autonomous

Question **9**

Correct

Mark 1.00 out of 1.00

How does ONAP support cloud network elements and services instantiation?

- a. Only for major telco activities
- b. Only at the design-time
- c. In a real-time, dynamic, and closed-loop manner ✔
- d. Only in a static manner

Your answer is correct.

The correct answer is:
In a real-time, dynamic, and closed-loop manner

Question **10**

Correct

Mark 1.00 out of 1.00

What role does ONAP play in the context of emerging edge cloud architectures?

- a. It is not compatible with edge computing.
- b. It provides edge cloud architectures for service orchestration.
- c. ONAP can potentially be integrated into edge cloud architectures for service orchestration.
- d. It serves as a separate network automation platform for edge computing. ✔

Your answer is correct.

The correct answer is:
It serves as a separate network automation platform for edge computing.

◄ Early Open Quiz -10 (ETSI NFV)

Jump to...

Early Open Quiz -12 (ETSI MEC Services API and Specifications) ►

Started on	Thursday, 9 November 2023, 8:38 AM
State	Finished
Completed on	Thursday, 9 November 2023, 8:39 AM
Time taken	1 min 32 secs
Grade	**2.00** out of 2.00 (**100**%)

Question **1**

Correct

Mark 1.00 out of 1.00

ETSI MEC has developed a comprehensive set of guidelines and standards to enable the development and usage of various MEC services, with a focus on APIs and service discovery. Match the followings.

ETSI MEC Service: General Principles for Mobile Edge Service APIs (GS MEC 009) ✔	Defines the philosophy and principles behind the APIs exposed by the MEC system, providing guidance on how MEC service
ETSI MEC Service: Radio Network Information Service (RNIS) (GS MEC 012) ✔	Allows MEC applications to adjust data transmission rates for user flows based on real-time radio network information. It pr
ETSI MEC Service: MEC Location Service (LS) (GS MEC 013) ✔	A powerful tool for applications to leverage user proximity information, such as monitoring the list of users connected to a s
ETSI MEC Service: Bandwidth Management Service (GS MEC 015) ✔	Enables applications to reserve networking resources in the host, allowing for effective bandwidth management and QoS op

Your answer is correct.

The correct answer is:
ETSI MEC Service: General Principles for Mobile Edge Service APIs (GS MEC 009) → Defines the philosophy and principles behind the APIs exposed by the MEC system, providing guidance on how MEC services should be accessed through RESTful APIs. It sets the foundation for the development of future MEC APIs.,

ETSI MEC Service: Radio Network Information Service (RNIS) (GS MEC 012) → Allows MEC applications to adjust data transmission rates for user flows based on real-time radio network information. It provides control over network resources to optimize data delivery.,

ETSI MEC Service: MEC Location Service (LS) (GS MEC 013) → A powerful tool for applications to leverage user proximity information, such as monitoring the list of users connected to a specific cell. It provides location-based data to MEC applications.,

ETSI MEC Service: Bandwidth Management Service (GS MEC 015) → Enables applications to reserve networking resources in the host, allowing for effective bandwidth management and QoS optimization for various applications.

Question **2**

Correct

Mark 1.00 out of 1.00

ETSI MEC has developed a comprehensive set of guidelines and standards to enable the development and usage of various MEC services, with a focus on APIs and service discovery. Match the followings.

ETSI MEC Specification: Mobile Edge Platform Application Enablement (GS MEC 011) ✔	Defines environmental interfaces over the Mp1 reference point, enabling MEC applications to discover the services they wisl
ETSI MEC Specification: Management Interfaces (Part 1 - GS MEC 010-1) ✔	Focuses on host and platform management, targeting the Mm2 reference point, addressing management aspects of the ME
ETSI MEC Specification: Management Interfaces (Part 2 - GS MEC 010-2) ✔	Focuses on application Lifecycle and Configuration Management (LCM) over reference points Mm1 and Mm3, addressing ap
ETSI MEC Specification: User App LCM Proxy (GS MEC 016) ✔	Describes the interfaces over Mx2 reference, facilitating communication between an application running on the user device

Your answer is correct.

The correct answer is:
ETSI MEC Specification: Mobile Edge Platform Application Enablement (GS MEC 011) → Defines environmental interfaces over the Mp1 reference point, enabling MEC applications to discover the services they wish to consume and register the services they intend to offer. It facilitates service discovery and integration.,

ETSI MEC Specification: Management Interfaces (Part 1 - GS MEC 010-1) → Focuses on host and platform management, targeting the Mm2 reference point, addressing management aspects of the MEC platform itself.,

ETSI MEC Specification: Management Interfaces (Part 2 - GS MEC 010-2) → Focuses on application Lifecycle and Configuration Management (LCM) over reference points Mm1 and Mm3, addressing application lifecycle and configuration management.,

ETSI MEC Specification: User App LCM Proxy (GS MEC 016) → Describes the interfaces over Mx2 reference, facilitating communication between an application running on the user device and the MEC system through the User App LCM proxy. It helps manage and control user-facing applications.

◄ Early Open Quiz -11 (Orchestration and Networking Framework)

Jump to...

Early Open Quiz -13 (Switch Router SDN Basics) ►

Started on	Wednesday, 27 December 2023, 10:16 PM
State	Finished
Completed on	Wednesday, 27 December 2023, 10:20 PM
Time taken	4 mins 18 secs
Grade	**10.00** out of 10.00 (**100**%)

Question **1**

Correct

Mark 1.00 out of 1.00

1.4-1 Components of packet delay. Match the description of each component of packet delay to its name in the pull down list.

Time need for bits to physically propagate through the transmission medium from end one of a link to the other.	Propagation delay ✔
Time spent transmitting packets bits into the link.	Transmission delay ✔
Time spent waiting in packet buffers for link transmission.	Queueing delay ✔
Time needed to perform an integrity check, lookup packet information in a local table and move the packet from an input link to an output link in a router	Processing delay ✔

Propagation delay

Queueing delay

Transmission delay

Processing delay

Question **2**

Correct

Mark 1.00 out of 1.00

1.5-1 Layers in the Internet protocol stack. Match the function of a layer in the Internet protocol stack to its its name in the pulldown menu.

Transfer of a bit into and out of a transmission media.	Physical layer ✔
Delivery of datagrams from a source host to a destination host (typically).	Network layer ✔
Transfer of data between one process and another process (typically on different hosts).	Transport layer ✔
Transfer of data between neighboring network devices.	Link layer ✔
Protocols that are part of a distributed network application.	Application Layer ✔

Application Layer
Link layer
Transport layer
Physical layer
Network layer

Question **3**

Correct

Mark 1.00 out of 1.00

1.5-2 What's a "packet" really called? Match the name of an Internet layer with unit of data that is exchanged among protocol entities at that layer, using the pulldown menu.

Transport layer	Segment ✔
Physical layer	Bit ✔
Application layer	Message ✔
Link layer	Frame ✔
Network layer	Datagram ✔

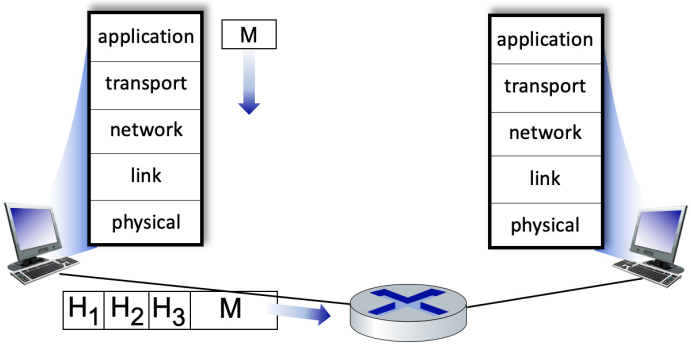
Message
Frame
Datagram
Bit
Segment

Question **4**

Correct

Mark 1.00 out of 1.00

1.5-3 Protocol headers. Consider the figure below, showing a link-layer frame heading from a host to a router. There are three header fields shown. Match the name of a header with a header label shown in the figure.



Header H_1	Link layer ✔	Transport layer
Header H_3	Transport layer ✔	Application layer
Header H_2	Network Layer ✔	Network Layer
		Physical layer
		Link layer

Question **5**

Correct

Mark 1.00 out of 1.00

1.6-1 Security defenses. Match the description of a security defense with its name.

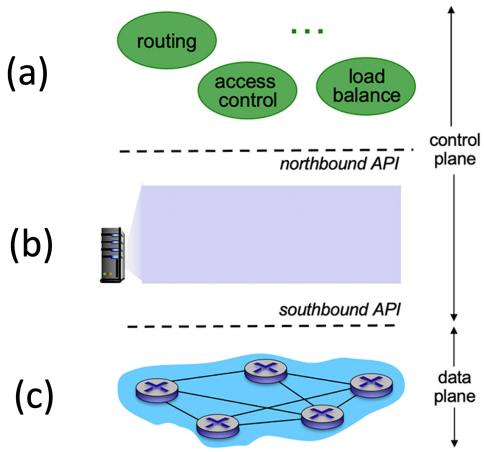
Used to detect tampering/changing of message contents, and to identify the originator of a message.	Digital signatures ✔	Firewall
Limiting use of resources or capabilities to given users.	Access control ✔	Digital signatures
Provides confidentiality by encoding contents	Encryption ✔	Authentication
Specialized "middleboxes" filtering or blocking traffic, inspecting packet contents inspections	Firewall ✔	Encryption
Proving you are who you say you are.	Authentication ✔	Access control

Question **6**

Correct

Mark 1.00 out of 1.00

5.5-1. SDN Layers. Consider the SDN layering shown below. Match each layer name below with a layer label (a), (b) or (c) as shown in the diagram.



Network-control applications	(a) ✔	(a)
SDN Controller (network operating system)	(b) ✔	(b)
SDN-controlled switches	(c) ✔	(c)

Question **7**

Correct

Mark 1.00 out of 1.00

5.5.2 Internal structure of the SDN controller (4). Match of the functions below belong in the controller layer labeled

(a) Interface, abstractions for network control apps	Network Graph, Intent ✔
Network-wide distributed, robust state management	Host, Switch and Link-state information with Flow Table and Statistics ✔
Communication to/from controlled device	OpenFlow protocol ✔

Your answer is correct.

The correct answer is:
(a) Interface, abstractions for network control apps → Network Graph, Intent,

Network-wide distributed, robust state management → Host, Switch and Link-state information with Flow Table and Statistics,

Communication to/from controlled device → OpenFlow protocol

Question **8**

Correct

Mark 1.00 out of 1.00

1.3-1 Routing versus forwarding. Choose one the following two definitions that makes the correct distinction between routing versus forwarding.

- a. **Routing** is the local action of moving arriving packets from router's input link to appropriate router output link, while **forwarding** is the global action of determining the source-destination paths taken by packets.
- b. **Forwarding** is the local action of moving arriving packets from router's input link to appropriate router output link, while **routing** is the global action of determining the source-destination paths taken by packets. ✔ Nice! Your answer is correct.

The correct answer is: **Forwarding** is the local action of moving arriving packets from router's input link to appropriate router output link, while **routing** is the global action of determining the source-destination paths taken by packets.

Question **9**

Correct

Mark 1.00 out of 1.00

4.1-3. The control plane versus the data plane. For each of the actions below, select those actions below that are primarily in the network-layer data plane. The other actions that you don't select below then correspond to control-plane actions.

- a. Computing the contents of the forwarding table.
- b. Dropping a datagram due to a congested (full) output buffer. ✔ Nice! This answer is correct.
- c. Monitoring and managing the configuration and performance of an network device.
- d. Moving an arriving datagram from a router's input port to output port ✔ Nice! This answer is correct.
- e. Looking up address bits in an arriving datagram header in the forwarding table. ✔ Nice! This answer is correct.

The correct answers are: Looking up address bits in an arriving datagram header in the forwarding table., Moving an arriving datagram from a router's input port to output port, Dropping a datagram due to a congested (full) output buffer.

Question **10**

Correct

Mark 1.00 out of 1.00

7.4-5. Connecting 4G cellular networks together. Which of the following statements is true about how 4G cellular networks (operated by different carriers/companies) connect together?

a. In a 4G network, the radio access network connects to the legacy phone network for voice calls, but to the public Internet for data connections.

b. 4G networks are generally all-IP, and so cellular networks interconnect (peer) directly to each other, or peer at the cellular equivalents of the Internet Exchange Points that we saw used for interconnecting wired networks in the public Internet.

✔ Nice! This answer is correct.

c. 4G networks connect to each other using the existing phone interconnection networks from earlier 3G and 2G networks.

The correct answer is: 4G networks are generally all-IP, and so cellular networks interconnect (peer) directly to each other, or peer at the cellular equivalents of the Internet Exchange Points that we saw used for interconnecting wired networks in the public Internet.

◄ Early Open Quiz -12 (ETSI MEC Services API and Specifications)

Jump to...

Early Open Quiz -13 (Switch Router SDN Basics) (For those whose drag and drop is not working) ►

Started on	Wednesday, 27 December 2023, 10:24 PM
State	Finished
Completed on	Wednesday, 27 December 2023, 10:32 PM
Time taken	7 mins 47 secs
Grade	**9.00** out of 9.00 (**100**%)

Question **1**

Correct

Mark 1.00 out of 1.00

Key capabilities defined by the International Telecommunication Union (ITU-R) are

Peak data rate	20 Gbps DL (Downlink) ✔
User data rate	100 Mbps ✔
Latency	1 ms ✔
Spectrum efficiency	3X than 4G ✔
Mobility	500 Km/hr. ✔
Connection density	1 Million devices/sq. km ✔
Network energy efficiency	100X than 4G ✔
Area traffic capacity	10 Mbps/sq. km ✔

Your answer is correct.

The correct answer is:
Peak data rate → 20 Gbps DL (Downlink),

User data rate → 100 Mbps,

Latency → 1 ms,

Spectrum efficiency → 3X than 4G,

Mobility → 500 Km/hr.,

Connection density → 1 Million devices/sq. km,

Network energy efficiency → 100X than 4G,

Area traffic capacity → 10 Mbps/sq. km

Question **2**

Correct

Mark 1.00 out of 1.00

Choose the correct 3GPP Technical Specification Group

CT WG1
User Equipment to Core Network protocols

CT WG3
Interworking with External Networks & Policy and Charging Control

TSG CT Core (Technical Specification Group) Network and Terminal ✔

CT WG4
Core Network Protocols

CT WG6
Smart Card Application Aspects

RAN WG1
Radio Layer 1 (Physical layer)

RAN WG2
Radio layer 2 and Radio layer 3 Radio Resource Control

RAN WG3
UTRAN/E-UTRAN/NG-RAN architecture and related network interfaces

TSG RAN (Technical Specification Group) Radio Access Network ✔

RAN WG4
Radio Performance and Protocol Aspects

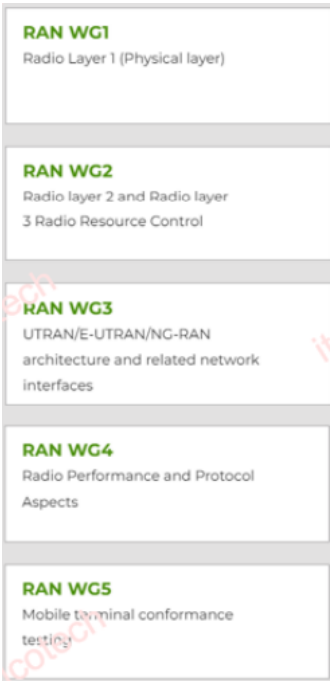
RAN WG5
Mobile terminal conformance testing

TSG SA (Technical Specification Group) Service and System Aspect ✔

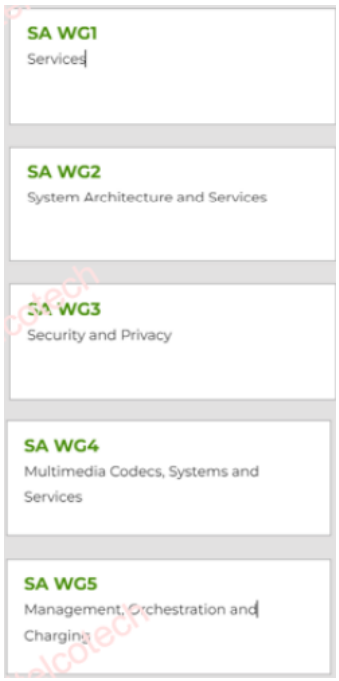
Your answer is correct.

The correct answer is:

→ TSG CT Core (Technical Specification Group) Network and Terminal,



→ TSG RAN (Technical Specification Group) Radio Access Network,



→ TSG SA (Technical Specification Group) Service and System Aspect

Question **3**

Correct

Mark 1.00 out of 1.00

Which 5G use cases contributes to GDP and in what proportion?

5G is expected to boost the global economy by adding US $ 1.3tn to GDP by 2030.
5G contribution to GDP by use case will be:

Fixed wireless access on 5G (FWA) –	33% ✔
Massive Internet of things (MIOT)/ Massive machine type communication –	17% ✔
Ultra-reliable low latency (URLLC) –	17% ✔
Enhanced mobile broadband (eMBB) –	33% ✔

Your answer is correct.

The correct answer is:
Fixed wireless access on 5G (FWA) – → 33%,

Massive Internet of things (MIOT)/ Massive machine type communication – → 17%,

Ultra-reliable low latency (URLLC) – → 17%,

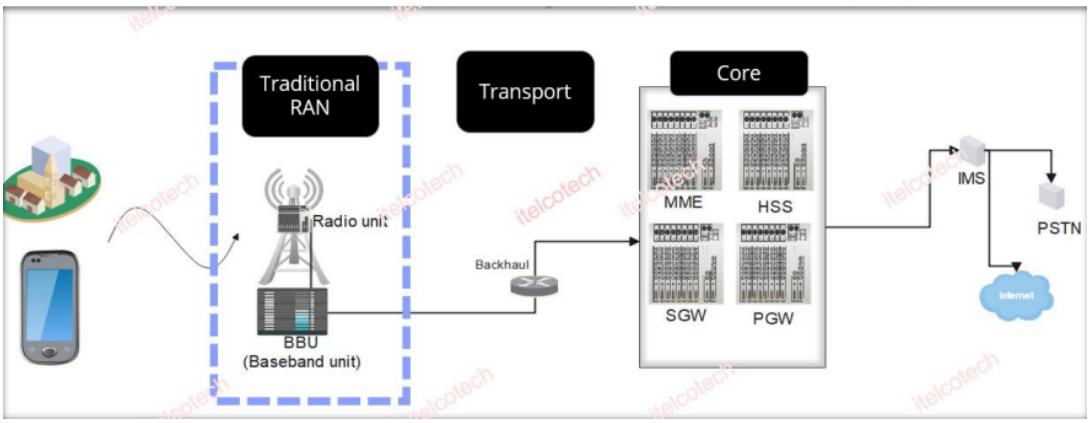
Enhanced mobile broadband (eMBB) – → 33%

Question **4**

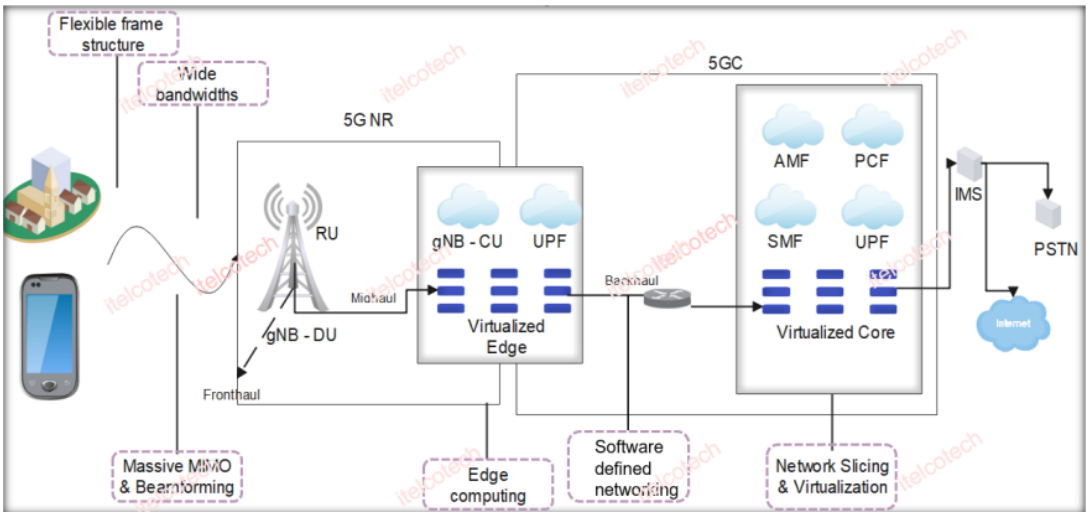
Correct

Mark 1.00 out of 1.00

Choose the correct Options



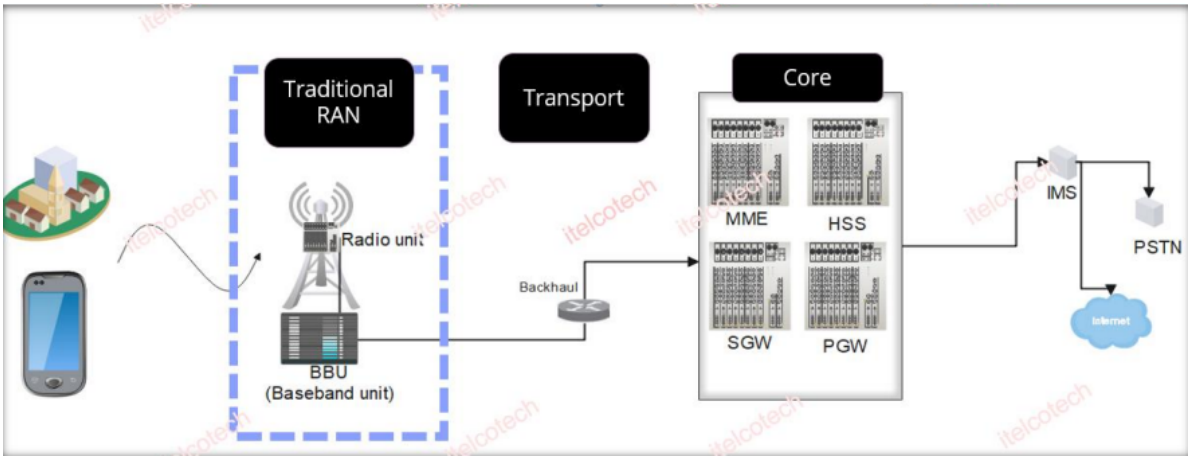
4G ✔



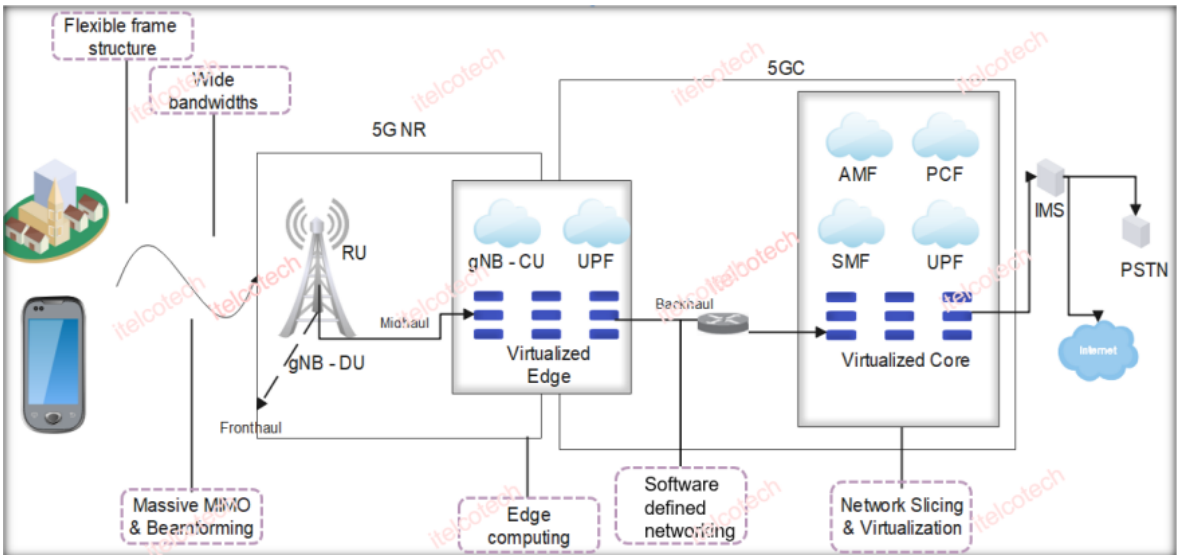
5G ✔

Your answer is correct.

The correct answer is:



→ 4G,



→ 5G

Question **5**

Correct

Mark 1.00 out of 1.00

Match the following: Modern 5G services currently require the modern infrastructure (in the name of NFVi)

Compute Service	CPUs, GPUs, TPUs ✔
Storage Service	NAS, SAN, SDS ✔
Network Service	DPUs, IPUs ✔

Your answer is correct.

The correct answer is:
Compute Service → CPUs, GPUs, TPUs,

Storage Service → NAS, SAN, SDS,

Network Service → DPUs, IPUs

Question **6**

Correct

Mark 1.00 out of 1.00

Match each aspect of 5G technology with its corresponding description:

Massive machine to machine communication (MMTC) ✔	Supports a large number of connected devices, making it suitable for IoT applications and sensor networks.
Enhanced broadband (eMBB) ✔	Focuses on providing better wireless connectivity for high-speed internet, high-definition video streaming, and virtual reality experien
Ensures highly reliable and low-latency communication for critical applications such as autonomous vehicles and industrial automation. ✔	Ultra reliable low latency communication (URLLC)

Your answer is correct.

The correct answer is:
Massive machine to machine communication (MMTC) → Supports a large number of connected devices, making it suitable for IoT applications and sensor networks.,

Enhanced broadband (eMBB) → Focuses on providing better wireless connectivity for high-speed internet, high-definition video streaming, and virtual reality experiences.,

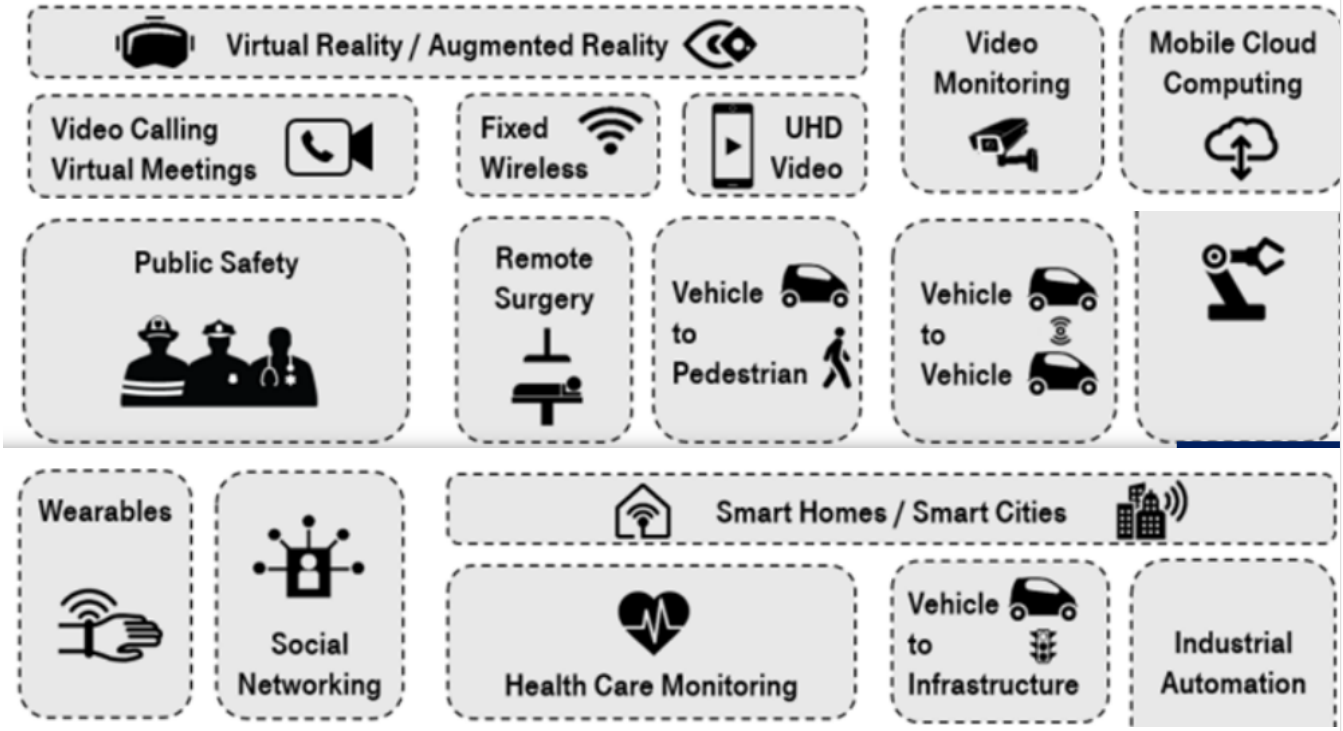
Ensures highly reliable and low-latency communication for critical applications such as autonomous vehicles and industrial automation. → Ultra reliable low latency communication (URLLC)

Question **7**

Correct

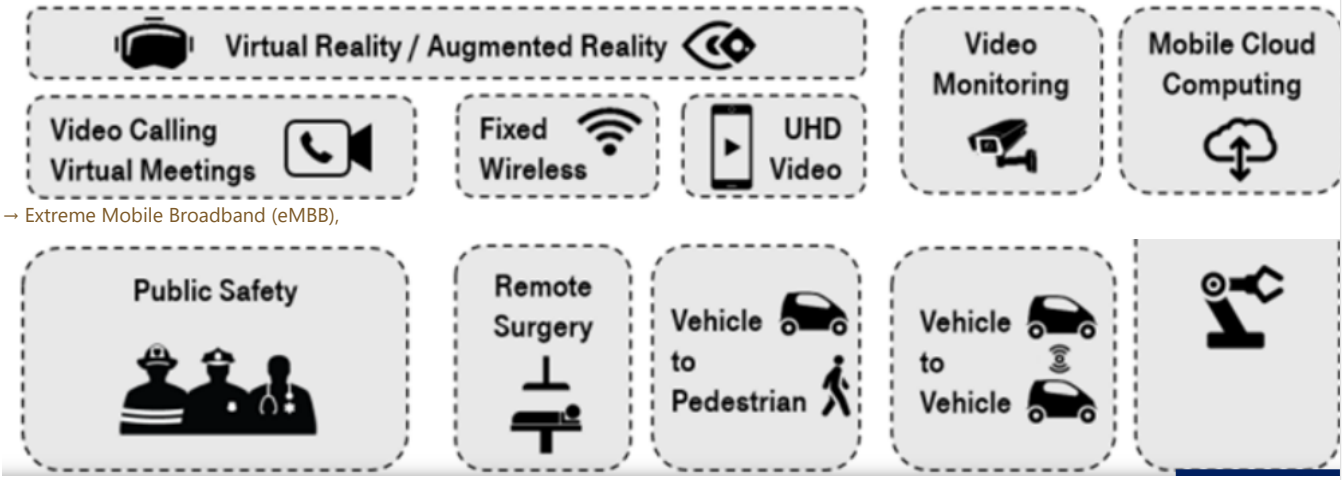
Mark 1.00 out of 1.00

Match the 5G use cases



Your answer is correct.

The correct answer is:



→ Extreme Mobile Broadband (eMBB),

→ Ultra Reliable Low Latency Services,

→ Massive Scale Connectivity

Question **8**

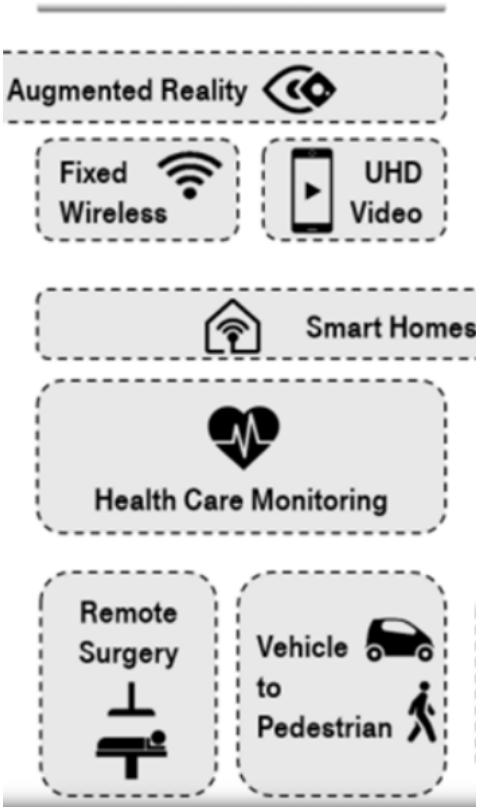
Correct

Mark 1.00 out of 1.00

Match the 5G Human and Machine Interaction

Human to Human ✔

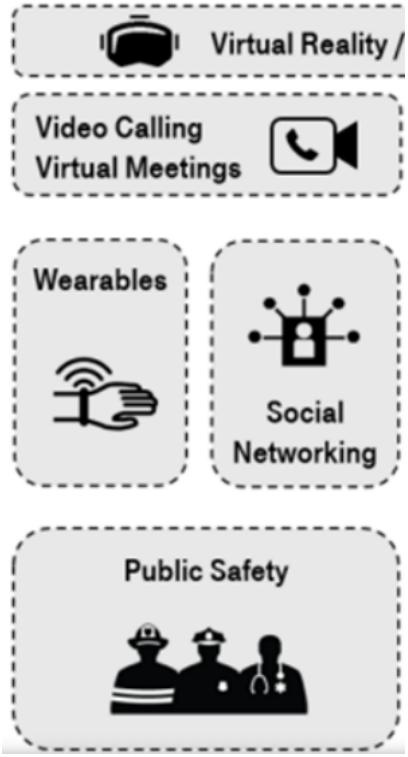
Machine to Machine ✔



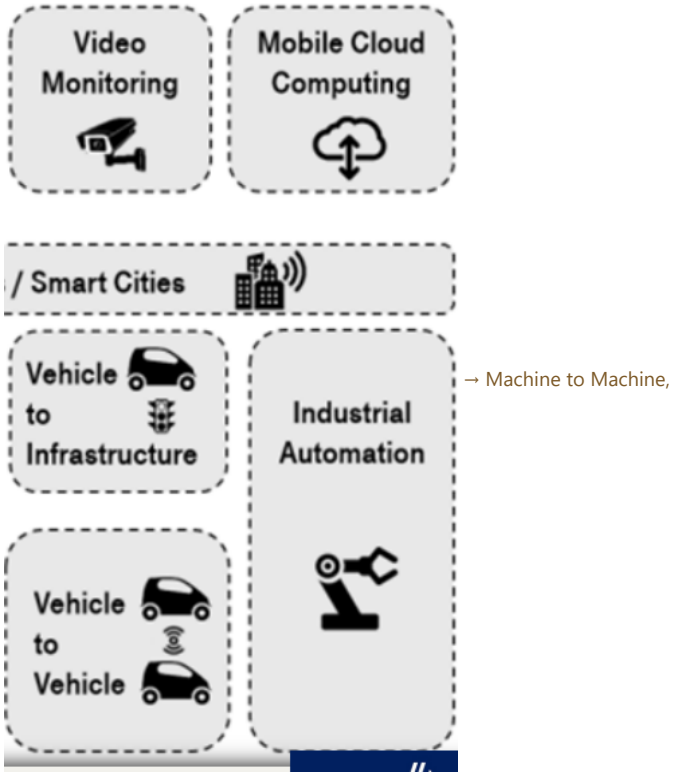
Human to Machine ✔

Your answer is correct.

The correct answer is:



→ Human to Human,



→ Machine to Machine,

→ Human to Machine

Question **9**

Correct

Mark 1.00 out of 1.00

Which standard bodies are working towards evolving 5G technology?

- a. Internet Governance Forum (IGF)
- b. 3rd Generation Partnership Project (3GPP). ✔
- c. Internet Corporation for Assigned Names and Numbers (ICANN)
- d. Internet Engineering Task Force (IETF)

Your answer is correct.

The correct answer is:
3rd Generation Partnership Project (3GPP).

◄ Early Open Quiz -13 (Switch Router SDN Basics) (For those whose drag and drop is not working)

Jump to...

Early Open Quiz - 15 (Feedback) ►

What is the composition of symbols in a single slot in the discussed system?

- ○ 16 symbols
- ○ 10 symbols
- ○ 12 symbols
- ◉ 14 symbols

In the context of subcarriers, why are larger frequency subcarriers essential?

- ○ They increase slot size
- ○ They improve signal strength
- ○ They lower network congestion
- ◉ They reduce latency

How many subcarrier numerologies are mentioned in the discussed system?

- ○ 4
- ○ 6
- ◉ 5
- ○ 3

What comprises a resource block in the system under discussion?

- ○ 15 subcarriers
- ○ 8 subcarriers
- ○ 10 subcarriers
- ◉ 12 subcarriers

Which channels aid in initial network access by synchronizing time, frequency, and conveying essential network details?

- ○ PSS and DM symbols
- ○ PBCH and DM symbols
- ◉ SSS, PSS and PBCH
- ○ Synchronization Signal Blocks (SSB) and PSS

Which frequency ranges are predominantly considered for 5G technology?

- ○ 2 GHz - 3 GHz
- ○ 800 MHz - 1 GHz
- ◉ 24.25 GHz - 52.6 GHz
- ○ 5 GHz - 10 GHz

What is the primary advantage of lower frequency bands in 5G?

- ○ Lower cost
- ○ Greater speed
- ○ Higher capacity
- ◉ Better coverage

What trade-off is associated with higher frequency bands in 5G?

- ○ Reduced speed but better reliability
- ○ Lower cost and higher speed
- ◉ Reduced coverage but higher capacity
- ○ Better coverage and higher capacity

What term is used to describe the band with higher bandwidth in 5G?

- ○ Legacy band
- ○ Lower frequency
- ◉ FR2 band
- ○ Sub-6GHz

Why is selecting 5G spectrum crucial for telecommunications companies (Telcos)?

- [x] It requires significant investment and affects coverage and capacity.
- [ ] It directly impacts smartphone prices.
- [ ] It determines the number of cell towers needed.
- [ ] It influences the number of subscribers a Telco can acquire.

In 5G, how long does a frame typically last?

- [ ] 15 milliseconds
- [ ] 1 millisecond
- [x] 10 milliseconds
- [ ] 5 milliseconds

What is numerology in the context of 5G?

- [ ] The process of allocating time slots in a frame
- [ ] The study of numerical sequences in data transmission
- [ ] A framework for assigning numbers to data packets
- [x] Different frequency ranges and domains within frames

How does 5G differ from 4G in terms of slot size flexibility?

- [ ] 4G slots have greater frequency variability than 5G slots
- [ ] 5G and 4G slots have identical flexibility in size
- [x] 5G allows adjustment of slot sizes in terms of time or frequency
- [ ] 5G slots are fixed at 1 millisecond, unlike 4G slots

What is the typical frequency allocation for sub-carriers in 4G networks?

- ○ 10 kHz
- ◉ 15 kHz
- ○ 30 kHz
- ○ 20 kHz

What does the term 'numerology 5 and 6' signify in 5G?

- ○ Transmission codes for specific data types
- ○ Slot durations within a frame
- ○ Specific frequency bands for satellite communication
- ◉ Sub-carrier spacings ranging from 15 to 40 kHz

Which downlink channels are crucial for initial access in a 5G network?

- ○ PUSCH and PUCCH
- ◉ PSS, SSS, and Broadcast Channels
- ○ PRACH and PMCH
- ○ PDSCH and PDCCH

How many subcarriers does the Primary Synchronization Signal (PSS) exclusively utilize within a frame?

- ◉ 126 subcarriers
- ○ 336 subcarriers
- ○ 240 subcarriers
- ○ 56 subcarriers

What is the primary purpose of the Physical Cell Identity (PCI) in a 5G network?

- ○ Handling user authentication
- ○ Transmitting synchronization signals
- ○ Identifying individual users
- ◉ Differentiating cells within an area

How frequently are the PSS and SSS transmitted in a 5G network?

- ○ Every 1 millisecond
- ○ Every 10 milliseconds
- ◉ Every 20 milliseconds
- ○ Every 30 milliseconds

In the Physical Broadcast Channel (PBCH), how many OFDM symbols are utilized, and how many of these symbols remain unused within the block?

- ○ Two symbols utilized, two symbol unused
- ○ Four symbols utilized, one symbol unused
- ◉ Three symbols utilized, one symbol unused
- ○ Three symbols utilized, two symbol unused

What is the primary reason for introducing the concept of bandwidth parts in 5G networks?

- ◉ To conserve device power and reduce interference
- ○ To reduce the carrier bandwidth in 5G
- ○ To limit the number of available frequency bands
- ○ To increase interference among user devices

How does 5G differ from 4G regarding the utilization of carrier bandwidth?

- ○ 4G utilizes broader carrier bandwidth compared to 5G
- ○ In 5G, carrier bandwidth is consistently transmitted
- ○ In 4G, carrier bandwidth allocation is dynamic
- ◉ 5G demands more efficient usage due to wider bandwidth

What is the function of the Downlink Control Indicator (DCI) in managing bandwidth parts?

- ○ Defines numerology for bandwidth allocation
- ◉ Manages dynamic switching between active bandwidth parts
- ○ Allocates carrier spectrum for user selection
- ○ Switches between different carrier frequencies

How are bandwidth parts defined for users in 5G networks?

- ○ By allowing users to select any portion of the spectrum at any time
- ○ Through static allocation of specific frequency bands
- ○ Through continuous transmission of the entire allocated frequency spectrum
- ◉ By subdividing the allocated frequency spectrum into smaller sections

What role does efficient utilization of resource blocks play within the channel bandwidth in 5G?

- ○ Reduces the number of available bandwidth parts
- ○ Increases interference and power consumption
- ○ Impacts the Downlink Control Indicator's functionality
- ◉ Helps conserve device power and optimizes communication

What is the primary role of subcarrier spacing variations in 5G networks?

- ◉ To impact resource block composition and symbol duration
- ○ To influence the frequency allocation for Bandwidth Parts (BWPs)
- ○ To increase the number of resources within a resource block
- ○ To decrease the number of subcarriers in a resource block

What is the fundamental composition of a resource block in 5G networks?

- ○ 15 kHz subcarrier spacing
- ○ 12 resource elements
- ○ Varying symbol durations
- ◉ 12 subcarriers

How does doubling the subcarrier spacing impact symbol duration in 5G networks?

- ○ Symbol duration becomes unpredictable
- ○ Symbol duration increases
- ◉ Symbol duration decreases
- ○ Symbol duration remains unchanged

What impact does halving the subcarrier spacing have on symbol duration in 5G networks?

- ○ Symbol duration remains unchanged
- ○ Symbol duration becomes unpredictable
- ◉ Symbol duration increases
- ○ Symbol duration decreases

How does adjusting subcarrier spacing influence Bandwidth Parts (BWPs) in 5G networks?

- ○ It doesn't affect BWPs
- ○ It increases the symbol duration for BWPs
- ○ It reduces the number of available BWPs
- ◉ It alters resource allocations within the spectrum for BWPs

What is the primary purpose of using a guard band in Orthogonal Frequency Division Multiplexing (OFDM) within the frequency domain?

- ○ To limit the utilization of available spectrum
- ◉ To maintain separation between subcarriers and prevent interference
- ○ To increase interference among subcarriers
- ○ To decrease spectrum utilization efficiency

In OFDM, how are non-transmitting subcarriers managed while one specific subcarrier transmits data?

- ○ They switch frequencies rapidly to avoid overlapping
- ○ They maintain maximum amplitude to enhance data transmission
- ○ They transmit data simultaneously to maximize bandwidth
- ◉ They maintain zero amplitude to prevent interference

What advantage does Orthogonal Frequency Division Multiple Access (OFDMA) offer over traditional Time Division Multiplexing (TDM)?

- ○ Increased interference between frequency and time domains
- ○ Limitation of resource allocation within specific slots or carriers
- ◉ Efficient utilization of resources irrespective of time slots for any user
- ○ Reduced resource sharing among different users

What flexibility does OFDMA introduce compared to traditional resource allocation methods?

- ○ Allocating resources to a single user for a specific slot or carrier
- ◉ Allowing any user to access specific resources within a resource frame, regardless of time slot
- ○ Limiting user access to resources within predefined time slots
- ○ Maintaining fixed resource distribution among users

How does OFDM differ from OFDMA in terms of resource allocation among users?

- ◉ OFDMA allows any user to access resources within a resource frame regardless of time slots or carriers
- ○ OFDM allocates resources based on specific time slots for each user
- ○ OFDM provides exclusive resource access to one user at a time
- ○ OFDMA allows any user to access resources irrespective of frequency domains

What is the primary role of modulation in 5G networks?

- ○ To increase interference among carrier signals
- ○ To reduce the number of modulation techniques
- ○ To limit the use of multiplexing for different signals
- ◉ To adjust carrier signals for effective data transmission

How does modulation contribute to reducing the antenna size needed for transmitting lower frequency information?

- ○ By increasing the size of antennas at lower frequencies
- ○ By employing a larger number of carrier signals
- ○ By maintaining a constant amplitude for all carrier signals
- ◉ By adjusting carrier signals to higher frequencies

Which aspect of modulation helps in minimizing interference among signals?

- ○ Reducing the number of modulation schemes used
- ○ Transmitting baseband signals at lower frequencies
- ◉ Adjusting carrier signals in terms of amplitude or phase
- ○ Employing carrier signals with constant amplitude

What purpose do different modulation schemes serve in 5G networks?

- ○ They reduce the efficiency of data transmission per symbol
- ○ They enable uniform data transmission irrespective of carrier frequencies
- ○ They limit the use of amplitude and phase differences for data distinction
- ◉ They utilize varying numbers of bits per symbol for efficient data transmission

How do modulation schemes like QPSK and 16QAM differ in their transmission efficiency?

- ○ QPSK transmits more bits per symbol compared to 16QAM
- ○ Both QPSK and 16QAM transmit the same number of bits per symbol
- ◉ QPSK transmits fewer bits per symbol compared to 16QAM
- ○ Neither QPSK nor 16QAM transmit bits per symbol

What do modulation orders such as QPSK, 16QAM, and 256QAM primarily determine in 5G communication?

- ○ The frequency range allocated for uplink data transmission
- ○ The number of users connected to a specific cell site
- ○ The total number of time slots available for data transmission
- ◉ The number of bits transmitted within a symbol

In 5G networks, what parameter influences the selection of modulation orders like QPSK or 256QAM?

- ○ Downlink transmission frequency allocation
- ○ The total number of available antennas at the cell site
- ○ Uplink transmission power of the user equipment
- ◉ Channel Quality Indicator (CQI) feedback from user equipment

How does increasing the modulation order impact the code rate in 5G communication?

- ◉ It increases the code rate
- ○ It decreases the code rate
- ○ It has no impact on the code rate
- ○ It alters the transmission power

What is the range of CQI values in the uplink that influences efficient data transmission in 5G networks?

- ○ 0 to 5
- ○ 0 to 25
- ◉ 0 to 15
- ○ 0 to 10

How do factors like signal degradation due to distance impact the modulation order and overall network performance in 5G?

- ◉ Signal degradation can lower the modulation order and impact network performance
- ○ Signal degradation has no impact on modulation orders or network performance
- ○ Higher signal degradation ensures better network performance
- ○ Higher signal degradation leads to higher modulation orders for efficient transmission

Which statement accurately describes the fundamental difference between Time Division Duplex (TDD) and Frequency Division Duplex (FDD) in 5G?

- ◉ FDD involves the same carrier frequency for uplink and downlink, whereas TDD separates transmissions by time intervals.
- ○ TDD allocates different frequencies for uplink and downlink, while FDD uses the same carrier frequency.
- ○ TDD uses separate carrier frequencies for uplink and downlink, while FDD utilizes the same frequency.
- ○ FDD separates transmissions in the time domain, while TDD employs separate carrier frequencies.

What is the primary challenge in Frequency Division Duplex (FDD) concerning effective resource allocation?

- ○ Increased interference due to shared carrier frequencies
- ○ Limited bandwidth availability for separate carrier frequencies
- ◉ Synchronization issues between users and base stations
- ○ Inefficient utilization of the time domain

Which duplexing scheme offers flexibility in allocating resources across different time domains or frequencies?

- ◉ Time Division Duplex (TDD)
- ○ Half Duplex (HD)
- ○ Frequency Division Duplex (FDD)
- ○ Full Duplex (FD)

In Time Division Duplex (TDD), how is resource allocation managed for uplink and downlink transmissions?

- ○ By employing different modulation techniques
- ◉ By using separate carrier frequencies
- ○ By employing different modulation techniques
- ○ By allocating distinct frequency bands for each direction

What capability does Full Duplex (FD) offer in 5G communication?

- ◉ Transmission separation in either frequency or time domains
- ○ Transmission separation only in frequency domains
- ○ Transmission separation only in time domains
- ○ Transmission separation in both frequency and time domains

What distinguishes Frequency Division Duplex (FDD) from Time Division Duplex (TDD) in 5G communication?

- ○ FDD uses different modulation techniques for uplink and downlink, while TDD employs the same technique.
- ◉ FDD utilizes the same frequency for uplink and downlink, while TDD uses different frequencies.
- ○ FDD separates transmissions in a time domain, whereas TDD allocates separate carrier frequencies.
- ○ FDD demands synchronization between user and base station, unlike TDD, which requires no synchronization.

What role does synchronization play in Time Division Duplex (TDD) to ensure efficient transmission in 5G networks?

- ○ To limit the flexibility of OFDM symbol allocation within a time slot
- ○ To prevent the negotiation of resource allocation between devices and cells
- ◉ To enable seamless communication without interference between uplink and downlink
- ○ To increase interference between uplink and downlink transmissions

What does 5G's flexibility in allocating different OFDM symbols within a time slot facilitate?

- ○ Fixed allocation patterns for uplink and downlink transmissions
- ◉ Negotiation between devices and cells for efficient resource utilization
- ○ Fixed modulation orders for uplink and downlink communication
- ○ Negotiation between devices and cells for better synchronization

What is defined within a 10-millisecond duration at the cell level in 5G communication?

- ◉ Specific allocation patterns for uplink and downlink transmissions
- ○ Dynamic negotiation patterns between devices and cells
- ○ Flexible modulation techniques for efficient resource utilization
- ○ Fixed carrier frequencies for uplink and downlink communication

What purpose does the Dynamic Slot Format Indicator serve in 5G networks?

- ◉ To signal uplink and downlink allocations dynamically for efficient resource usage
- ○ To restrict negotiation between devices and cells for resource utilization
- ○ To eliminate flexibility in OFDM symbol allocation within time slots
- ○ To synchronize carrier frequencies between devices and cells

What is the primary purpose of carrier aggregation in 5G NR?

- ○ To reduce the number of frequency carriers used in data transmission
- ○ To limit the data rates achievable in 5G networks
- ◉ To aggregate various frequency carriers and achieve multi-gigabit data rates
- ○ To restrict the use of different frequency bands for carrier aggregation

How does 5G differ from LTE regarding carrier spacing and data rate requirements?

- ◉ LTE had limited carrier spacing of 20 megahertz, whereas 5G demands planning for 20 times higher data rates
- ○ LTE had higher carrier spacing compared to 5G for achieving higher data rates
- ○ 5G demands less carrier aggregation compared to LTE for similar data rates
- ○ LTE required less planning for higher data rates compared to 5G

In situations where telecom operators lack contiguous spectrum, how does carrier aggregation help achieve desired data rates in 5G?

- ○ By restricting the use of multi-gigabit data rates
- ○ By reducing the need for diverse frequency ranges
- ○ By limiting the available data rates
- ◉ By aggregating carriers from different frequency ranges

What are the two primary options available for carrier aggregation in 5G?

- ◉ Inter-band and contiguous aggregation
- ○ Intra-band and extra-band aggregation
- ○ Multi-carrier and single-carrier aggregation
- ○ Multi-band and single-band aggregation

At which protocol layer is carrier aggregation implemented for enhancing data rates in 5G?

- ○ Network layer (Layer 3)
- ○ Physical layer (PHY)
- ○ Data Link layer (DLL)
- ◉ Medium Access Control (MAC) layer

What is the primary role of the scheduler operating at the MAC layer in 5G NR?

- ○ To regulate the power levels of individual devices
- ○ To manage user equipment hardware components
- ○ To control the physical layer modulation techniques
- ◉ To allocate diverse resources across the air interface to different users

What factors influence resource allocation by the scheduler in 5G NR?

- ◉ Channel quality indicators (CQI) and modulation efficiency
- ○ Assigned bandwidth per user
- ○ User equipment hardware specifications
- ○ Only user-defined Quality of Service (QoS)

How does the scheduler prioritize resource allocation concerning users' varying throughput needs in 5G NR?

- ○ By employing a single scheduler for all users, regardless of their needs
- ○ By reducing resource allocation for users with higher throughput requirements
- ◉ By assigning more resources to users requiring higher throughput
- ○ By allocating higher resources to users with lower throughput needs

What approach does the scheduler adopt concerning users located at cell edges in 5G NR?

- ○ Prioritizing users at cell edges for minimal resource allocation
- ○ Providing minimal resources to users at cell edges due to their remote location
- ○ Allocating the same resources to all users, irrespective of their locations
- ◉ Granting more resources to users at cell edges to meet a minimum threshold of throughput

Why is it crucial for the scheduler in 5G NR to avoid extreme resource allocation discrepancies between users?

- ○ To limit the overall data throughput in the network
- ◉ To maintain fairness and ensure a judicious distribution of resources
- ○ To increase interference among users with varying radio conditions
- ○ To prioritize specific users based on their modulation techniques

Which network performance indicators are significantly influenced by various scheduler modes in 5G NR?

- ○ Data rate and modulation techniques
- ◉ Throughput, delays, and fairness index
- ○ Latency and spectral efficiency
- ○ Signal propagation and interference levels

What is the primary impact of the MaxRB scheduler mode in an illustrative scenario with three users connected to a single cell in 5G NR?

- ◉ It prioritizes quality for resource allocation, leading to potential throughput imbalances.
- ○ It significantly improves the Modulation and Coding Schemes (MCS) for Users 2 and 3.
- ○ It guarantees fairness by allocating resources based on users' signal strengths.
- ○ It evenly allocates resources among all users, ensuring optimal throughput.

What drawback is observed with the Round Robin scheduler mode concerning users with lower Modulation and Coding Schemes (MCS) in the illustrative scenario?

- ○ It maximizes resource allocation for Users 2 and 3, enhancing their MCS.
- ○ It significantly improves throughput for all users.
- ○ It guarantees fairness by allocating resources based on users' signal strengths.
- ◉ It distributes resources unevenly among users, affecting fairness.

What distinguishes the Proportional Fair scheduler mode from MaxRB and Round Robin concerning resource allocation in 5G NR?

- ○ It focuses solely on optimizing delay metrics for each user in the cell.
- ◉ It balances resources, ensuring better throughput and fairness across users.
- ○ It maximizes resource allocation for Users 1 and 2 to maintain fairness.
- ○ It prioritizes quality and signal strengths for all users equally.

How do advanced scheduler algorithms in 5G NR, leveraging machine learning and deep learning, contribute to resource optimization?

- ○ By ensuring static and unalterable resource allocation to maintain fairness
- ○ By prioritizing users with higher MCS, disregarding fairness across the cell
- ○ By limiting resource allocation to users based on predefined patterns
- ◉ By dynamically optimizing resource allocation based on changing network conditions

Which stage in the RAN evolution relies on proprietary hardware for radio access and is prone to potential over-provisioning due to limited resource optimization?

Legacy Stage ⇕

At which stage of RAN evolution does the transition from legacy networks to virtual machines occur, allowing flexibility in software changes based on requirements?

Virtualized Stage ⇕

In which RAN evolution stage are SLAs and KPIs no longer tied to hardware, offering increased agility, scalability, and resource optimization through cloud solutions and automation?

Cloud-Ready Stage

At which stage of RAN evolution are automation techniques introduced, allowing for scaling up and down of the network to optimize resources efficiently?

In which RAN evolution stage does the transition occur from a complex, proprietary system to a more flexible, cloud-based solution with improved agility and efficiency?

Which stage of the RAN evolution incorporates containerization, orchestrates self-configuration, resolves network issues autonomously, and integrates third-party applications for enhanced intelligence?

Cloud-Native Stage

Which stage in the RAN evolution emphasizes the shift from virtual machines to containerization, enabling self-configuration and issue resolution in the network?

Involves transitioning to a phased approach as the initial step in RAN evolution.	Virtualized RAN
Involves co-locating Centralized Unit (CU) and Distributed Unit (DU) at cell sites.	Distributed RAN
Allows software changes for functions without requiring different hardware.	Distributed RAN
Extends CU to the cloud, allocating resources among connected sites.	Centralized RAN

Represents the flexible resource pool for functions like CU and DU in Open RAN's cloud architecture.	Cloud Platform
Software responsible for managing multiple VMs and containers in virtualization.	Hypervisor
Virtualized component handling distributed functionalities in Open RAN's cloud platform.	vO-DU
Virtualized component managing centralized functionalities in Open RAN's cloud architecture.	vO-CU

Decouples software and hardware in the cloud platform transition of Open RAN.	Cloud Platform
Extracts functions like CU, DU, and RIC from underlying hardware in virtualization.	Hypervisor
Manages multiple VMs and containers in the cloud platform of Open RAN.	Cloud Platform
Connects the baseband unit to the radio unit in the traditional 4G RAN setup.	Hypervisor

Open RAN (Open Space RAN)	Refers to the general vision of an Open RAN.
OpenRAN	A term logic generally used by Telecom Info Project.
O-RAN	Associated with the ORAN Alliance, a community dedicated to evolving the Open Radio Access Network ecosystem.

Majority of Capital cost contributed by the Radio Access Network in conventional setups	Capital Expenditure (CapEx) in RAN
Issue arising from hardware and software supplied by a single vendor, leading to limited interoperability and upgrade dependency.	Vendor Lock-in and Proprietary Constraints
Accelerated service deployment and reduced upgrade costs due to open systems, avoiding reliance on a single supplier; resolves interoperability concerns.	Time to Market and Dependency on Suppliers
Focus on reducing ongoing operational costs through innovative RAN design and practices.	Operating Expenditure (OpEx) Optimization
Implementation of machine learning and AI in network operations to enhance automation and efficiency.	Intelligent Network Implementation

Need for seamless integration of Brownfield Networks with legacy systems.	Integration with Legacy Networks
Concerns regarding the evolving nature of Open RAN and the need for assurance from involved vendors.	Maturity and Assurance
Ensuring robust connectivity and meeting stringent latency requirements in desegregated RAN nodes.	Connectivity and Latency Requirements
Challenges in identifying and resolving issues at the same pace in multi-vendor environments.	Operational Issues with Multi-vendor Environments
Requirement for upskilling the workforce in areas like automation, DevOps, and software upgrades for operational readiness in Open RAN.	Operational Readiness and Workforce Skills