

- If not registered online (QISPOS) or in our office: provide the accrediting examination authority certificate (yellow/pink receipt).
- Place your student ID card and photo identification visible in front of you.
- Place your bags to the side corridor and switch off your mobile devices.
- A blue or black pen (document-quality) is the only allowed resource.
- Please show the solution process or explain you answer, where suitable.
- If you claim more than one answer for a single question, none will not be evaluated.
- If we can't read your answer, it will also not be evaluated.
- Attempts to deceive will result in a failed exam for all involved parties.
- Dictionaries are not allowed. You can answer in English or German.
- Results will be published: at <http://www.av.tu-berlin.de>.
- You will have 80 minutes to finish the exam.

Good Luck!

1	2	3	4	5	6	Σ	Grade
Convergence	Use Cases	NFV	SDN	5G Architecture	Research	Total	
6	4	8	1	25	6	50	

First examiner

Second examiner

Exercise 1: Convergence, 6 Points

- a) What is convergence? Give an educated example of convergence including a functional feature example.(4P)

Solution:

- b) What are the next steps in wireless network convergence (1P)

- (a) satellite networks
- (b) critical infrastructures

- (c) factory automation
- (d) Car-to-X communication

Solution:

- c) What does 4-nines mean (in telecom industry)(1P)
- (a) Standby functionality is available 99,999% of time
 - (b) the system is active 99,999% of time
 - (c) the system can support 99,999 subscriber all the time
 - (d) QoS resources are guaranteed for 99,999% of the subscribers

Solution:

Exercise 2: Use Cases, 4 Points

- a) Which are the main 5G use cases categories proposed by the Next^I Generation Mobile Networks (NGMN) alliance? (3p)

Solution:

b) Which are the types of accesses which dock to the 5G convergent core network? (1P)

- (a) LTE-4G
- (b) WiFi
- (c) 5G New Radio
- (d) WiMAX femto-cells

Solution:

Exercise 3: NFV, 8 Points

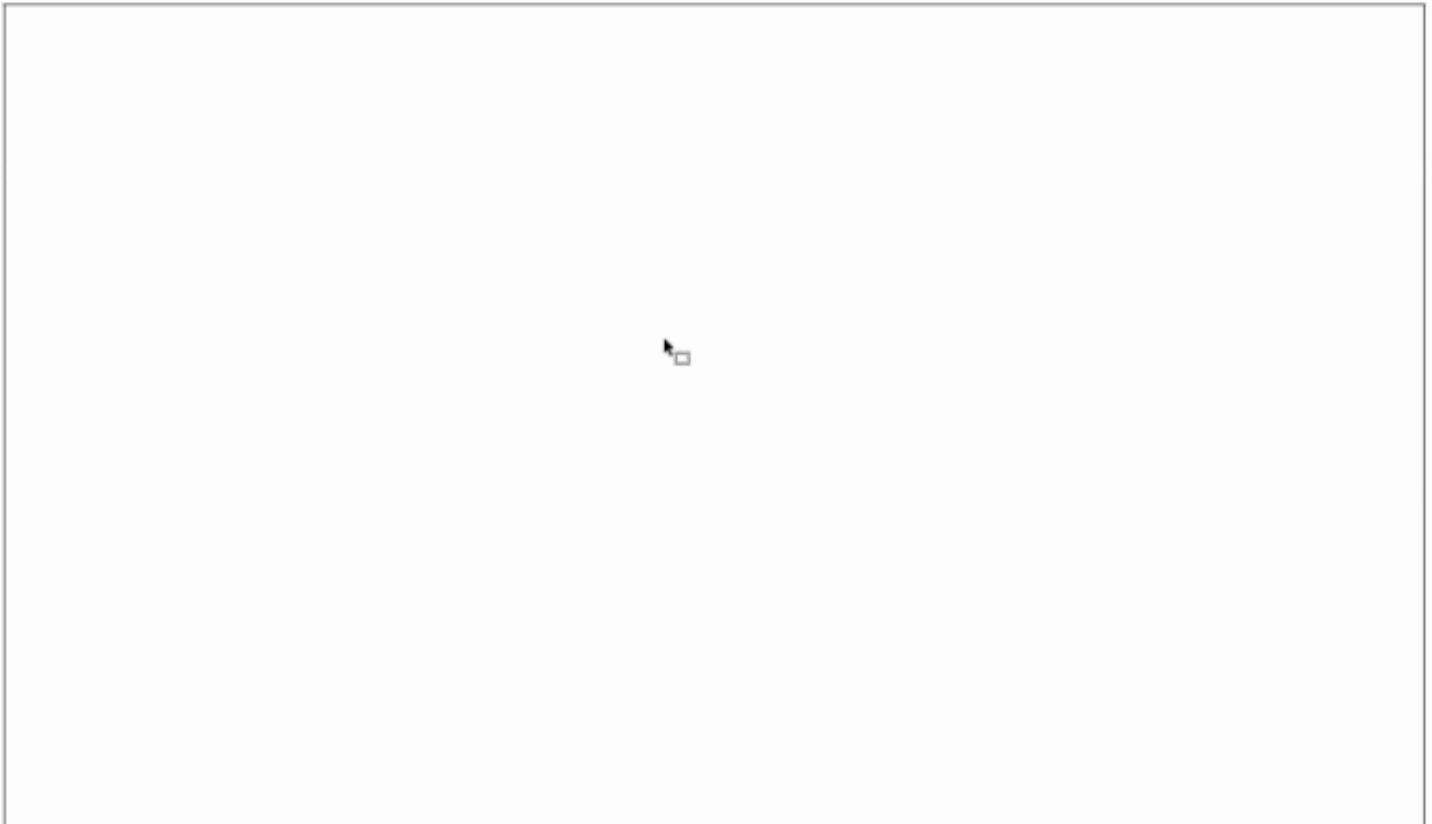
a) What is the role of network slicing? (1P)

- (a) Convergence of access networks
- (b) Overcomplicating the network system
- (c) Providing isolated hardware components towards customized networks
- (d) Customizing networks for addressing specific requirements

Solution:

b) Please explain the static versus stateful model with figure representation? (3P)

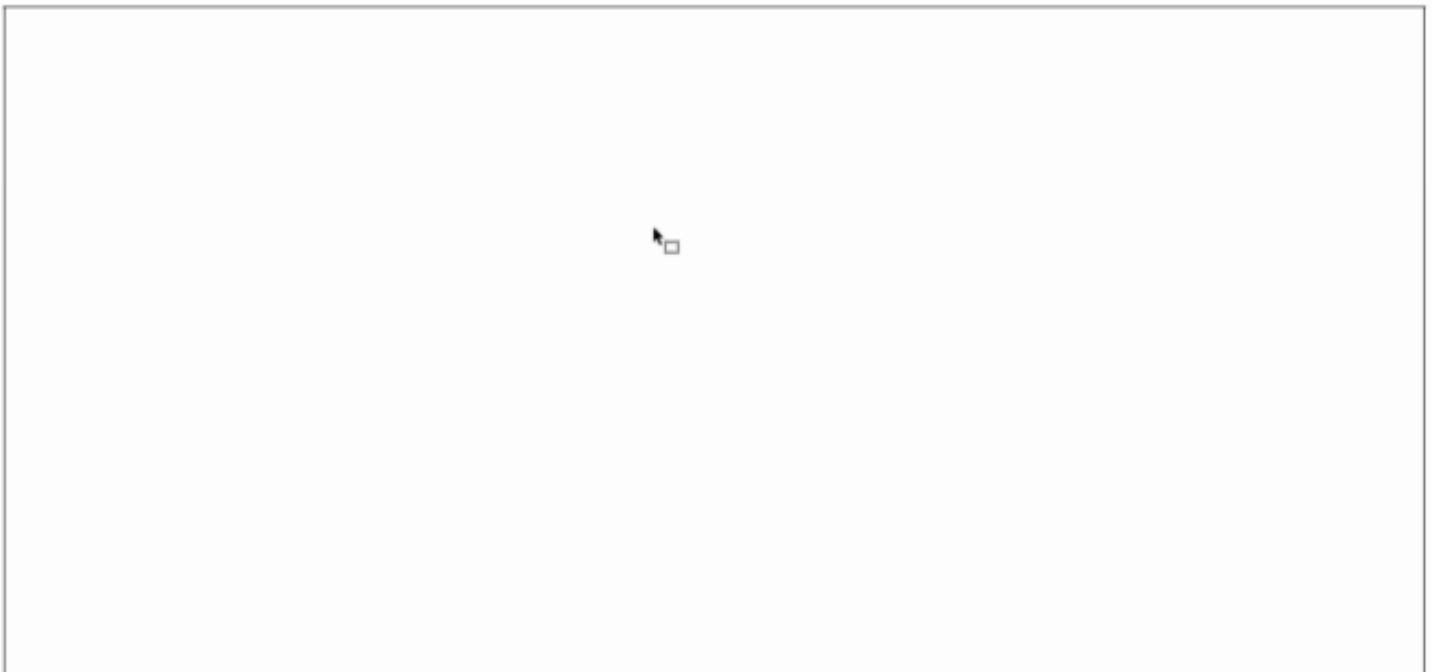
Solution:



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- c) Describe the VNF load balancing models. Depict the relationship between the VNFs, VNFs including LB and NF(4P)

Solution:



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Exercise 4: SDN, 1 Points

a) What are the planes of an SDN architecture? (1p)

- (a) Data, control and over-control planes
- (b) Data, control and subscriber information planes
- (c) Data, control and management planes
- (d) Data and control planes

Solution:

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Exercise 5: 5G Architecture, 25 Points

a) What are the main advantages of the 5G evolution (3P)

Solution:

b) Why use a 5G system instead of a 4G one (1P)

- (a) Network functions are fixed
- (b) The system can not use the infrastructure available at he location
- (c) The system can not integrate with different access networks
- (d) Provides optimized communication for outside and mobile local networks

Solution:

c) Describe the high level functionality for authentication and authorization (with figure) (4P)

d) Describe the User Plane Function (UPF) in as much detail as possible: functionality, integration in the architecture, interactions with other network functions, etc. (10p)

Solution:

a) Name 3 functions of the Session Management Function (SMF) (3p)

Solution:

b) Describe the interaction between the network function (services) within Service Based Architecture (with figure) (3p)

Solution:

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c) During the AMF selection procedure (1P)

- (a) AMF is selected with assistance from the NSSF
- (b) AMF is selected with assistance from the PCF
- (c) There is no such procedure in 5G
- (d) AMF selection is verified by the network administrator

Solution:

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Exercise 6: Research, 6 Points

a) Toolkits are not products. Name three differences between them (3P)

Solution:

b) What is a network function? (3p)

Solution: