Course Takeaways

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1. What makes SDN different from legacy computer networks ? What are the appealing opportunities that it paves the way for ? What are its main challenges ?

Hint : Shortly, list the SDN principles that do not hold for legacy computer networks. Briefly, elaborate on these principles to sketch some of the opportunities that SDN brings.

Response : According to the SDN course, the SDN architecture introduces a fundamental break with traditional networks by separating the control functions of the network equipment. This separation makes it possible to centralize the network intelligence in an external controller that supervises the entire network. The network equipment then becomes simple executors responsible only for routing packets according to the rules defined by the controller. The SDN controller, as shown in the SDN/OpenFlow practical exercise, offers a standardized programming interface to dynamically define the behavior of the network. This programmability represents a major opportunity because it makes it possible to quickly adapt the network to the needs of the applications, which was impossible with traditional networks where each device had to be configured individually.

to summarize:

- The separation of the control plane and the data plane
- The programmability of the network via open interfaces
- A global vision of the network

2. What does NFV (Network Function Virtualization) stand for ? What are the opportunities that it paves the way for ?

Response : The course defines NFV as an approach to virtualize network functions traditionally implemented in proprietary hardware. These functions are transformed into software modules that run on standard servers. This virtualization brings considerable flexibility in the deployment and management of network services.
This approach, as explained in the course, not only reduces operating costs by using standard hardware, but also offers the possibility to dynamically adjust the resources allocated to the different network functions according to needs. The deployment of new services also becomes much faster since it no longer requires the installation of new physical equipment.

3. Are SDN and/or NFV relevant for your semester project ? If not, choose one of the assignments below ?

Hint : After briefly describing your semester project, elaborate very shortly on the relevance of adopting SDN and/or NFV in your semester project. Alternatively, choose one of the papers below, which propose some concrete applications of SDN/NFV in the IoT context. Read the recommended sections and answer the corresponding questions.

Response : Based on the concepts presented in the SDN/OpenFlow lab, we can identify several relevant applications of SDN and NFV in the IoT context. The centralized control offered by SDN allows for fine-grained management of IoT data flows, while the virtualization of network functions facilitates the deployment of specific services as close as possible to the connected objects. The lab shows in particular how to dynamically configure forwarding rules for different types of traffic, which is particularly relevant in an IoT environment where quality of service requirements can vary significantly depending on the applications. The flexibility offered by these technologies also allows the network infrastructure to be quickly adapted to the changing needs of the connected objects.

Assignments related to question 3 :

Hint : Select one of the papers listed below and answer the questions. A couple of criteria are provided to help you choose the paper that better meets your expectations.

Paper	Questions
Title : IoT Gateway Edge VNFs on uCPE **Venue** : IEEE Conference on Network Function Virtualization and Software Defined Networks (NFV-SDN), 2018 **Keywords** *:* IoT, NFV, microservices **Abstract** : With the emergence of 5G and Internet of Things technologies, there is an increasing trend of network services integrating the edge and centralized cloud computing for guaranteeing low latency, real-time processing, and better security/privacy. In this demo, we present an intelligent IoT edge solution with IoT virtual network functions (VNFs) running on uCPE. We demonstrate the system architecture and IoT VNFs on uCPE and show that, in addition to typical uCPE VNFs, IoT VNFs can be included to increase opportunities for new IoT services and revenues while using the same management/deployment platforms as typical VNFs. **required expertise in communication networks :** low **Link to the document** *:* here	Cet article (de plus de 6 ans) introduit une démonstration montrant l'utilisation des approches NFV (Network Function Virtualisation) dans un contexte domotique. 1. Quelle est la finalité de la solution technique qui fait l'objet de la démonstration ? 2. Décrire en qcq lignes les principes de la solution proposée ? 3. Quels sont les bénéficiaires d'une telle solution ? (utilisateurs ? opérateur réseau ? les prestataires de services applicatifs ?)

Analyze :

1. Finalité de la solution technique :

D'après l'article, la solution vise à implémenter des fonctions réseau virtualisées (VNF) dédiées à l'IoT sur des équipements uCPE (universal Customer Premises Equipment) situés en bordure de réseau. Cette approche permet de :

- Réduire la latence pour les applications IoT nécessitant des temps de réponse courts (moins de 10ms)
- Améliorer la sécurité et la confidentialité des données en les traitant localement
- Assurer la continuité de service même en cas de perte de connexion avec le cloud
- Optimiser les coûts en mutualisant l'infrastructure avec d'autres services réseau

According to the article, the solution aims to implement virtualized network functions (VNFs) dedicated to IoT on uCPE (universal Customer Premises Equipment) devices located at the edge of the network. This approach allows to:

- Reduce latency for IoT applications requiring short response times (less than 10ms)
- Improve data security and confidentiality by processing them locally
- Ensure continuity of service even in the event of loss of connection with the cloud
- Optimize costs by sharing the infrastructure with other network services

2. **Principes de la solution proposée :**

La solution, comme présentée dans l'article, repose sur plusieurs composants clés :

- Une passerelle IoT virtualisée sous forme de VNF déployée sur uCPE
- Des interfaces physiques (dongles USB) pour supporter différents protocoles IoT (ZigBee, BLE, LoRa)
- Des fonctions de traitement local (agrégation de données, analyse, stockage temporaire)
- Une connexion avec différents clouds publics (AWS, Azure, IBM) via le protocole MQTT

3. **Les bénéficiaires de cette solution sont multiples :**

Pour les utilisateurs finaux :

- Meilleure réactivité des applications IoT
- Protection accrue des données sensibles
- Continuité de service garantie

Pour les opérateurs réseau :

- Mutualisation de l'infrastructure avec d'autres services réseau (SD-WAN, vFW)
- Simplification du déploiement et de la gestion des services
- Nouvelles opportunités de revenus

Pour les fournisseurs de services :

- Facilité de déploiement de nouveaux services IoT
- Flexibilité dans l'allocation des ressources
- Réduction des coûts d'infrastructure

Cette solution illustre parfaitement les avantages de la virtualisation des fonctions réseau (NFV) vus dans le cours, en les appliquant spécifiquement au domaine de l'IoT et du edge computing.