SY28

TD 2

Exercice 1 :

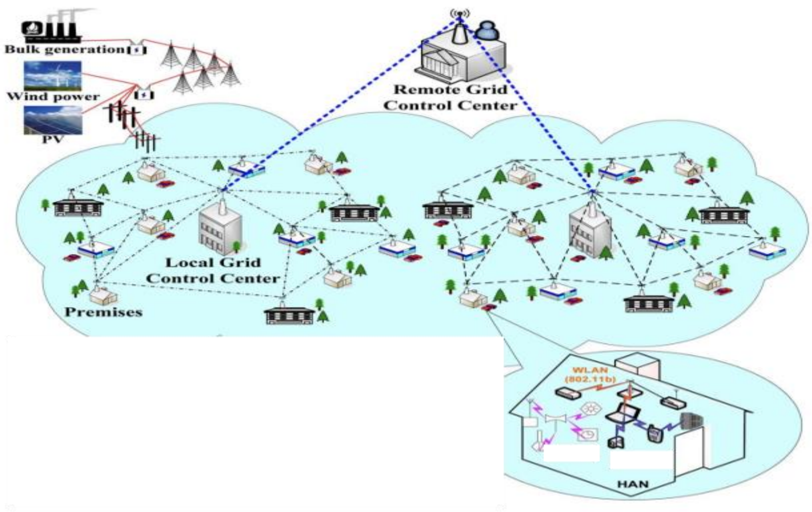
1. Soit un système CPS utilisant le Wi-Fi qui fonctionne à la vitesse de 11 Mbit/s. Les cartes d'accès ainsi que le point d'accès peuvent moduler leur puissance d'émission.
    a. Si l'on diminue la puissance d'un point d'accès de 100 mW à 10 mW, par exemple, quelles sont les conséquences sur la taille de la cellule ?
    b. Montrer qu'il faut beaucoup plus de points d'accès pour recouvrir un même territoire.
    c. Augmente-t-on ainsi la capacité globale du réseau ?
    d. La mobilité est-elle réduite ?

2- Soit un système cyber-physique utilisant le Bluetooth pour communiquer.
    a. Pourquoi un réseau Bluetooth peut-il coexister sur la bande des 2,4 GHz avec un réseau Wi-Fi ?
    b. Montrer que le saut de fréquence est une solution qu'il est plus difficile d'écouter.
    c. La vitesse du réseau Bluetooth vous paraît-elle suffisante pour transporter de la vidéo sur ce système cyber-physique ?

3- On aimerait développer un système cyber-physique reposant sur un réseau Wi-Fi de future génération ayant des propriétés meilleures que celles des réseaux Wi-Fi actuels.
    a. Montrer qu'un premier inconvénient des réseaux actuels est de ne pas avoir la possibilité de se connecter au même temps à la fréquence de la bande des 2.4, 5 et 6 GHz. Qu'en déduisez-vous comme amélioration ?
    b. Quels sont les principaux avantages inconvénients des bandes 2.4 et 5GHZ ?
    c. Montrer qu'un contrôle de puissance permettrait d'améliorer le débit global d'un réseau Wi-Fi.
    d. Une bonne partie de la bande passante est perdue par le point d'accès à cause de la supervision et des temporisateurs de démarrage des accès des terminaux vers le point d'accès. Pouvez-vous proposer des améliorations ?
    e. La détérioration de la capacité d'un point d'accès provient en grande partie de l'éloignement de certains utilisateurs. Pourquoi ? Quel pourrait être le remède ? Indiquer les conséquences du remède proposé.

Exercice 2 :

Voici un exemple d'un système cyber-physique pour les Smart Grid. Ce système fait appel à plusieurs protocoles pour arriver à interconnecter les machines entre elles, les sous-réseaux entre eux, ainsi que les sous-réseaux à la centrale de contrôle.



Lisez le descriptif en annexe et répondez aux questions suivantes :

1- Quelle est la topologie du réseau utilisée dans ce système ?
2- Quels sont les avantages derrière l'utilisation de WIMAX ?
3- Identifier les protocoles utilisés pour la communication « Remote Grid Control Center » et « Local Grid Control Center » et pour la communication M2M communication Link (rose, violet et rouge).
4- Quels sont les avantages offerts par un tel système hybride ?
5- Pourquoi utilise-t-on les réseaux hybrides ?

Annexe

- Although WiMAX may not be able to compete with LTE-A as a most popular 4G broadband technology, it has been considered to be utilized as a communication backbone in SG (Smart Grid). The pilot SGs that use WiMAX as part of their data communications have already been implemented in San Diego, Michigan, Texas, and parts of Australia. A hybrid network architecture using WiMAX and wireless mesh networks (WMNs) was described in a paper research as shown in the figure. In this hybrid architecture, a group of electric utility subscribers are clustered into wireless mesh domains, each of which can be easily managed by a local control center using wireless standards such as IEEE 802.15.4g (SUNs), IEEE 802.11 family, or wireless sensor networks (WSNs). The remote-control center in a global network monitors each wireless mesh cluster over WiMAX. With the integration of WMNs and WiMAX, electrical utilities can exploit full advantages of multiple wireless networks. The wireless mesh domain in a hybrid network is also known as NAN (Neighberhood Area Network), which bridges the gap between HAN (Home Area Network) and WAN (Wide Area Network). A NAN usually contains thousands of communication nodes distributed in a very large area, and the formation of WMN can improve reliability and self-healing of the whole network. On the other hand, IEEE 802.11s might be another choice as it extends IEEE 802.11 MAC protocol for WMNs and supports frame delivery and route selection at MAC layer through radio-aware metrics. In the topology of an IEEE 802.11s mesh network, a central gateway is used for data transmission to mesh stations. Mesh access points offer the access interfaces to the end users in either static or dynamic state. IEEE 802.11s supports high-speed data transmission, which is different from SUNs. Therefore, it might serve as an option to implement reliable and high-speed wireless NANs in SG. With the help of of WiMAX technology, the capacity of a network backbone can be increased up to 1 Gbps fixed speed. Furthermore, electric systems suffering from environmental impairments can benefit from WiMAX technology to improve the performance of their communication systems, since WiMAX is characterized by its ability to cover a long distance. A large coverage as well as sufficiently high data rates makes the hybrid network topology more suitable for Wireless Automatic Meter Reading (WAMR) as part of utility automatic metering infrastructure. Implementation of WAMR for revenue metering offers several advantages to electric utilities and service providers by eliminating the needs for human meter readers. Hybrid network can be used to provide real-time pricing information based on real-time energy consumption of the customers. This capability is very beneficial to let customers to shift off their loads during peak load times and lower their electricity bills. Due to the advancement achieved in wireless communications and digital electronics, hybrid network architectures can enable scalable wireless communications and provide different quality of service (QoS) requirements of electric systems in an economical manner. Major benefits of hybrid network architectures include improved communication reliability, lower installation costs, larger network coverage, and better network connectivity
- Recently we have seen increased attention given to machine to machine (M2M) communications in wired and wireless links. The aim of M2M communications is to enable M2M components to be interconnected, networked, and controled remotely with low-cost, scalable, and reliable technologies. Diverse applications of M2M have already started to emerge in various sectors such as healthcare, smart home technologies, and

so forth. The evolution of M2M has also taken place in SG. The focus of network infrastructure has shifted over from an emphasis on wired and fixed communications to flexible connectivity of wireless communications. The paper [16] provided extensive discussions of a number of existing communication technologies that can be adopted for M2M communications in SG, such as Bluetooth, IEEE 802.11 (WiFi), ultra-wideband (UWB), IEEE 802.15.4 ZigBee, 6LoWPAN, and so forth. As demonstrated by the authors, ZigBee is a superior technology for HAN communications due to its characteristics of low power consumption, flexibility and short wake-up time. In addition, they presented a technique to improve the performance of conventional ZigBee-based M2M communications in SG by incorporating intelligence in the gateway (GW) and M2M devices of the HAN. In a conventional HAN, if M2M devices always attempt to send their periodic messages to a HAN GW, the HAN GW is expected to receive a relatively large number of messages. To this end, the authors proposed a new strategy for transmitting power requirement message, in which a M2M device remains in silent mode unless its power requirement changes. Therefore, a HAN GW will not receive any repeated requests from the same M2M devices and thus is less likely to be overwhelmed by incoming requests from many M2M devices at the same time. As demonstrated by the authors, ZigBee is a superior technology for HAN communications due to its characteristics of low power consumption, flexibility and short wake-up time. In addition, they presented a technique to improve the performance of conventional ZigBee-based M2M communications in SG by incorporating intelligence in the gateway (GW) and M2M devices of the HAN. In a conventional HAN, if M2M devices always attempt to send their periodic messages to a HAN GW, the HAN GW is expected to receive a relatively large number of messages. To this end, the authors proposed a new strategy for transmitting power requirement message, in which a M2M device remains in silent mode unless its power requirement changes. Therefore, a HAN GW will not receive any repeated requests from the same M2M devices and thus is less likely to be overwhelmed by incoming requests from many M2M devices at the same time.