Assignment Two: UMTS Homework

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1. **What are the main differences between the GSM and UMTS radio network?**

GSM uses Time Division Multiple Access (TDMA) and Frequency Division Multiple Access (FDMA) as its primary radio access technologies, while UMTS employs Wideband Code Division Multiple Access (WCDMA). The use of WCDMA allows UMTS to offer higher data rates and better spectral efficiency, supporting a broader range of services than GSM. (From GSM to LTE-Advanced Pro and 5G, 2021, p. 27)

1. **What advantages does the UMTS radio network have compared to previous technologies for users and network operators?**

UMTS provides significantly higher data rates, enhanced multimedia capabilities, and improved voice quality compared to previous technologies like GSM. For network operators, UMTS offers increased capacity, better spectrum utilization, and a more efficient way to handle growing data traffic, which can lead to increased revenue opportunities. (From GSM to LTE-Advanced Pro and 5G, 2021, pp. 111-115)

1. **What data rates for a packet-switched connection were offered by early Release-99 UMTS network?**

Early Release-99 UMTS networks offered packet-switched data rates of up to 384 kbps for downlink and uplink under optimal conditions. This marked a significant improvement over the data rates provided by GSM and GPRS. (From GSM to LTE-Advanced Pro and 5G, 2021, p. 110)

1. **What does OVSF mean?**

Orthogonal Variable Spreading Factor (OVSF) codes are used in UMTS to separate different users and services on the same frequency channel. OVSF codes maintain orthogonality among different connections, preventing interference and allowing simultaneous data transmission. (From GSM to LTE-Advanced Pro and 5G, 2021, p. 121)

1. **Why is scrambling code used in addition to the spreading code?**

Scrambling codes are used in addition to spreading codes to distinguish different cells and users in UMTS. While spreading codes provide separation within a single cell, scrambling codes help reduce interference from other cells, ensuring clear and distinct communication channels. (From GSM to LTE-Advanced Pro and 5G, 2021, p. 122)

1. **What does cell breathing mean?**

Cell breathing refers to the phenomenon in UMTS networks where the coverage area of a cell dynamically changes based on traffic load. As the load increases, the effective cell radius shrinks, and as the load decreases, the cell expands. This is primarily due to power control mechanisms in WCDMA. (From GSM to LTE-Advanced Pro and 5G, 2021, p. 125)

1. **What are the differences between the Cell DCH and the Cell FACH RRC states?**

In the Cell DCH (Dedicated Channel) state, a dedicated communication channel is assigned to the user, providing high data rates suitable for continuous transmission. In contrast, the Cell FACH (Forward Access Channel) state uses shared resources with lower data rates, suitable for sporadic data transmission and signaling. (From GSM to LTE-Advanced Pro and 5G, 2021, pp. 135-137)

1. **In which RRC states may a mobile device be in PMM connected mode?**

A mobile device can be in PMM (Packet Mobility Management) connected mode in the Cell DCH, Cell FACH, and Cell PCH (Paging Channel) RRC states. These states manage the connection between the mobile device and the network with varying levels of resource allocation and activity. (From GSM to LTE-Advanced Pro and 5G, 2021, p. 167)

1. **(a) How is a UMTS soft handoff performed and (b) what are its advantages and disadvantages?**

(a) UMTS soft handoff occurs when a mobile device simultaneously communicates with multiple cells during a transition from one cell to another, maintaining a connection with the network through multiple links. (From GSM to LTE-Advanced Pro and 5G, 2021, pp. 123-124)

(b) The advantages include improved connection reliability and reduced call drop rates. The disadvantage is increased complexity and resource usage, as multiple cells need to maintain connections with the same user. (From GSM to LTE-Advanced Pro and 5G, 2021, pp. 123-124)

1. **What is an SRNS relocation?**

SRNS (Serving Radio Network Subsystem) relocation involves transferring control of a mobile device's connection from one RNC (Radio Network Controller) to another during movement between cells or areas, ensuring continuous service without interruption. (From GSM to LTE-Advanced Pro and 5G, 2021, p. 161)

1. **How is the mobility of a user managed in Cell FACH state?**

In the Cell FACH state, mobility is managed through cell reselection, where the mobile device continuously monitors and selects the best available cell to connect with based on signal quality and other criteria. (From GSM to LTE-Advanced Pro and 5G, 2021, p. 152)

1. **What is the compressed mode used for?**

Compressed mode allows the mobile device to create gaps in transmission, enabling it to measure the signal quality of neighboring cells on different frequencies. This facilitates smooth handovers between UMTS and other networks like GSM. (From GSM to LTE-Advanced Pro and 5G, 2021, p. 163)

1. **What are the basic HSDPA concepts for increasing the user data rate?**

HSDPA (High-Speed Downlink Packet Access) increases user data rates by using adaptive modulation and coding, fast scheduling, and hybrid automatic repeat request (HARQ) mechanisms. These techniques optimize data transmission efficiency and reduce latency. (From GSM to LTE-Advanced Pro and 5G, 2021, pp. 174-176)

1. **How is a circuit-switched voice connection handled during an ongoing HSDPA session?**

During an HSDPA session, circuit-switched voice connections are handled by prioritizing voice traffic over data. The system allocates the necessary resources for voice transmission while maintaining data service continuity, ensuring that voice quality is not compromised. (From GSM to LTE-Advanced Pro and 5G, 2021, p. 150)

1. **What are the advantages of the E-DCH concept?**

The E-DCH (Enhanced Dedicated Channel) concept offers advantages such as higher uplink data rates, reduced transmission latency, and improved uplink capacity through techniques like fast scheduling and rate control. This benefits applications requiring high-speed data transmission from the user to the network. (From GSM to LTE-Advanced Pro and 5G, 2021, p. 183)

1. **Which options does the Node-B have for scheduling the uplink traffic of different E-DCH mobile devices in a cell?**

Node-B can schedule uplink traffic using various methods, including priority-based scheduling, where resources are allocated based on predefined priorities, and dynamic scheduling, where resources are adjusted based on real-time demand and channel conditions. These methods ensure efficient use of available uplink resources. (From GSM to LTE-Advanced Pro and 5G, 2021, pp. 178-180)

# References

From GSM to LTE-Advanced Pro and 5G. (2021). In M. Sauter, *And Introduction to Mobile Networks and Mobile Broadband* (pp. 15 - 100). Hoboken, New Jersey: John Wiley and Sons Ltd.

Sauter, M. (2024, 08 28). *GSM Q&A*. Retrieved from Wirelessmoves: https://blog.wirelessmoves.com/2006/05/answers\_for\_cha.html