TÉCNICO LISBOA

Mestrado em

Engenharia Electrotécnica e de Computadores

Redes Móveis e Sem Fios

2º Teste – 2ª parte

16 de Junho de 2015

Duração 1h15

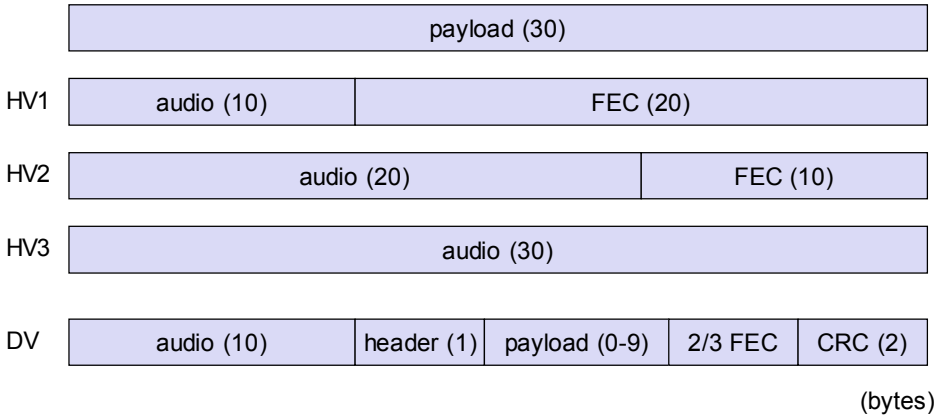
In order to avoid grading mistakes, please answer each question <u>on a different page</u> and keeping the order as much as possible.

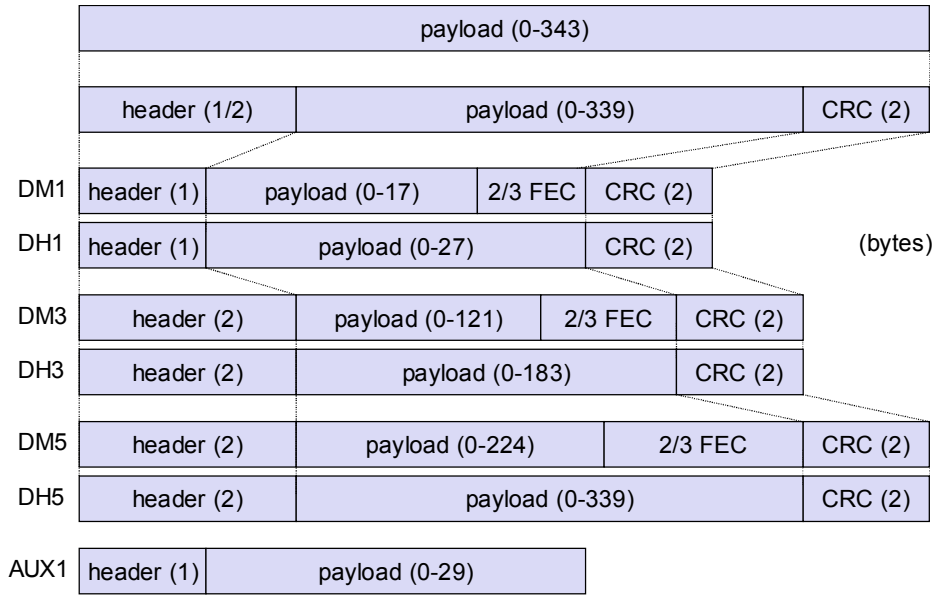
1) Consider an ad-hoc network formed by 4 nodes A, B, C and D in a linear topology. Node A generates data packets whose destination is D. The routing protocol supported in this network is AODV.
   a) Compare AODV and DSR, highlighting their similarities, as well as their relative advantages and disadvantages. (2,0 val)
   b) Draw the message diagram of route establishment between A and D, identifying unicast and broadcast transmissions, the main message fields, as well as the contents of all the routing tables at the end of the procedure. (3,0)
2) Consider a Bluetooth piconet, comprising one master and two slave devices (S1 and S2). The master device has the following ACL packets in its transmission queue, which are ordered as follows (format is <destination, packet>): <S2, DM3>, <S1, DH1>, <S2, DM1>. Regarding the ACL uplink traffic: S1 has two packets in the queue: DH1 and DM3; S2 has a single waiting DM1 packet in the queue. There is also SCO session going on in which S2 participates, which employs HV3 packets.
   a) Draw the timeline diagram of packet transmissions, clearly indicating the timeslot assignment (for each packet, indicate the type, the occupied slots, the sender and the receiver). Assume that SCO transmission starts in the first slot. The diagram ends when the last ACL packet is transmitted. (3,0 val)
   b) Indicate the frequency that is used in each slot, considering that the frequency is f_k in the first slot, where k is the respective number in the hop sequence. (2,0 val)
3) The Orthogonal Variable Spreading Factor (OVSF) codes are employed in UMTS UTRA-FDD.
   a) Consider a scenario where two mobile stations simultaneously try to send the maximum possible number of data streams with SF=4. What is the maximum bitrate that each mobile station will be able to send to the base station? Note: UMTS employs a fixed chip rate of 3.84 Mchip/s. (2,0 val)
   b) Explain the roles of *spreading* and *scrambling* in UMTS UTRA-FDD. (2,0 val)
4) Consider one of the orbital planes of a LEO satellite system operating in the 2 GHz frequency. The footprint of each satellite is 655 km, and the latter overlaps each neighbor footprint by at least 100 km. The satellite and ground station antennas have similar characteristics, featuring the same divergence angle of 25º.
   a) Calculate the rotational frequency of the satellites. Note: $\boldsymbol{r} = \sqrt[3]{\frac{g \cdot R^2}{\omega^2}}$ with the following constants: $\boldsymbol{g} = \boldsymbol{9.81 m/s^2}$ (gravitational acceleration), $\boldsymbol{R = 6370\ km}$ (radius of the Earth), $\boldsymbol{r}$ is the distance of the satellite to the center of the Earth. (2,0 val)
   b) What is the minimum number of the satellites in an orbital plane? (2, 0 val)
   c) What is the maximum time interval during which a ground station can maintain connectivity with the same satellite? Note: assume that the rotational speed of the Earth is negligible compared with the rotational speed of the satellite. Note2: assume that the ground station is located on the line that corresponds to the projection of the satellite's orbit on the Earth's surface. (2,0 val)

Bluetooth

1 slot = 625us

SCO stream throughput = 64 kbit/s





Satellite Systems

$F_g = m \cdot g \cdot (R/r)^2$	$F_c = m \cdot r \cdot \omega^2$
$L = \left(\frac{4 \cdot \pi \cdot r \cdot f}{c}\right)^2$	$Footprint\ Diameter = \theta_{div} \times d$
$G_{t\_plane} = 10 \cdot log_{10}(2\pi/\theta_{div})$	$A_{eff} = \eta \cdot A_{phy} = \frac{\lambda^2}{4\pi} G_r$
$P_r(dB) = P_t(dB) - 10 \cdot log_{10}\left(\frac{4 \cdot Footprint}{\pi^2 \cdot A_{eff}}\right) - At$	