1 Introduction

1.1 Discover the current numbers of subscribers for the different systems. As mobile communications boom, no printed number is valid for too long!

1.2 Check out the strategies of different network operators while migrating towards third generation systems. Which are reasons why a single common system is not in sight?

2 Wireless Transmission

2.1 Frequency regulations may differ between countries. Check out the regulations valid for your country (within Europe the European Radio Office may be able to help you, www.ero.dk, for the US try the FCC, www.fcc.gov, for Japan ARIB, www.arib.or.jp).

2.2 Why can waves with a very low frequency follow the earths surface? Why are they not used for data transmission in computer networks?

Nicht benutzt in Computernetzwerken weil man riesige Antennen bentigt um sie zu empfangen -¿ unpraktisch und teuer. Auerdem sind damit nur geringe Datenraten zu erreichen, da die Bandbreite gering ist.

2.3 Why does the ITU-R only regulate lower frequencies (up to some hundred GHz) and not higher frequencies (in the THz range)?

2.4 What are the two different approaches in regulation regarding mobile phone systems in Europe and the US? What are the consequences?

In den USA Versteigerung der Frequenzen an den Meistbietenden. In Europa wird nach Technologie separiert. Konsequenz ist, dass in Amerika verschiedene Technologien auf dem gleichen Frequenzband mit einander konkurrieren und sich gegenseitig stren.

2.5 Why is the international availability of the same ISM bands important?

Fr den Export von Gerten wie Routern, Mikrowellen oder medizinischen Gerten ohne das die Funkmodule regional angepasst werden mssten?

2.6 Is it possible to transmit a digital signal, e.g., coded as square wave as used inside a computer, using radio transmission without any loss? Why?

Man hat im Funk ja nur ein gewisses Frequenzband zur Verfgung. Ein digitales Signal besteht aber aus unendlich vielen analogen Signalen mit unterschiedlicher Frequenz. Es mssen also alle Frequenzen weggelassen werden, die nicht in der verfgbaren Bandbreite liegen -¿ Signal wird ungenauer.

2.7 Is a directional antenna useful for mobile phones? Why? How can the gain of an antenna be improved?

Nein, also nicht direkt am Handy bzw. am UE/MS. Man wei ja nicht in welcher Richtung sich die gerade verbundene Base Station befindet. Es sollte also in alle Richtungen gleichmig gesendet werden. Zumal die Zelle ja auch regelmig durch die implizierte Mobilitt gewechselt wird.

2.8 What are the main problems of signal propagation? Why do radio waves not always follow a straight line? Why is reflection both useful and harmful?

- Fading: Frequenzabhngig, Umwelt beeinflusst das Signal indem es die Wellenlnge vergrert oder verringert
- Shadowing: Abschirmung bestimmter Frequenzen durch Materialien wie Stahlbetonwnde, Bume, Wasser. Je hher die Frequenz, desto strker treten shadowing-Effekte auf.
- Reflection: Reflektion von Signalen an Wnden, etc. Besonders stark in Innenstdten mit engen Gassen
- Refraction: Wie beim Licht im Wasser. Ablenkung des Signals durch ein Medium
- Scatter: Brechung des Signals wie beim Licht und einem Prisma. Spaltet Signal in seine Frequenzbestandteile auf.
- Diffraction an Kanten. Ablenkung + Aufspaltung des Signals.

Frage 2 ergibt sich aus obigen Problemen. Signale haben selten freie Bahn, sondern kollidieren mit Objekten und werden abgelenkt. Reflektion hilft dabei schlecht erreichbare Ecken in z.B. Innenstdten abzudecken, ohne zustzliche Antennen aufstellen zu mssen. Allerdings lenkt sie auch das Signal ab, was dazu fhrt, das gesendete Signale nicht dort ankommen wo sie hin sollen oder zu spt und in schlechter Qualitt am Empfnger eintreffen.

2.9 Name several methods for ISI mitigation. How does ISI depend on the carrier frequency, symbol rate, and movement of sender/receiver? What are the influences of ISI on TDM schemes?

- Krzere Impulse nutzen, sodass mglichst wenig Energie sich auf die benachbarten Symbole auswirken kann
- Zeitliche Trennung von Symbolen durch guard-periods.
- Equalizer im Receiver, der versucht die Effekte rckgngig zu machen
- Sequence Detector im Receiver um mithilfe des Viterbi Algorithmus die bertragene Symbolfrequenz zu schtzen.

Carrier Frequenz hoch -¿ strkere Interferenzen, weil die Impulse nher beieinander liegen

Symbol Rate hoch -¿ mehr Symbole pro Impuls -¿ ßchneresSSignal notwendig zum decodieren -¿ mehr Interferenzen und kaputte Signale

Bewegungen von Sender und Empfnger fhren zu unterschiedlichen bertragungszeiten der einzelnen Signale. Gerade wenn diese Bewegungen sehr schnell sind, treffen Signale eventuell zu einem unerwarteten Zeitpunkt ein (auch zugleich) und stren sich.

ISI bedeutet auch, dass eventuell die Signale unterschiedlicher Time Slots miteinander interferieren und somit Signale an einer Stelle erscheinen, wo sie nichts zu suchen haben. Behoben durch guard spaces zwischen den Time Slots.

2.10 What are the means to mitigate narrowband interference? What is the complexity of the different solutions?

Spread Spectrum.

Direct Sequence Spread Spectrum -¿ XOR von Signal mit einer random-Number (der sog. Chipping-Sequence). Je mehr Chips pro Bit, desto breiter das Signal

Frequency Hopping Spread Spectrum -¿ Sprunghaftes ndern der Trgerfrequenz (Bluetooth) Fast Hopping: mehrere Frequenzen per Bit, Slow Hopping: mehrere Bits per Frequenz

FHSS ist deutlich einfacher zu implementieren, da einfach in einem gewissen Takt gesprungen werden muss. Bei DSSS muss hingegen bei Sender und Empfnger das Signal umgerechnet werden was Prozessorleistung erfordert.

2.11 Why, typically, is digital modulation not enough for radio transmission? What are general goals for digital modulation? What are typical schemes?

Sender unterschiedlicher Dienste (z.B. Zellen, Radiosender) haben bestimmte zugewiesene Frequenzbnder in denen sie sich bewegen knnen ohne andere Sendestationen zu stren. Deshalb muss das Signal mit den Nutzdaten noch auf die genutzte Trgerfrequenz moduliert werden.

Ziele von digitaler Modulation sind spektrale Effizienz (bin mir unsicher was das sein soll), Stromsparen und robuste Signale.

Digitale Modulation nennt sich auch Shift Keying

- Amplitude Shift Keying: Verndere Ausschlag der Welle passend zum zu bertragenden Bit
- Frequency Shift Keying: ndere Frequenz passend zu 0 oder 1
- Phase Shift Keying: Verschiebe die Phase des Signals abhngig vom Bit-wert.

2.12 Think of a phase diagram and the points representing bit patterns for a PSK scheme (see Figure 2.29). How can a receiver decide which bit pattern was originally sent when a received point lies somewhere in between other points in the diagram? Why is it, thus, difficult to code more and more bits per phase shift?

Wir nehmen den Punkt, der am nchsten liegt? Und wenn komplett Zentral raten? Also random. Ich bin mir da unsicher...

Wenn man viele Bits per Phase verwendet, resultiert das in mehr Punkten in unserer Map. Dadurch sind die Bereiche in denen ein Bit eindeutig einem Wert zugeordnet werden kann kleiner und das Signal ist weniger robust.

2.13 What are the main benefits of a spread spectrum system? How can spreading be achieved? What replaces the guard space in Figure 2.31 when compared to Figure 2.32? How can DSSS systems benefit from multipath propagation?

Strungen, die nur einen kleinen Frequenzbereich betreffen stellen kein Problem mehr dar, da das Signal sich ber einen greren Bereich erstreckt. Das Signal wird also robuster. Weiterhin ist mit einer geheimen und wechselnden Chipping Sequence eine Verschlsselung zu erzielen. Nutzer knnen auch auf dem selben Frequenzband gleichzeitig senden, wenn sie unterschiedliche Codes zum spreaden nutzen.

Wie funktioniert Spreading siehe oben

Ich bin mir unsicher welche guard spaces da gemeint sind. Vielleicht wurden die Folien gendert?

Offensichtlich nutzen DSSS Systeme sog. rake receivers (?). Dadurch knnen sie leicht verschiedene Signale einfangen und zum Ausgangssignal rekombinieren.

2.14 What are the main reasons for using cellular systems? How is SDM typically realized and combined with FDM? How does DCA influence the frequencies available in other cells?

Mehr Nutzer mglich, weniger Strom fr die bertragung notwendig wegen krzerer Wege, dezentral daher robuster.

Jede Zelle deckt einen bestimmten Bereich ab. Alle Nutzer in diesem Bereich nutzen die Basisstation dieser Zelle(SDM). Jede Zelle hat ein bestimmtes Frequenzband, welches disjunkt zum Frequenzband benachbarter Zellen ist(FDM).

Wenn eine Zelle viele Nutzer hat, ßtiehltßie den benachbarten Zellen dynamisch unbenutzte Frequenzen.

2.15 What limits the number of simultaneous users in a TDM/FDM system compared to a CDM system? What happens to the transmission quality of connections if the load gets higher in a cell, i.e., how does an additional user influence the other users in the cell?

TDM/FDM ist irgendwann voll belegt und lehnt dann einfach neue Nutzer ab, weil die verfgbaren Frequenzen bzw. die Timeslots aufgebraucht sind.

CDM kann neue Nutze aufnehmen, solange diese sich nicht gegenseitig auslschen. Je mehr Nutzer in einer Zelle mit CDM, desto strker das Rauschen -¿ geringere Reichweite der Basisstation -¿ irgendwann fallen entferntere Nutzer aus der Zelle.

3 Medium Access Control

3.1 What is the main physical reason for the failure of many MAC schemes known from wired networks? What is done in wired networks to avoid this effect?

Signalstrke -¿ hidden Terminals

3.2 Recall the problem of hidden and exposed terminals. What happens in the case of such terminals if Aloha, slotted Aloha, reservation Aloha, or MACA is used?

- Aloha: Hidden: Terminals A und C senden einfach frhlich drauflos -¿ Kollision -¿ Kein ACK von B -¿ neue bertragung bis die Daten irgendwann ankommen

  Exposed: Es wird einfach gesendet und damit auch keine Rcksicht auf irgendwelche belegten Medien genommen

- slotted Aloha: s.o. Vielleicht Probleme beim Synchronisieren der Time Slots? Wobei das dann vermutlich einfach ber das Terminal B laufen wrde.

- reservation Aloha: Synchronisation und Reservierung ber Terminal B?

- MACA: Hidden: A sendet RTS -¿ B sendet CTS -¿ C empfngt CTS von B und wartet deshalb

  Exposed: B mchte etwas zu A senden, C irgendwo anders hin (zu D). C empfngt kein CTS von A, da A nicht sichtbar und muss deshalb nicht warten

3.3 How does the near/far effect influence TDMA systems? What happens in CDMA systems? What are countermeasures in TDMA systems, what about CDMA systems?

TDMA gar nicht? Also ich wsste nicht weshalb. Jedes Terminal hat seinen Zeitslot und sendet da auf seiner Frequenz. Es muss nur, je nach Entfernung zwischen Sender und Empfnger, der Sendezeitpunkt angepasst werden sodass das Signal im richtigen Time slot eintrifft.

Bei CDMA kann ein weiter entferntes Terminal von einem Nheren bertnt werden. Eine Gegenmanahme wre die Signalstrke anzupassen, wenn keine ACKs vom Receiver kommen bzw. vielleicht den nheren Terminals zu signalisieren schwcher zu senden. Also entfernungsabhngiges power-management.

3.4 Who performs the MAC algorithm for SDMA? What could be possible roles of mobile stations, base stations, and planning from the network provider?

Der Provider legt die Zellstrukturen fest, also die Netztopologie. Also ist der Provider derjenige, der fr den SDMA zustndig ist.

Die MS suchen sich ber die Signalstrke die nchstgelegene BS und tauschen sich mit dieser aus.

3.5 What is the basic prerequisite for applying FDMA? How does this factor increase complexity compared to TDMA systems? How is MAC distributed if we consider the whole frequency space as presented in chapter 1?

Wir mssen in der Lage sein unser digitales Signal auf eine bestimmte Trgerfrequenz zu modulieren. Also bentigen Sender und Empfnger analoge Modulatoren(nennt man das so?). Whrend in TDMA Systemen einfach nur synchronisiert auf immer der gleichen Frequenz gesendet wird - also vom Empfnger auch nur eine Frequenz äbgehrt”werden muss - muss der Empfnger bei FDMA Systemen mehrere Frequenzen gleichzeitig handeln. Die Kommunikation geschieht also parallel und nicht sequentiell wie beim TDMA.

3.6 Considering duplex channels, what are alternatives for implementation in wireless networks? What about typical wired networks?

FDD, also eine Menge an Frequenzen fr den Uplink und eine Menge fr den Downlink oder TDD als in einer bestimmten Zeit wird gesendet und in der Restlichen empfangen. CDD mit unterschiedlichen Codes fr Uplink und Downlink? Verkabelte Netzwerke nutzen gewhnlich einfach unterschiedliche Leitungen/Kabelstrnge.

3.7 What are the advantages of a fixed TDM pattern compared to random, demand driven TDM? Compare the efficiency in the case of several connections with fixed data rates or in the case of varying data rates. Now explain why traditional mobile phone systems use fixed patterns, while computer networks generally use random patterns. In the future, the main data being transmitted will be computer-generated data. How will this fact change mobile phone systems?

Fairness, einfach zu implementieren. Feste Timeslots sind effektiver bei festen Datenraten, da weniger Overhead entsteht und keine Kapazitt fr die Reservierung von Time Slots verbraucht wird. Bei wechselnden Datenraten ist logischerweise DAMA-TDMA effektiver, da jede Station hier nur so viel Kapazitt belegt wie sie braucht. Wenn bei fixed TDMA bspw. eine Station zeitweise nur wenig bis gar keine Daten sendet, werden ihre Time Slots verschwendet.

3.8 Explain the term interference in the space, time, frequency, and code domain. What are countermeasures in SDMA, TDMA, FDMA, and CDMA systems?

- SDMA: Zwei Sender stehen zu nah beieinander. Guard space durch gengende Abstnde zwischen den Antennen.

- TDMA: das Signal einer Station kommt im falschen Slot an und trifft auf das Signal einer anderen Station. Guard Spaces in Form von Sendepausen zwischen den Slots, bessere Synchronisation.
- FDMA: die Frequenzbnder von Stationen berlappen. Guard Spaces in Form von ungenutzten Frequenzen bzw. Frequency Reuse erst ab einer gewissen Entfernung bei Zellen, Frequency Hopping
- CDMA: Codes canceln sich gegenseitig. Orthogonale Codes nutzen

3.9 Assume all stations can hear all other stations. One station wants to transmit and senses the carrier idle. Why can a collision still occur after the start of transmission?

Geschwindigkeit des Signals in der Luft begrenzt. Station beginnt also zu senden, doch bevor das Signal eine andere Station erreichen kann, checkt eine weitere Station das Medium, erkennt es als frei und sendet.

3.10 What are benefits of reservation schemes? How are collisions avoided during data transmission, why is the probability of collisions lower compared to classical Aloha? What are disadvantages of reservation schemes?

Vorteile der Reservierung ist ein grtenteils Kollisionsfreier Datenaustausch. Durch die Reservierung kann eine Station je nach bedarf auch mehr Daten senden oder eben weniger. Es werden keine unntigen Ressourcen wie Time Slots, Codes oder Frequenzen blockiert. Die ALOHA Phase in der wild gesendet wird ist vergleichsweise kurz.

Ein Nachteil der Reservierung ist der zustzliche Overhead (Reservation Lists up to date halten etc.)

3.11 How can MACA still fail in case of hidden/exposed terminals? Think of mobile stations and changing transmission characteristics.

3.12 Which of the MAC schemes can give hard guarantees related to bandwidth and access delay?

TDMA mit festen Slots und FDMA

3.13 How are guard spaces realised between users in CDMA?

Orthogonale Codes, quasi-orthogonale Codes.

3.14 Redo the simple CDMA example of subsection 3.5, but now add random noise to the transmitted signal $(2, 0, 0, 2, +2, 0)$**. Add, for example,** $(1, 1, 0, 1, 0, 1)$**. In this case, what can the receiver detect for sender A and B respectively? Now include the near/far problem. How does this complicate the situation? What would be possible countermeasures?**

Signal + noise = -1,-1,0,-1,+2,-1

A beim Empfnger: +1-1+0+1+2-1 = 2 also 1

B beim Empfnger: -1-1+0-1-2-1 = -6 also 0

Der Empfnger kann die Signale trotz des Noise decodieren. Bei einem zustzlichen Near-Far Problem knnte bspw. das Signal von A und das Noise deutlich heftiger ausfallen, sodass das decodieren der Bits nicht mehr mglich ist. Um dies zu beheben knnten z.B. lngere Keys fr A und B verwendet werden.

4 Telecommunication systems

4.1 Name some key features of the GSM, DECT, TETRA, and UMTS systems. Which features do the systems have in common? Why have the older three different systems been specified? In what scenarios could one system replace another? What are the specific advantages of each system?

4.2 What are the main problems when transmitting data using wireless systems that were made for voice transmission? What are the possible steps to mitigate the problems and to raise efficiency? How can this be supported by billing?

4.3 Which types of different services does GSM offer? Name some examples and give reasons why these services have been separated.

4.4 Compared to the TCHs offered, standard GSM could provide a much higher data rate (33.8 kbit/s) when looking at the air interface. What lowers the data rates available to a user?

4.5 Name the main elements of the GSM system architecture and describe their functions. What are the advantages of specifying not only the radio interface but also all internal interfaces of the GSM system?

4.6 Describe the functions of the MS and SIM. Why does GSM separate the MS and SIM? How and where is user-related data represented/stored in the GSM system? How is user data protected from unauthorised access, especially over the air interface? How could the position of an MS (not only the current BTS) be localised? Think of the MS reports regarding signal quality.

4.7 Looking at the HLR/VLR database approach used in GSMhow does this architecture limit the scalability in terms of users, especially moving users?

4.8 Why is a new infrastructure needed for GPRS, but not for HSCSD? Which components are new and what is their purpose?

4.9 What are the limitations of a GSM cell in terms of diameter and capacity (voice, data) for the traditional GSM, HSCSD, GPRS? How can the capacity be increased?

4.10 What multiplexing schemes are used in GSM for what purposes? Think also of other layers apart from the physical layer.

4.11 How is synchronisation achieved in GSM? Who is responsible for synchronisation and why is synchronisation very important?

4.12 What are the reasons for the delays in a GSM system for packet data traffic? Distinguish between circuit-switched and packet-oriented transmission.

4.13 Where and when can collisions occur while accessing the GSM system? Compare possible collisions caused by data transmission in standard GSM, HSCSD, and GPRS.

4.14 Why and when are different signalling channels needed? What are the differences?

4.15 How is localisation, location update, roaming, etc. done in GSM and reflected in the data bases? What are typical roaming scenarios?

5 Satellite systems

5.1 **Name basic applications for satellite communication and describe the trends.**

5.2 **Why are GEO systems for telecommunications currently being replaced by fibre optics?**

5.3 **How do inclination and elevation determine the use of a satellite?**

5.4 **What characteristics do the different orbits have? What are their pros and cons?**

5.5 **What are the general problems of satellite signals travelling from a satellite to a receiver?**

5.6 **Considered as an interworking unit in a communication network, what function can a satellite have?**

5.7 **What special problems do customers of a satellite system with mobile phones face if they are using it in big cities? Think of in-building use and skyscrapers.**

5.8 **Why is there hardly any space in space for GEOs?**

6 Broadcast systems

6.1 **2G and 3G systems can both transfer data. Compare these approaches with DAB/DVB and list reasons for and against the use of DAB/DVB.**

6.2 **Which web pages would be appropriate for distribution via DAB or DVB?**

6.3 **How could location based services and broadcast systems work together?**

7 Wireless LAN

7.1 How is mobility restricted using WLANs? What additional elements are needed for roaming between networks, how and where can WLANs support roaming? In your answer, think of the capabilities of layer 2 where WLANs reside.

7.2 What are the basic differences between wireless WANs and WLANs, and what are the common features? Consider mode of operation, administration, frequencies, capabilities of nodes, services, national/international regulations.

7.3 With a focus on security, what are the problems of WLANs? What level of security can WLANs provide, what is needed additionally and how far do the standards go?

7.4 Compare IEEE 802.11, HiperLAN2, and Bluetooth with regard to their ad-hoc capabilities. Where is the focus of these technologies?

7.5 If Bluetooth is a commercial success, what are remaining reasons for the use of infrared transmission for WLANs?

7.6 Why is the PHY layer in IEEE 802.11 subdivided? What about HiperLAN2 and Bluetooth?

7.7 Compare the power saving mechanisms in all three LANs introduced in this chapter. What are the negative effects of the power saving mechanisms, what are the tradeoffs between power consumption and transmission QoS?

7.8 Compare the offered QoS in all three LANs in ad hoc mode. What advantages does an additional infrastructure offer? How is QoS provided in Bluetooth? Can one of the LAN technologies offer hard QoS (i.e., not only statistical guarantees regarding a QoS parameter)?

7.9 How do IEEE 802.11, HiperLAN2 and Bluetooth, respectively, solve the hidden terminal problem?

7.10 How are fairness problems regarding channel access solved in IEEE 802.11, HiperLAN2, and Bluetooth respectively? How is the waiting time of a packet ready to transmit reflected?

7.11 What different solutions do all three networks offer regarding an increased reliability of data transfer?

7.12 In what situations can collisions occur in all three networks? Distinguish between collisions on PHY and MAC layer. How do the three wireless networks try to solve the collisions or minimize the probability of collisions?

7.13 Compare the overhead introduced by the three medium access schemes and the resulting performance at zero load, light load, high load of the medium. How does the number of collisions increase with the number of stations trying to access the medium, and how do the three networks try to solve the problems? What is the overall scalability of the schemes in number of nodes?

7.14 How is roaming on layer 2 achieved, and how are changes in topology reflected? What are the differences between infrastructure based and ad hoc networks regarding roaming?

8 Mobile network layer

8.1 **Recall routing in fixed IP networks (Kurose, 2003). Name the consequences and problems of using IP together with the standard routing protocols for mobile communications.**

8.2 **What could be quick solutions and why do they not work?**

8.3 **Name the requirements for a mobile IP and justify them. Does mobile IP fulfil them all?**

8.4 **List the entities of mobile IP and describe data transfer from a mobile node to a fixed node and vice versa. Why and where is encapsulation needed?**

8.5 **How does registration on layer 3 of a mobile node work?**

8.6 **Show the steps required for a handover from one foreign agent to another foreign agent including layer 2 and layer 3.**

8.7 **Explain packet flow if two mobile nodes communicate and both are in foreign networks. What additional routes do packets take if reverse tunnelling is required?**

8.8 **Explain how tunnelling works in general and especially for mobile IP using IP-in-IP, minimal, and generic routing encapsulation, respectively. Discuss the advantages and disadvantages of these three methods.**

8.9 **Name the inefficiencies of mobile IP regarding data forwarding from a correspondent node to a mobile node. What are optimizations and what additional problems do they cause?**

8.10 **What advantages does the use of IPv6 offer for mobility? Where are the entities of mobile IP now?**

8.11 **What are general problems of mobile IP regarding security and support of quality of service?**

8.12 **What is the basic purpose of DHCP? Name the entities of DHCP.**

8.13 **How can DHCP be used for mobility and support of mobile IP?**

8.14 **Name the main differences between multi-hop ad hoc networks and other networks. What advantages do these ad hoc networks offer?**

8.15 **Why is routing in multi-hop ad hoc networks complicated, what are the special challenges?**

8.16 **Recall the distance vector and link state routing algorithms for fixed networks. Why are both difficult to use in multi-hop ad hoc networks?**

8.17 **What are the differences between AODV and the standard distance vector algorithm? Why are extensions needed?**

8.18 **How does dynamic source routing handle routing? What is the motivation behind dynamic source routing compared to other routing algorithms from fixed networks?**

8.19 **How does the symmetry of wireless links influence the routing algorithms proposed?**

8.20 **Why are special protocols for the support of micro mobility on the network layer needed?**

9 Mobile transport layer

9.1 **Compare the different types of transmission errors that can occur in wireless and wired networks. What additional role does mobility play?**

9.2 **What is the reaction of standard TCP in case of packet loss? In what situation does this reaction make sense and why is it quite often problematic in the case of wireless networks and mobility?**

9.3 **Can the problems using TCP be solved by replacing TCP with UDP? Where could this be useful and why is it quite often dangerous for network stability?**

9.4 **How and why does I-TCP isolate problems on the wireless link? What are the main drawbacks of this solution?**

9.5 **Show the interaction of mobile IP with standard TCP. Draw the packet flow from a fixed host to a mobile host via a foreign agent. Then a handover takes place. What are the following actions of mobile IP and how does TCP react?**

9.6 **Now show the required steps during handover for a solution with a PEP. What are the state and function of foreign agents, home agents, correspondent host, mobile host, PEP and care-of address before, during, and after handover? What information has to be transferred to which entity in order to maintain consistency for the TCP connection?**

9.7 **What are the influences of encryption on the proposed schemes? Consider for example IP security that can encrypt the payload, i.e., the TCP packet.**

9.8 **Name further optimisations of TCP regarding the protocol overhead which are important especially for narrow band connections. Which problems may occur?**

9.9 **Assume a fixed Internet connection with a round trip time of 20 ms and an error rate of 10-10. Calculate the upper bound on TCPs bandwidth for a maximum segment size of 1000 byte. Now two different wireless access networks are added. A WLAN with 2 ms additional one-way delay and an error rate of 10-3, and a GPRS network with an additional RTT of 2 s and an error rate of 10-7. Redo the calculation ignoring the fixed networks error rate. Compare these results with the ones derived from the second formula (use RTO = 5 RTT). Why are some results not realistic?**

9.10 **Why does the link speed not appear in the formulas presented to estimate TCPs throughput? What is wrong if the estimated bandwidth is higher than the link speed?**

10 Support for mobility

10.1 **Why is strong consistency of file systems problematic in a wireless and mobile environment? What are the alternatives?**

10.2 **How do conventional file systems react to disconnected systems? Try unplugging a computer that has mounted a file system via a network.**

10.3 **What advantages has the statelessness of HTTP? In what situations is state useful and how is it provided today? Where is long-term state stored, where short-term?**

10.4 **Which properties of HTTP waste bandwidth? What is the additional problem using HTTP/1.0 together with TCP? How does HTTP/1.1 improve the situation?**

10.5 **How does caching improve access time and reduce bandwidth requirements? What are locations for a cache and their specific advantages?**

10.6 **What are problems of caches in real life? What type of content can be cached, which content causes problems? What are the additional problems with client mobility?**

10.7 **What discrepancies exist between the possibilities of HTML and the realities of wireless handheld devices? What are proposed solutions? What is the role of plug-ins today and how do they influence the usability of web pages?**

10.8 **Name mechanisms to improve web access for handheld devices. What is their common problem and what led finally to the development of WAP?**

10.9 **What are typical enhancements to the basic client/server architecture of the web? Reconsider these enhancements for a mobile wireless user with web access over a mobile phone network. What are efficient locations for the enhancements?**

10.10 **What are the primary goals of the WAP Forum efforts and how are they reflected in the initial WAP protocol architecture?**

10.11 **What migration paths does WAP 1.x offer for Internet and telephony applications and their protocols? Compare with WAP 2.0.**

10.12 **Is WDP a fixed protocol and why does WAP not define a SAP which WDP can use?**

10.13 **Why does WAP define its own security layer and does not rely on the security provided by the mobile phone network? What problems does the WAP security layer cause? Think of end-to-end security.**

10.14 **Name the advantages and disadvantages of user acknowledgements in WTP. What are typical applications for both cases?**

10.15 **Which WTP class reflects the typical web access best? How is unnecessary overhead avoided when using WSP on top of this class for web browsing?**

10.16 **What problems of HTTP can WSP solve? Why are these solutions especially needed in wireless mobile environments?**

10.17 **Why does WSP/B not put responses into the same order as the requests? Think, for example, of requests for different items on a**