

## Assignment 2

1. **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?**

The Hypertext Transfer Protocol (HTTP) is a stateless application protocol. An HTTP transaction consists of an HTTP request issued by a client and an HTTP response from a server. Stateless means that all HTTP transactions are independent of each other. HTTP does not remember a transaction, request, or response.

HTTP causes many problems in wireless networks:

? **Bandwidth and delay:** HTTP/HTML was not designed with low bandwidth and high delay connections in mind. HTTP protocol headers are quite large and redundant. Many information fields are transferred repeatedly with each request because HTTP is stateless. Servers transfer content uncompressed. As TCP connections are typically used for each item on the web page, a huge overhead comes with each item in HTTP/1.0. Another problem is caused by the DNS look-up, necessary for many items on a web page, reducing bandwidth and increasing the delay even further.

? **Caching:** Caching is quite often disabled by content providers. Many companies want to place advertisements on web pages and need feedback, e.g. through the number of clicks. Many present-day pages contain dynamic objects that cannot be cached, e.g., access counters.

? **POSTing:** Sending content from a client to a server can cause additional problems if the client is currently disconnected. The POST request cannot be fulfilled in a disconnected state.

HTTP/1.1 offers several improvements:

? **Connection re-use:** Clients and servers can use the same TCP connection for several requests and responses. A client may send multiple requests at the beginning of a session, and the server can send all responses in the same order.

? Caching enhancements: A cache may now also store cacheable responses. The correctness of cached entries has been enhanced. A special tag allows for the identification of content and helps to determine if two different URIs map to the same content. Several more tag determines if content is cacheable.

? Bandwidth optimisation: HTTP/1.1 supports not only compression, but also the negotiation of compression parameters and different compression styles. It allows for partial transmission of objects.

? Security: HTTP/1.1 comprises further mechanisms to check message integrity and to authenticate clients, proxies, and servers.

**2. Why HTTP/HTML is not suitable for mobile applications and devices? Describe some approaches that might help wireless access and some system supports for mobile www.**

HTML is broadly used to describe the content of web pages in the World Wide Web. HTML was designed for standard desktop computers with relatively high performance, a colour high-resolution display, mouse, sound system, and large hard disks. Web pages using the current HTML often ignore these differences in end-systems. Pages are designed primarily for a nice presentation of content, not for efficient transfer of this content. HTML itself offers almost no way of optimising pages for different clients or different transmission technologies. Web pages typically ignore the heterogeneity of endsystems altogether.

Some approaches that might help wireless access:

? Image scaling: pictures can be scaled down to fewer colors, lower resolution or to just image title. The user can then decide to download the picture separately.

? Content transformation: Because handled devices have limited browsers, special converters could translate the documents into plain text.

? Content extraction/ semantic compression: Headlines or keywords could be extracted from a document and presented to a user. The user could then decide to download more information. An abstract from some given text could be automatically generated.

? Special languages and protocols: There are some approaches that try to replace HTML and HTTP with other languages and protocols better adapted to a wireless environment, such as Handheld Device Transport Protocol (HDTP) and the Handheld Device Markup Language (HDML).

? Push technologies: Instead of polling the content from a server, the server could also push content to the client. This avoids the overhead of setting up new connection for each item (this is a limited function for content like news, road condition, etc.).

? Application gateway: Used to provide www content to users with mobile phones, and comprise entities for compression, filtering, content extraction and automatic adaptation to network characteristics.

? Caching/ pre-fetching: It is the only way of supporting partially disconnected web browsers. The user can go offline and still browse through the cached content.

**3. What is WAP? Simply describe the functions of each layer in WAP protocol stack. What are major differences between WAP 2.0 and WAP 1.x? What influenced the WAP 2.0 development?**

The basic objectives of WAP are to bring diverse Internet content and other data services to digital cellular phones and other wireless, mobile terminals. WAP is a protocol suit that enables global wireless communications across different wireless network technologies. It creates a framework for the development of content and applications that scales across a very wide range of wireless bearer networks and wireless devices types. WAP is independent from wireless network standards it is open for everyone to participate, while protocol specifications will be proposed to standardization bodies.

Layers in WAP protocol stack:

? Physical Layer - this layer in a communication system is responsible for the conversion of a stream of bits into signals that can be transmitted over transmission medium. The physical layer of the receiver then transforms the signals back into a bit stream. For wireless communication, the physical layer is responsible for frequency selection, generation of the carrier frequency, signal detection, modulation of data onto a carrier frequency and encryption.

? Data Link Layer - the data link layer is responsible for a reliable point-to-point connection between two devices or a point-to- multipoint connection between one sender and several receivers. For wireless communication, the main tasks of this layer include accessing the medium, multiplexing of different data streams, correction of transmission errors, and synchronization.

? Network Layer - this layer is responsible for routing packets through a network or establishing a connection between two entities over many other intermediate systems. Important topics are addressing, routing, device location, and handover between different networks.

? Transport Layer - this layer is used to establish an end-to-end connection. Topics like quality of service, flow and congestion control are relevant, especially if the transport protocols known from the Internet, TCP and UDP are to be used with some optimizations over a wireless link.

? Application Layer - this layer is situated on top of all transmission-oriented layers. The application layer contains the logic needed to support the various user applications. The topics of this layer in wireless environment include service location, support for multimedia applications, adaptive applications that can handle the large variations in transmission characteristics, and also wireless access to the World Wide Web using a portable device.

Differences between WAP 2.0 and WAP 1.x:

? WAP 2.0 does not necessary need a proxy; the WAP device can directly access Internet content.

? WAP 2.0 integrates a lot of Internet technology while still offering special telephony services that aren't available in today's standards Internet devices.

? Additionally integrates IP, TCP (With wireless profile), TLS and HTTP (wireless profiled).

? Unlike WAP 1.0, the new version browser support XHTMLMP as a replacement and enhancement to the current HTML.

? WAP 2.0 protocol framework consists of four components: Bearer networks, Transport services, Transfer services, and Session services.

? WAP 2.0 supports multi-media messaging and push services

? WAP 2.0 enhances support for content formats include color images, audio, video, calendar information, phone book entries etc.

Due to the influence of the Internet and I-mode, along with increasing power of mobile devices were big issues in the evolvement of WAP version 2.

**4. Give a comparison of the four basic MAC schemes: SDMA, TDMA, FDMA and CDMA.**

Summarise their principles, advantages, disadvantages, and typical applications.

Approach	SDMA	TDMA	FDMA	CDMA
<b>Idea</b>	segment space into cells/sectors	segment sending time into disjoint time-slots, demand driven or fixed patterns	segment the frequency band into disjoint sub-bands	spread the spectrum using orthogonal codes
<b>Terminals</b>	only one terminal can be active in one cell/one sector	all terminals are active for short periods of time on the same frequency	every terminal has its own frequency, uninterrupted	all terminals can be active at the same place at the same moment, uninterrupted
<b>Signal separation</b>	cell structure, directed antennas	synchronization in the time domain	filtering in the frequency domain	code plus special receivers
<b>Advantages</b>	very simple, increases capacity per km?	established, fully digital, flexible	simple, established, robust	flexible, less frequency planning needed, soft handover
<b>Disadvantages</b>	inflexible, antennas typically fixed	guard space needed (multipath propagation), synchronization difficult	inflexible, frequencies are a scarce resource	complex receivers, needs more complicated power control for senders
<b>Comment</b>	only in combination with TDMA, FDMA or CDMA useful	standard in fixed networks, together with FDMA/SDMA used in many mobile networks	typically combined with TDMA (frequency hopping patterns) and SDMA (frequency reuse)	still faces some problems, higher complexity, lowered expectations; will be integrated with TDMA/FDMA

**5. What is the purpose of PIFS, DIFS and SIFS time intervals and how are they used in the IEEE 802.11?**

The PIFS, DIFS and SIFS provide three different parameters that define the priorities of medium access.

? SIFS (Short Inter Frame Spacing): The shortest waiting time for medium access, this has the highest priority. It is defined for short control messages, such as acknowledgements of data packet or polling response.

? PIFS (PCF - point coordination function, IFS - Inter-frame spacing). A waiting time between DIFS & SIFS, this has a medium priority. It is used for a time-bounded service. An access point polling other nodes only has to wait PIFS for medium access. PIFS is defined as SIFS plus one slot time

? DIFS (DCF - Distribution combination function, IFS - Inter frame spacing). This parameter denotes the longest waiting time and has the lowest priority for medium access. This waiting time is used for asynchronous data service within a contention period. It defines as SIFS plus two slot times.

**6. What are the purposes of frequency hopping in Bluetooth? How is it possible to combine frequency hopping and time division duplex?**

Frequency hopping pattern is used to separate different Pico nets. The Pico net channel is represented by a pseudo-random hopping sequence. The hopping sequence is unique for the Pico net and is determined by the device address of the master of the Pico net. A Pico net is a collection of Bluetooth devices, which are synchronized to the same hopping sequence. In order for devices to be able to communicate between each other, the master determines the hopping sequence or pattern in the Pico net and the slaves have to synchronize to this pattern. Each Pico net has a unique hopping pattern, which is determined by the device ID, a 48-bit unique identifier. A collision occurs if two or more Pico nets use the same carrier frequency at the same time. This might happen as the hopping sequences are not coordinated. The phase in the hopping pattern is determined by the master's clock. After adjusting the internal clock according to the master a device may participate in the Pico net.

Frequency-hopping/time-division duplex scheme is used for transmission with a fast hopping rate of 1,600 hops per second. The time between two hops is called a slot, which is an interval of 0.625 ms,

each slot uses different frequency. Bluetooth uses 79 hop carriers equally spaced within 1MHz. Each device participating in a certain Pico net hops at the same time to the same carrier frequency. Within each slot the master or one out of the seven slaves may transmit data in an alternating fashion. Master and slaves alternately transmit and listen.

7. **Explain how tunneling 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.**

Tunneling is a mechanism used for forwarding packets between home agent and care-off address. A tunnel establishes a virtual pipe for packets between an entry-to-end point. The packet itself is unchanged during the process of entry-exit the tunnel. Sending the packets through the tunnel is achieved by using encapsulation. With mobile IP the HA takes the original packet with the MN as destination, puts it into the data part of a new packet and sets the new IP header in such a way that the packet is routed to the COA. The new header is called "outer header".

IP-in-IP encapsulation is mandatory for IP. The entire IP datagram becomes payload in new IP datagram. The original, inner IP header is unchanged except for the time to live number, which is decremented by 1. The outer header is a full IP header, while the inner header is identical to the original header. The big advantage of this technique is that the whole tunnel is considered a single hop from the original packet's point of view. This feature allows the MN to behave as if it were attached to the home network. No matter how many number of hops the packet has to take in the tunnel, it is just a one logical hop away from the MN.

Minimal encapsulation is an optional encapsulation technique. With this method the tunnel entry point and the endpoint are specified. A new header is inserted between the original IP header and original IP payload. The original IP header is modified to form new outer IP header. This technique avoids repetition of identical fields, as TTL, IHL, version and TOS. It is only applicable for the unfragmented packets, because no space is left for the fragment identification.

Generic routing is a method that allows the encapsulation of packet of one protocol suite into the payload portion of a packet of another protocol suite. The outer header is the standard IP header with HA as

source address and COA as destination address. The big advantage of this technique is that it supports other network layer protocols in addition to IP.

8. **Explain the principle of the routing protocol DSDV (Destination Sequenced Distance Vector).**

DSDV is an enhancement to distance-vector routing for ad-hoc networks. It is of a proactive type, where each node maintains routing information for all known destinations. Distance vector routing is needs periodic updates and therefore it results in traffic overhead even if there is no change in network topology.

DSDV keeps the simplicity of distance vector, it guarantees loop freeness. DSDV features new table entry for destination along with a feature as a sequence number, which allow fast reaction to topology changes. It also makes immediate route advertisement on significant changes in routing table.

DSDV adds two main functions.

- Sequence numbers: Each routing advertisement comes with a sequence number which helps to apply the advertisement in correct order and therefore it avoids loop that are likely to be a part of distance vector algorithm.
- Damping: Advertisement containing changes in the topology currently stored and therefore not spread further between the routers. This technique includes a timer, which relates to the waiting time between the first and the best announcement of a path to a specific destination.

DSDV routing tables contain flags and a setting time, that helps with stable status of paths or links, and are used to delete stale entries from the table. Update information is compared to own routing table, the route is selected with the higher destination sequence number, ensuring that the newest information from destination is used. It also supports immediate advertisements which means that change in the network such as information on new routes, broken links, and metric are immediately propagated to neighbours.

9. **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?**

TCP assumes a network congestion if acknowledgment does not arrive in time. Standard TCP reacts with slow start if acknowledgments are missing. It is practical in fixed networks but this process doesn't facilitate in the case of transmission errors over wireless link and during handover. This behavior results in severe performance degradation and decreases the efficiency of TCP used in mobile network. TCP acknowledgment mechanism cannot distinguish between the different causes of packet loss, which means that missing acknowledgment due to a transmission error is misinterpreted for congestion or network overload.