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TTM4150 NETTARKITEKTUR I INTERNETT

TTM4150 INTERNET NETWORK ARCHITECTURE

December 15, 2008
Kl. 0900 - 1300

No remedies/Ingen hjelpemidler.

Results will be ready before 190109.
Sensuren faller innen 190109.

E: English
Glance over all pages before you start answering the exercises.
Take care to share your time between the exercises.
It is better to answer a little on all the exercises than to answer a lot on a few.
If you feel there is a lack of information to solve an exercise, state the assumptions you make.

N: Norsk/Norwegian
Se raskt over hele oppgavesettet før du starter å besvare oppgavene.
Pass på å fordele tiden mellom oppgavene! Det er bedre å svare litt på alle oppgavene enn å svare mye på noen få oppgaver.
Dersom du føler informasjon mangler for å løse oppgaven, angi de antakelser du gjør deg.

Exercise 1 Internet architecture/ Internett arkitektur

(a) **E:** A network architecture is a set of high-level design principles that guide the technical design of the network, especially the engineering of its protocols and algorithms.
What was the top-level goal of the original Internet architecture?

N: En nettverksarkitektur er et sett av høynivå designprinsipper som gir retningslinjer for design av nettverket, spesielt konstruksjon av protokoller og algoritmer.
Hva var det primære målet til Internett-arkitekturen?

(b) **E:** One of the second level goals is that "The Internet must support multiple types of communications service."
How does the original internet architecture satisfy this goal?

N: Ett av de sekundære målene var "The Internet must support multiple types of communications service."
Hvordan tilfredsstiller den originale internettarkitekturen dette målet?

(c) **E:** To assign a primary IP address and a network mask to a network interface, the following command may be used: "IP <IP address>/mask".
When and why is the mask attribute needed?

N: For å tilordne en primær IP-adresse og en nettverksmaske til et nettverks-grensesnitt kan den følgende kommandoen benyttes: "IP <IP address>/mask".
Når og hvorfor trengs "mask" attributtet?

(d) **E:** First-in, first-out (FIFO) queuing is an example of which service model?
N: First-in, first-out (FIFO) køing er eksempel på hvilken tjenestemodell?

A. Differentiated Service
B. Traffic engineering Service
C. Integrated Service
D. Best-Effort Service

Exercise 2 Forwarding and routing/ Videresending og ruting

(a) **E:** Describe three of the operations a router performs when forwarding a unicast packet in a router without any QoS (quality of service) processing.

N: Beskriv tre operasjoner som en ruter utfører når den videresender en unicast pakke uten QoS (quality of service) prosessering.

(b) **E:** Describe the interrelationship between congestion in a router and end-to-end jitter.
N: Beskriv sammenhengen mellom metning i en ruter og ende-til-ende jitter.

(c) **E:** Suppose we choose a larger buffer for a queue in a congested router. Which of the below results, A-D, is correct?
N: Anta at vi velger et større buffer for en kø i en ruter i metning. Hvilke av resultatene A-D under er korrekt?

A. Longer end-to-end delay, less packet loss
B. Longer end-to-end delay, higher packet loss
C. Shorter end-to-end delay, less packet loss
D. Shorter end-to-end delay, higher packet loss

(d) **E:** A DiffServ core router distinguishes between packet flows in implementing different PHBs (per-hop behaviors) by using which of the statements A – E below?

N: En DiffServ kjerneruter skiller mellom pakkeflyt når den implementerer ulike PHBs (per-hop behaviors) ved å benytte hvilke av punktene A – E under?

A. Source IP address, destination IP address, and packet markings
B. Source and destination IP addresses
C. Source and/or destination port numbers
D. Packet markings alone
E. None of the above

(e) **E:** IPVPN is a virtual private network based on internet technology.
Briefly describe two different ways of assuring private exchange of routing information between provider edge routers within a layer 3 provider-provisioned IPVPN.

N: IPVPN er et virtuell privat nettverk basert på internetteknologi.
Beskriv kort to ulike måter å sikre privat utveksling av rutinginformasjon mellom operatørens kantrutere i et lag 3 "provider-provisioned" IPVPN.

Exercise 3 Mobility / Mobilitet

(a) **E:** Why is the DNS (domain name system) not suited as a location database in a mobility scheme?

N: Hvorfor er DNS (domain name system) ikke egnet til å være lokasjonsdatabase for mobilitet?

(b) **E:** How is DNS used in some mobility schemes, for example in HIP (host identity protocol)? Describe why this is a workable solution.

N: Hvordan er DNS benyttet i noen mobilitetsløsninger, for eksempel i HIP (host identity protocol)? Beskriv hvorfor dette er en løsning som fungerer.

(c) **E:** An enterprise is multi-homed between two different ISP. Both accesses are active and carry traffic. The enterprise runs mobile IP v4. One of the ISP offers to run the enterprise's Mobile IP home agent (HA) in its network.
What is your recommendation? Describe why.

N: Et selskap er multi-homed mellom to ulike ISPer. Begge aksessene er aktive og bærer trafikk. Selskapet benytter mobil IPv4. En av ISPene tilbyr å kjøre selskapets mobil IP hjemmeagent (HA) i sitt nettverk.
Hva er din anbefaling? Beskriv hvorfor.

(d) **E:** Describe the two major security threats that must be considered when evaluating a mobility scheme, and how these are addressed in mobile IPv4.

N: Beskriv de to primære sikkerhetstruslene som må vurderes ved evaluering av en mobilitetsløsning, og hvordan disse håndteres i mobil IPv4.

Exercise 4 Multicast / Multikast

(a) **E:** What are the deployment issues regarding multicast addressing in IPv4? Are these the same for deployment of multicast IPv6 addresses?

N: Hvilke utfordringer representerer multikast IPv4 adresser i forhold til bruk av multikast i nettverk? Er disse de samme for bruk av multikast IPv6 adresser?

(b) **E:** Given that PIM-SM is used, what are the arguments against placing the processing of multicast packets in the router's critical path?

N: Gitt at PIM-SM benyttes, hvilke argumentene taler mot å plassere prosessering av multikastpakker i ruterens "critical path"?

(c) **E:** Justify the number of RP's (rendezvous points) in a domain running PIM-SM (protocol independent multicast - sparse mode).

N: Rettferdiggjør antallet RPer (rendezvous point) i et domene som benytter PIM-SM (protocol independent multicast - sparse mode).

Exercise 5 Ad-hoc network protocols / Ad-hoc nettverksprotokoller

(a) **E:** In the reactive protocol AODV (ad-hoc on-demand distance vector) there is a sequence number for each route request (RREQ). In addition there is a sequence number in the RREQ associated with the destination. Explain why.

N: I den reaktive protokollen AODV (ad-hoc on-demand distance vector) er der et sekvensnummer for hver ruteforespørsel (RREQ). I tillegg er der et sekvensnummer i RREQ assosiert med destinasjonen. Forklar hvorfor.

(b) **E:** What are the most advantageous usage scenarios for geographic routing? Justify your answer and give a separate answer for unicast and for multicast.

N: Hva er de mest fordelaktige bruksscenarioene for geografisk ruting? Begrunn svaret og bruk separate beskrivelser for unicast og for multicast.

(c) **E:** Which role does the MRP (multi relay point) have in the proactive routing protocol OLSR (optimized link state routing), and how does this role impact the overhead of the routing protocol?

N: Hvilken rolle har MRP (multi relay point) i den proaktive rutingprotokollen OLSR (optimized link state routing), og hvordan påvirker denne rollen rutingsprotokollens ”overhead”?

Exercise 6 Congestion control/ Metningskontroll

(a) **E:** What indicates that a network interface in a router experiences congestion?

N: Hva indikerer at et nettverksgrensesnitt i en ruter opplever metning?

(b) **E:** DCCP (datagram congestion control protocol) is a transport protocol for unreliable flows with the application being able to specify either TCP-like or TFRC (TCP friendly rate control) congestion control. DCCP also supports ECN (explicit congestion notification).
Describe how ECN works.

N: DCCP (datagram congestion control protocol) er en transportprotokoll for upålitelige flyt hvor applikasjonen kan spesifisere enten TCP-liknende eller TFRC (TCP friendly rate control) metningskontroll. DCCP støtter også ECN (explicit congestion notification).
Beskriv hvordan ECN virker.

(c) **E:** Random Early Detection (RED) is a congestion avoidance mechanism that takes advantage of TCP's congestion control.
Describe the RED mechanism.

N: Random Early Detection (RED) er en mekanisme for ”congestion avoidance” som drar fordel av TCP sin metningskontroll.
Beskriv RED mekanismen.

(d) **E:** Which of A-E below describe benefits of the scheduling discipline WFQ (weighted fair queuing)?

N: Hvilke av A-E under beskriver fordelene med købetjenings-disiplinen WFQ (weighted fair queuing)?

A. WFQ is very easy to configure, and no manual traffic classification is necessary.

B. WFQ can provide fixed-bandwidth and fixed-delay guarantees.

C. WFQ alone can provide fixed-bandwidth guarantees.

D. WFQ can provide fixed-delay guarantees.

E. WFQ prevents the large-volume flows with large packet size from starving out the low-volume flows with small packet size.

F. Based on DSCP, WFQ allows weighted, random dropping of packets when the WFQ system is full.