



EKSAMENSOPPGAVE I TTM4130 – EXAM IN TTM4130
TTM4130 - Tjenesteintelligens og mobilitet
TTM4130 – Service intelligence and mobility

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| Faglig kontakt under eksamen: | Lill Kristiansen |
| Tlf.: | 97 72 72 27 |
| Eksamensdato / Date: | 21. mai 2010 / 21st May 2010 |
| Eksamenstid /Time: | 15.00 - 19.00 / 3pm - 7pm |
| Vekttall / Credits : | 7,5 SP |
| Examination aids: | D: No written and handwritten examination support materials. A specified, simple calculator is permitted. |
| Tillatte hjelpemidler/ | D: Ingen trykte eller håndskrevne hjelpemidler tillatt Bestemt, enkel kalkulator tillatt |
| Språkform / language: | English is the authoritative language (Bokmål finnes) Answer can be in nynorsk, bokmål or English |
| Number of pages in English: | 6 (pages 2 - 7) |
| Antall sider bokmål: | 6 (sidene 8 - 13) |
| Antall sider nynorsk: | 0 |
| Appendix (in English): | 4 (pages 14 - 17) |
| Sheets for drawings (in English): | 2 sheets which may be handed in (pages 18-19) |
| Sensurdato¹: | 14. juni 2010 / 14th June 2010 |

¹ Merk! Studentene må primært gjøre seg kjent med sensur ved å oppsøke sensuroppslagene. Evt. telefoner om sensur må rettes til sensurtelefonene. Eksamenskontoret vil ikke kunne svare på slike telefoner.

You should **start by reading through all the material** and then decide which sequence you want to use when answering the exercises. In some places there are some dependencies that are listed, but all other places the exercises are independent.

2 sheets with diagrams to be filled in by the candidate may be used to save some drawing and are attached at the end. It is optional to use these sheets.

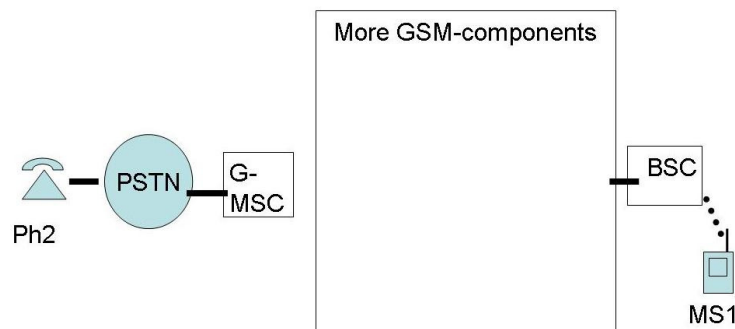
Short answers are requested, UNLESS otherwise stated.

Make your own reasonable assumptions if the text is unclear.

A **collaboration diagram** (or communication diagram) is a diagram with boxes and arrows showing a call flow in a semi-formal way. The arrows need not be placed as in an MSC, hence sequence numbers are attached to the arrows. (The "Sip trapezoid" is one example of such a diagram)

1 Exercise 1. (16 %) On GSM

Take as the starting point the following figure:



Figur 1 Illustration of GSM - - > PSTN and PSTN - - > GSM calls

NB Similar figure exists on an extra sheet on page 18 . Use this sheet if you like (recommended).

Assume for simplicity that MS1 is stationary and stays connected to one BSC for as long as this exam lasts. This BSC is in a foreign domain (i.e., MS1 is roaming).

Use the same level of details in your answer as used in figures in appendix 1.1 and 1.2 (Establish or similar).

a) (6 %)

Assume that MS1 is already registered with its own (home) HLR, and that the human using MS1 has activated CLIR (Calling Line Id. Restriction / hidden A-number) Explain what data is held by HLR, VLR and MSC at this point in time.

b) (6 %)

Draw a collaboration diagram for the case that MS1 places a call to Ph2. Indicate the right domain (H or V) for each GSM component. Indicate how the caller's activation of CLIR impacts the parameters in the various messages.

You may use the extra sheet on page 18 to save some drawing.

c) (4 %)

Draw a collaboration diagram for the case that Ph2 places a call to MS1. You shall also indicate the right domain (H or V) for each GSM component.

You may use the extra sheet on page 18 to save some drawing.

2 Exercise 2 (20 %) On GSM and IN

It might be useful to solve exercise 1 before this one.

a) (6 %)

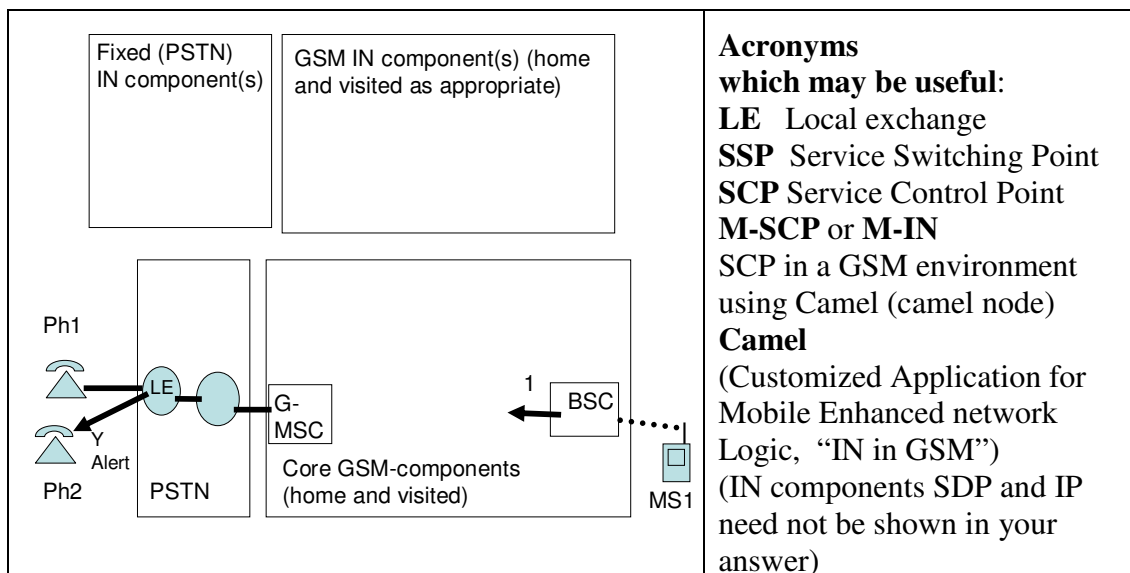
Read the appendix 2 about Italian Letizia visiting Norway.

Show a collaboration diagram or call flow or explain in text how the call is set up.

You need only show the messages from right to left, i.e., you may stop when Ph2 is receiving Alert.

You shall show how IN is involved, but you need not show details of the playing of the announcements via IP. You may use IN-1, IN-2 and similar as you find appropriate.

You may use the following figure to guide your drawing. You may **use the extra sheet on page 19** (or make your own drawing).



b) (14 %)

Read the material provided in Appendix 3.

You may assume that the calls taking place during the swindling are initiated and terminated in Italy, by a service similar to Future-TellingAS, here called Futura-Italia.

It might be useful to answer 2a) before you answer this task.

Write a small fact box explaining what IN and telemarket [Norw.: Teletorg] is. Use **approximately 150-250 words**. Make efforts to write in a way suitable for a newspaper article writing about the case. Pay attention to those parts of IN which is of relevance to the money laundry (i.e. the money aspects are of special interest).

For the particular task (2b) we will judge you based on technical correctness, but also on language, length, and relevance of the technical information.

3 Exercise 3. (27 %) On SIP

It might help you to think in the global case here, taking into account network delay, congestion and packet loss (as you find suitable).

(DNS and Location server are removed for simplicity, you need not reintroduce them.)

a) (4 %)

Explain the header in SIP ensuring that all responses for a SIP METHOD follow the same path back as the METHOD followed on its way forward.

Explain briefly how it works.

b) (4 %)

Explain two alternative paths ACK (and BYE and more) can be sent according to SIP (as defined by IETF).

Explain which of the alternatives that is *not* according to the specification in IMS.

For the rest of exercise 3 we will look into the establishment of a one-way media stream. This case is chosen to make it easier for you. In case you are unfamiliar with one-way streams, don't panic! You may then use the more familiar case of a two-way voice call.

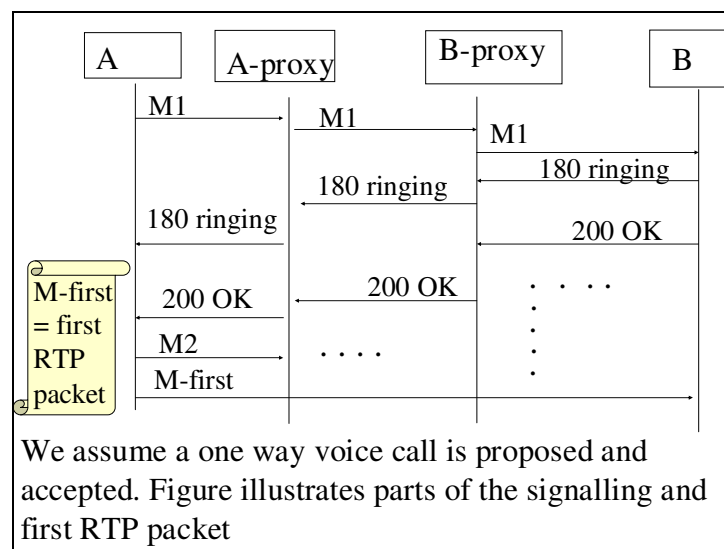


Figure 2 A partial MSC. A is a shorthand for UA-A and other entities on the terminal (similar for B). M1 and M2 are placeholders for real method names in SIP. The path followed by the signalling is the same as you used in the lab.

You shall assume for the rest of exercise 3 that all signalling goes via the proxies.

c) (4 %)

Complete the MSC in the case that everything works normal and that no messages are lost. Write the real names of SIP methods instead of M1 and M2. You shall not include the lookup in DNS etc, but you shall fill in the missing ACK's. Pay attention so that you draw the missing ACK messages in the right sequence. You **may start your own drawing with the first 200 OK** message and showing a total of 6 signalling messages (in either direction).

d) (4 %)

Explain why B must be prepared to receive M-first before it receives ACK.

List at least 2 different reasons for this.

e) (6 %)

Illustrate what happens when A 'hangs up' (by pressing the red button). You shall assume that A stops sending RTP packets before it sends the relevant METHOD towards B (via proxies).

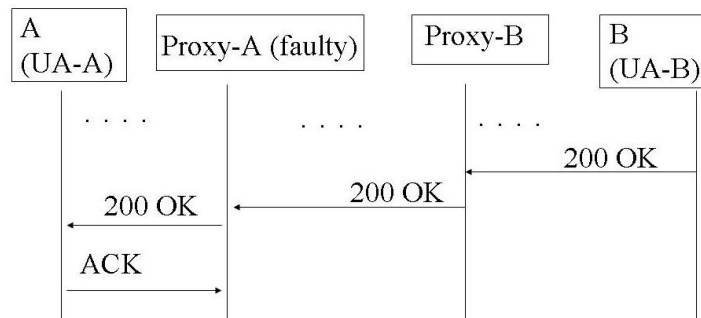
Show the signalling, but show also the (human) user interaction and how the RTP-stream stops. Chose MSC, collaboration diagram or text (or a combination).

In case you have chosen to use a two-way media stream instead: Make your own assumptions.

f) (5 %)

Assume now that Proxy-A is faulty. It behaves as it shall on all messages, except on ACK. Instead Proxy-A behaves as follows: When it receives an ACK (in any direction) it will simply ignore it (and hence not send it further), and stay in the same state as before. NB: UA-B is not aware of the faulty Proxy-A. UA-B and Proxy-B behaves as it should.

Explain what will happen further and why.



**Figur 3 Proxy-A is faulty and is just ignoring all ACKs.
The other entities behave according to the SIP specification.**

4 Exercise 4 (12 %) NGN, IMS and IP-telephony

These days Telio is running advertisements for video telephony (see appendix 4). Assume that you have NGCo as your broadband provider / ISP in your home.

a) (2 %)

NGN defines a horizontal layering with two major parts (planes or layers).

List the name of the bottom plane/layer

List the name of the plane /layer on top (several names are in use, list one)

b) (4 %)

Explain why the arrangement with Telio and NGCo is not fully in agreement with NGN.

Explain what business relationship there must be between NGCo and Telio in order for your video telephony service to work according to the promises from Telio.

c) (6 %)

Another trend in NGN and IMS is the separation between access and core network.

List three possible access technologies that can be used in IMS.

List at least one fixed access technology and one radio based access technology.

5 Exercise 5 (7 %) IMS

2nd and 3rd ed. of IMS book differs a bit on the description of the interconnection between IMS networks, as they are referring to different releases of IMS. As explained by wikipedia: " From Release 7 onwards this "entry point" function is removed from the I-CSCF and is now part of the *Interconnection Border Control Function (IBCF)*"

In this task you need *not* focus on the details of the I-CSCF/IBCF.

Assume that Bob with 'phone number' sip:abc@4g.org is registered at home as a roaming user. He has UA-B as his only registered endpoint, where all calls shall be delivered. You shall assume that the call signalling passes through the S-CSCF in the home network of A as illustrated below. (In other world: It is not an emergency call.)

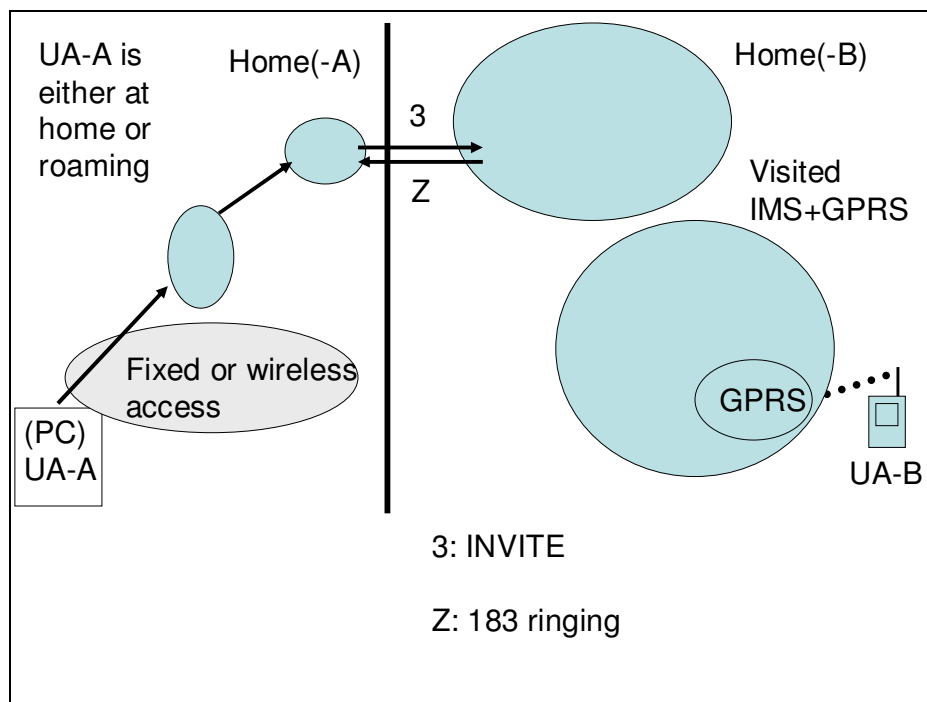
You may use the sheet on page 19

a) (5 %)

Focus shall be on the terminating side i.e. between the messages number 3 (INVITE) and number Z (183 ringing).

Make a collaboration diagram or similar illustrating an incoming call to Bob.

Illustrate various CSCF, HSS etc. as you find appropriate, and place them in the right domain (H or V) on the terminating side.



Figur 4 IMS (This figure exists also on the extra sheet on page 19)

b) (2 %)

Which messages are SIP messages (and which are not)?

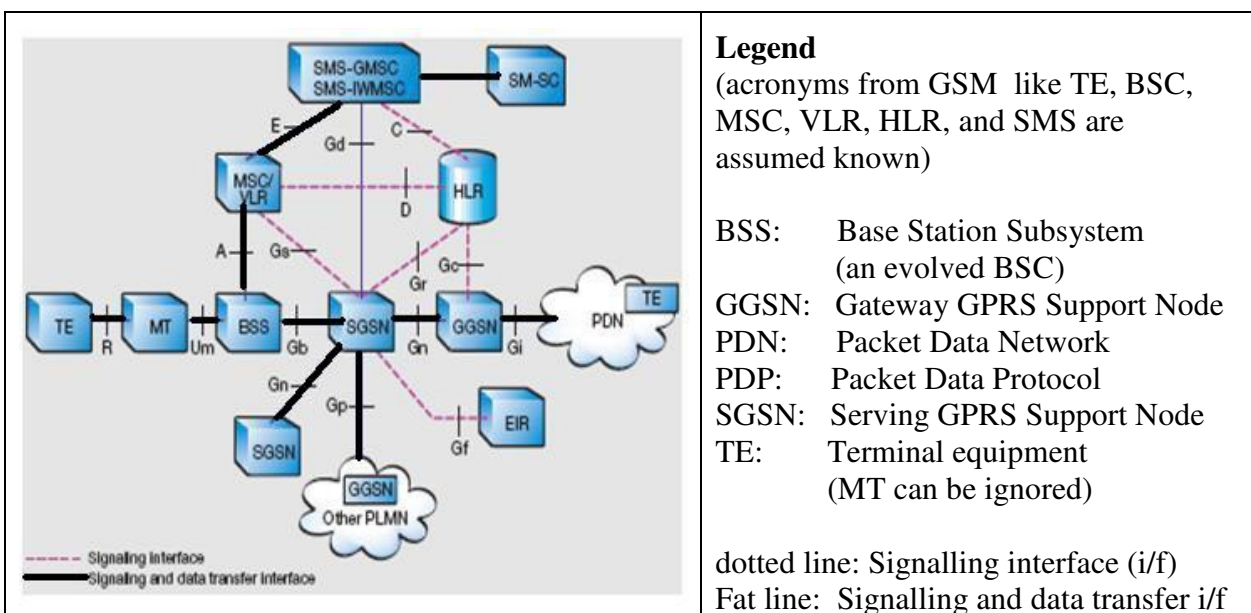
6 Exercise 6 (18 %) On GPRS (General packet radio service)

It might be that the candidate will prefer to answer a)-d) in a different sequence, which is of course allowed.

In GPRS we have the two procedures 'Attach' and 'Activate PDP context'. Attach results in an active network attachment (refer to the slogan 'Always on').

a) (6 %)

Explain class A, B and C in GPRS. Pay special attention in explaining the differences in network attachment between class B and class C.



Figur 5 The reference figure for GPRS from 1999 where GPRS and GSM is used together

b) (3 %)

Explain briefly the main steps in Attach (as of 1999, or a later release).

List the main components involved (ignore EIR and AUC; AUC is not shown on Figur 5)

c) (3 %)

After Attach a separate procedure "Activate PDP context" takes place.

Explain the main steps in "Activate PDP context" (as of 1999, or a later release). You may assume that the terminal wants to establish communication to a PDN (e.g. to www.mycomp.com).

d) (4 %)

Explain some differences between HLR as depicted here and HSS as in IMS.

List one major difference regarding the protocol stack.

List one major difference regarding subscriber data for voice.

e) (2 %)

List entities from Figur 5 that no longer exists in the new 'all IP architecture' with IMS as described in the IMS book. (I.e., you shall not look into VCC (voice call continuity); you shall consider only the IP-part of IMS.)

Du bør **starte med å lese gjennom alt materialet** og bestemme deg for den rekkefølgen du ønsker å benytte når du svarer. Noen få steder er det avhengigheter, disse er angitt. Alle andre steder er oppgavene uavhengige av hverandre.

Bakerst er der 2 ark med diagrammer som kandidaten kan fylle inn. Disse kan spare deg for noe tegning. Du velger selv om du vil bruke dem.

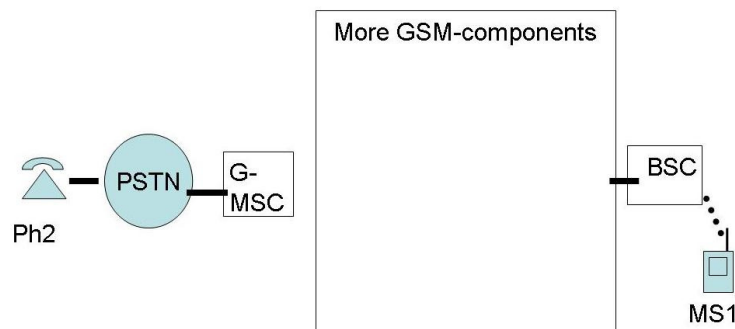
Korte svar er ønsket, MED MINDRE annet er eksplisitt angitt.

Gjør dine egne fornuftige/realistiske antakelser om teksten er uklår.

Er **kollorasjonsdiagram** (eller kommunikasjonsdiagram) er et diagram med bokser og pilier som viser en sekvens ('call flow') på en semi-formell mate. Pilene behøver ikke være plassert som i et MSC, så man plasserer nummer på pilene. ("Sip-trapesoidet" er et eksempel på et slikt diagram.)

1 Oppgave 1. (16 %) Om GSM

Ta som utgangspunkt følgende figur:



Figur 1 Illustrasjon av anrop GSM - - > PSTN og PSTN - - > GSM

NB Liknende figurer finnes på ekstraark på side 18. Bruk dette arket om du vil (anbefalt).

Anta for enkelhets skyld at MS1 er stasjonær og at den er tilknyttet til samme BSC så lenge denne eksamenen pågår. Denne BSC er i fremmed domene (dvs.: MS1 er roamende).

Bruk samme nivå på detaljene i svaret som det du finner i figurene i appendix 1.1 and 1.2 (Establish og liknende).

a) (6 %)

Anta at MS1 allerede er registrert hos sin egen (hjemme-) HLR, og at mennesket som bruker MS1 har aktivert CLIR (Calling Line Id. Restriction / sjult A-nummer) Forklar hvilke data som på dette tidspunktet befinner seg i HLR, VLR og MSC.

b) (6 %)

Tegn et kollorasjonsdiagram for tilfellet at MS1 ringer til Ph2. Marker korrekt domene (H eller V) på hver GSM komponent. Indiker hvordan anropers (caller's) aktivering av CLIR påvirker parameterene i meldingene.

Du kan benytte ekstraarket på side 18 for å spare litt tegning.

c) (4 %)

Tegn et kollorasjonsdiagram for tilfellet at Ph2 ringer til MS1. Du skal også indikere rett domene (H eller V) på hver GSM komponent.

Du kan benytte ekstraarket på side 18 for å spare litt tegning.

2 Oppgave 2 (20 %) Om GSM og IN

Det kan være nyttig å løse oppgave 1 før denne oppgaven.

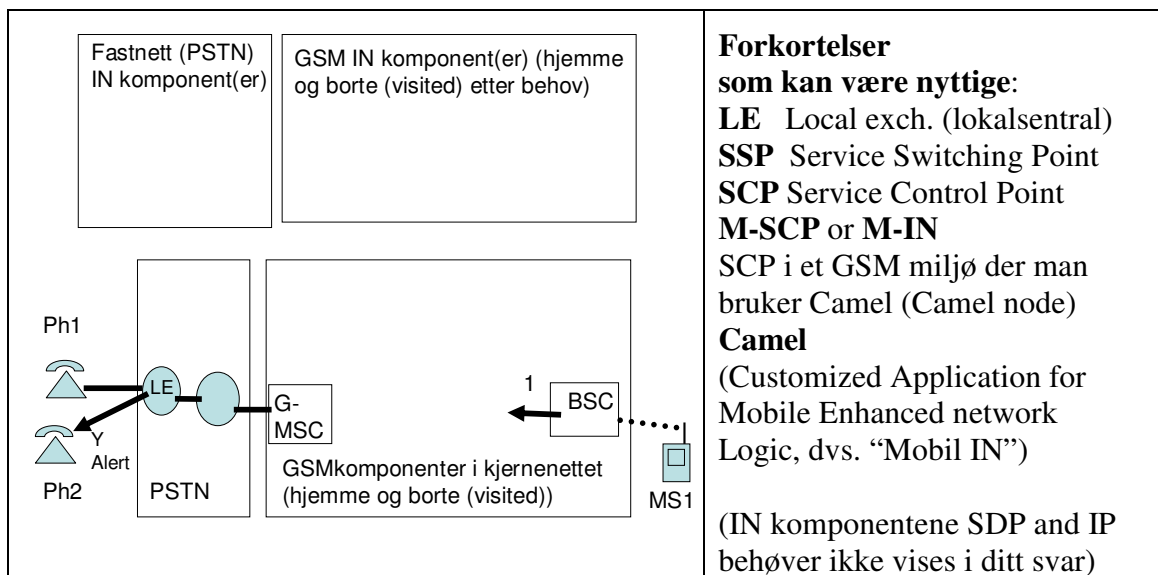
a) (6 %)

Les appendix 2 om italienske Letizia som besøker Norge.

Vis et kollaborasjonsdiagram eller meldingsflyt (“call flow”) eller forklar med tekst hvordan samtalen settes opp. Vis bare meldingene fra høyre mot venstre, dvs. du kan stoppe når Ph2 mottar meldingen Alert.

Du skal vise hvordan IN er involvert, men du behøver ikke vise detaljer om avspilling av talemeldinger via IP. Du kan bruke IN-1, IN-2 og liknende som du selv finner hensiktsmessig.

Følgende figur kan brukes som en mal. **Du kan også bruke ekstraarket på side 19** (eller lage din egen tegning).



b) (14 %)

Les materialet i Appendix 3.

Du kan anta at anropene som benyttes i svindelen er initiert og terminert i Italia, ved hjelp av en tjeneste tilsvarende Future-TellingAS. Vi kaller denne tjenesten for Futura-Italia.

Det kan være nyttig å besvare 2a) før du besvarer denne deloppgaven.

Skriv en liten faktaboks som forklarer hva IN og Teletorg er. Bruk **circa 150-250 ord**. Legg arbeid i å skrive på en måte som egner seg for en avisartikkel som skal omtale saken. Legg vekt på de delene av IN som er av relevans for hvitvaskingen (dvs. at pengeaspekter er av spesiell interesse).

For denne deloppgaven (2b), vil du bli bedømt utfra teknisk korrekthet, men også bedømt utfra språk, lengde og relevansen av den tekniske informasjonen.

3 Oppgave 3. (27 %) Om SIP

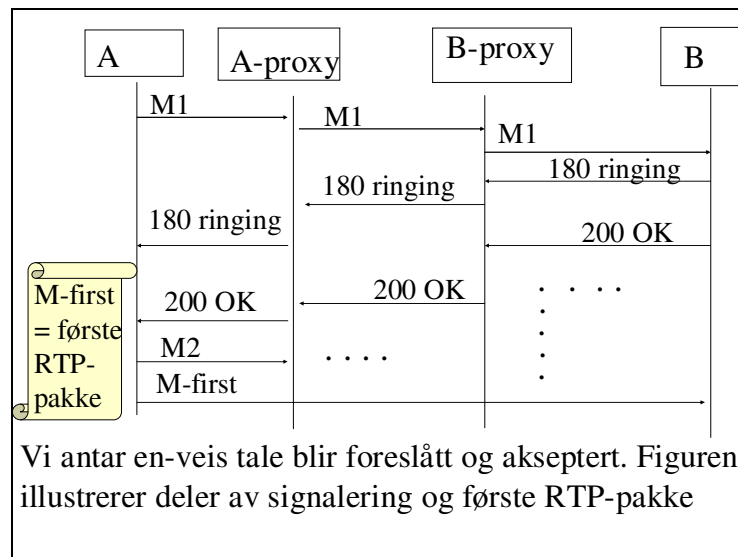
Det kan være nyttig å tenke på et globalt tilfelle her, der du tar hensyn til nettverksforsinkelser, flaskehalsar og pakketap (som du selv finner hensiktsmessig). (DNS og Lokasjonsserver er fjernet for å forenkle, du trenger ikke reintrodusere dem.)

- a) (4 %)

Forklar den headeren i SIP som sikrer at alle responsmeldinger til en SIP METHOD følger same sti (path) tilbake som METHOD brukte på sin vei forover. Forklar kort hvordan den fungerer.
- b) (4 %)

Forklar to alternative stier (paths) som ACK (og BYE med mer) kan sendes i henhold til SIP (som definert av IETF). Forklar hvilken av disse alternativene som *ikke* er i henhold til spesifikasjonene i IMS.

For resten av oppgave 3 skal vi se på etablering av en en-veis media strøm. Dette tilfellet er valgt for å gjøre det lettere for deg. Hvis du er ukjent med en-veis mediastrømmer, ikke få panikk! Du kan velge det mere familiære tilfellet med oppsett av 2-veis taleforbindelse.



Figur 2 Et ufullstendig MSC. A er kortform for UA-A og andre enheter på terminalen (tilsvarende for B). M1 og M2 er plassholdere for ekte metodenavn i SIP. Stien brukt av signaleringen er den samme som du brukte i labben.

For resten av oppgave 3 skal du anta at all signaleringen går via proxiene.

- c) (4 %)

Fullfør MSC'et i det tilfellet av alt virker normal tog at ingen meldinger blir tapt. Skriv inn de ekte navnene på meldingene M1 og M2. Du skal ikke inkludere oppslag i DNS etc, men du skal fylle inn manglende ACK'er. Fokuser på å tegne de manglende ACK meldingene i korrekt rekkefølge. Du **kan starte din egen figur med den første 200 OK** meldingen og vise totalt 6 signalingsmeldinger (totalt i begge retninger).
- d) (4 %)

Forklar hvorfor B må være forberedt på å motta M-first før den mottar ACK. Angi minst 2 forskjellige grunner for dette.

e) (6 %)

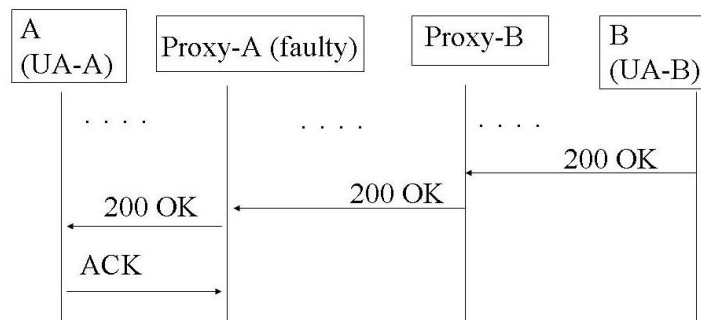
Illustrer hva som skjer nå A 'legger på ' (ved å trykke på den røde knappen). Du skal anta at A stopper å sende RTP pakker før den sender den relevante metoden (METHOD) i retning mot B (via proxier).

Vis signalleringen, men vis også brukerinteraksjon og hvordan RTP-strømmen stopper. Velg MSC, kollaborasjonsdiagram eller tekst (eller en kombinasjon). I tilfelle du har valgt å vise en to-veis strøm: Gjør dine egne antakelser.

f) (5 %)

Anta nå at Proxy-A har en feil. Den oppfører seg som den skal på alle meldinger, med unntak av ACK. På ACK oppfører den seg slik: Når den mottar en ACK (avhengig av i hvilken retning) så vil den bare ignorere den (og dermed ikke sende den videre), og den vil forbli i den tilstanden den var i på forhånd. NB: UA-B er ikke klar over denne feilen i Proxy-A. UA-B og Proxy-B oppfører seg korrekt.

Forklar hva som vil skje videre og hvorfor.



Figur 3 Proxy-A oppfører seg feil ved å ignorere alle ACK'er. De andre enhetene oppfører seg i henhold til SIP spesifikasjonen.

4 Oppgave 4 (12 %) NGN, IMS og IP-telefoni

I disse dager averterer Telio for videotelefoni (se appendix 4).

Anta at du har firmaet NGCo som din bredbåndsleverandør / ISP i heimen.

a) (2 %)

NGN definerer en horisontal lagdeling med 2 hoveddeler (plan eller lag).

List navnet på nedre lag/plan (norsk eller engelsk navn)

List navnet på øvre lag/plan. (Det er flere navn i bruk, du kan liste ett av dem, norsk eller engelsk navn)

b) (4 %)

Forklar hvorfor arrangementet med Telio and NGCo ikke er fullt ut i henhold til NGN. Forklar hvilke(n) forretningsrelasjon det må være mellom NGCo og Telio for at din videotelefonitjeneste skal virke i henhold til løftene fra Telio.

c) (6 %)

En annen trend i NGN og IMS er en separasjon mellom aksessnett og kjernenett.

List tre mulige aksessteknologier som kan brukes i IMS.

List minst en fast aksessteknologi og minst en radiobasert teknologi.

5 Oppgave 5 (7 %) IMS

2. og 3. utgave av IMS-boka avviker litt på beskrivelsen av interconnect (sammenkobling) mellom IMS networks. Dette siden de refererer til forskjellige versjoner (releases) av IMS. Som forklart på engelsk på wikipedia: ” From Release 7 onwards this "entry point" function is removed from the I-CSCF and is now part of the *Interconnection Border Control Function (IBCF)*”

I denne oppgava behøver du ikke å fokusere på detaljene med I-CSCF/IBCF.

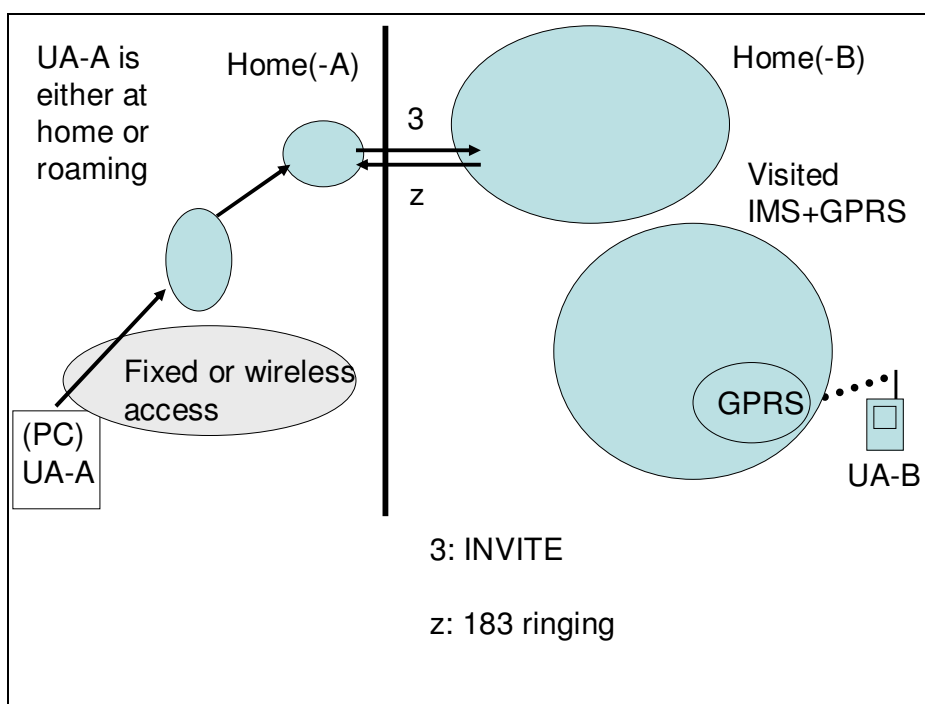
Anta at Bob med 'telefonnummer' sip:abc@4g.org er registrert hjemme som en roamende bruker. Han har UA-B som sitt eneste registrerte endepunkt, der alle samtaler skal leveres. Du skal anta at signalleringen passer gjennom S-CSCF i hjemmenettet til A som illustrert under. (Med andre ord: Det er ikke et nødnummer)

Du kan benytte ekstraarket på side 19.

a) (5 %)

Fokuser på terminerende side dvs. på meldingene mellom melding nummer 3 (INVITE) and nummer z (183 ringing).

Lag et kollaborasjonsdiagram (el.likn.) som illustrerer innkommende samtale til Bob. Illustrer forskjellige CSCF, HSS etc. som du finner passende og plasser dem i rett domene (H eller V) på terminerende side.



Figur 4 IMS (Denne figuren finnes også på ekstraarket på side 19)

b) (2 %)

Hvilke meldinger er SIP meldinger (og hvilke er ikke)?

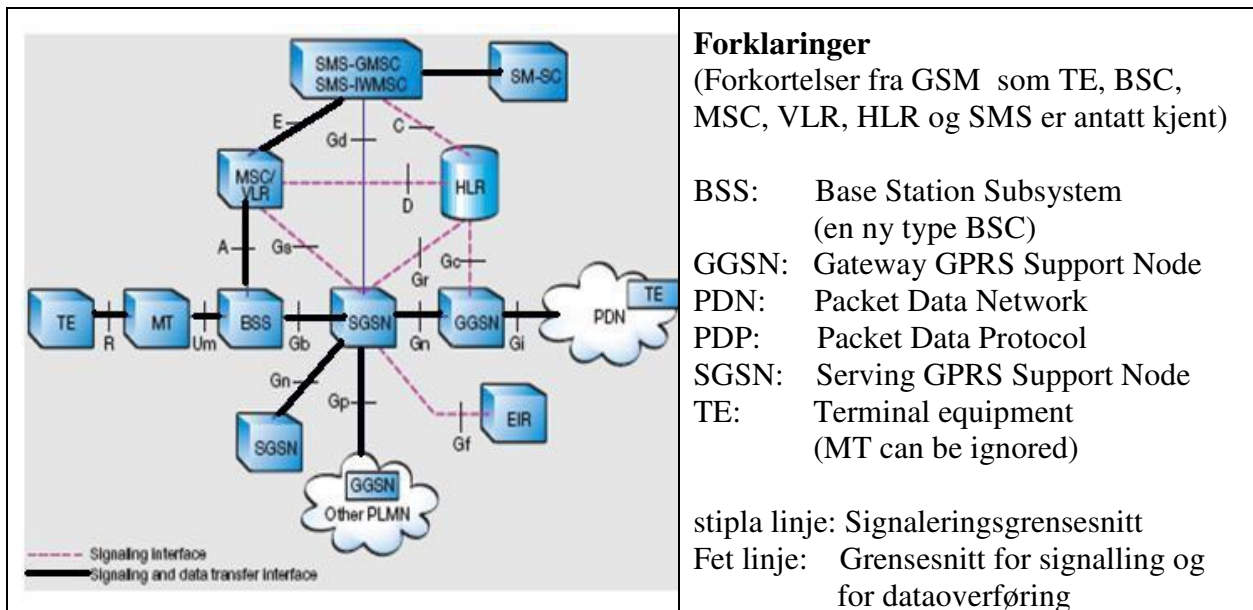
6 Oppgave 6 (18 %) On GPRS

Det kan være at kandidaten ønsker å besvare a)-d) i en annen rekkefølge, det er selvsagt lov.

I GPRS har vi to prosedyrer 'Attach' (som jeg velger å ikke oversette) og 'Aktiver PDP kontekst'. 'Attach' resulterer i en aktivert 'network attachment' (ref. slagordet 'Always on').

a) (6 %)

Forklar klassene A, B og C i GPRS. Legg vekt på å forklare forskjellen i 'network attachment' for klassene B og C.



Figur 5 Referansefigur for GPRS (fra 1999) hvor GPRS og GSM benyttes i samme system

b) (3 %)

Forklar kort hovedskrittene i Attach (slik den var i 1999 eller i en nyere versjon). List hovedkomponentene som er involvert (ignorer EIR og AUC; AUC er ikke vist på Figur 5)

c) (3 %)

Etter Attach skjer en egen prosedyre "Aktiver PDP kontekst". Forklar hovedskrittene i "Aktiver PDP kontekst" ((slik den var i 1999 eller i en nyere versjon). Du kan anta at terminalen ønsker å kommunisere med en PDN (f.eks. til www.mycompany.com).

d) (4 %)

Forklar noen forskjeller mellom HLR som beskrevet her og HSS slik den er i IMS. Angi en viktig forskjell relatert til protokollstakken. Angi en viktig forskjell relatert til abonnentdata (subscriber data) for tale.

e) (2 %)

Angi enheter fra Figur 5 som ikke lenger finnes i den nye "alt-er-IP" ('all IP') arkitekturen med IMS som beskrevet i IMS boka. (Dvs. du skal ikke gå inn i VCC (voice call continuity); du skal kun se på IP-delen av IMS)

Appendix

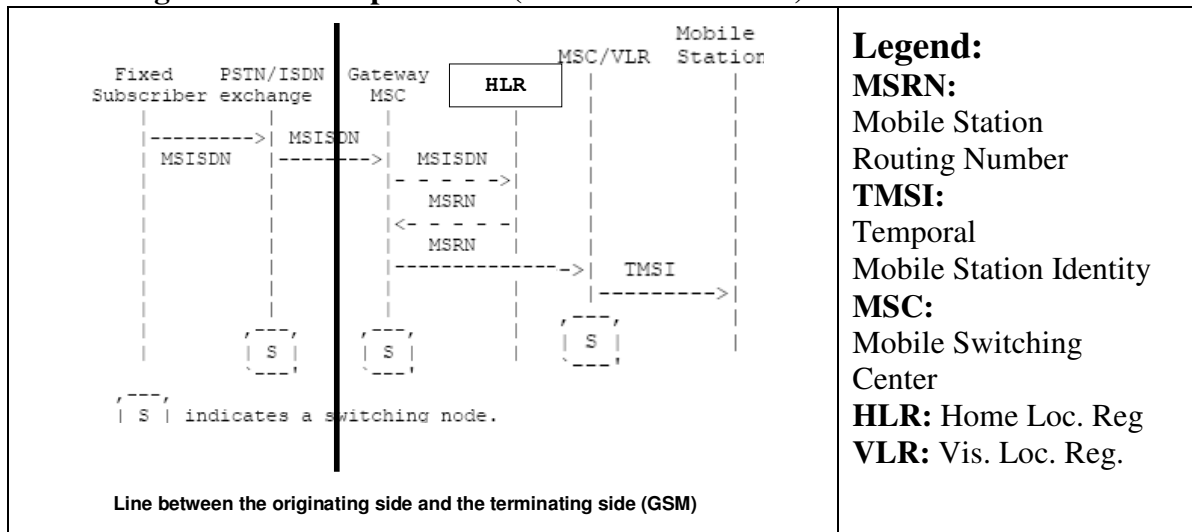
Some of the material given here is referred to in a specific exercise in the exam, while other material is given for your convenience or in order to confuse you!

All material marked 'authoritative' can be assumed to be true. All other material must be read with caution, as Wikipedia and newspapers are not reliable sources for technology.

1. GSM related information

1.1. Authoritative GSM information

A correct figure of call setup in GSM (from PTSN to GSM) is as follows:

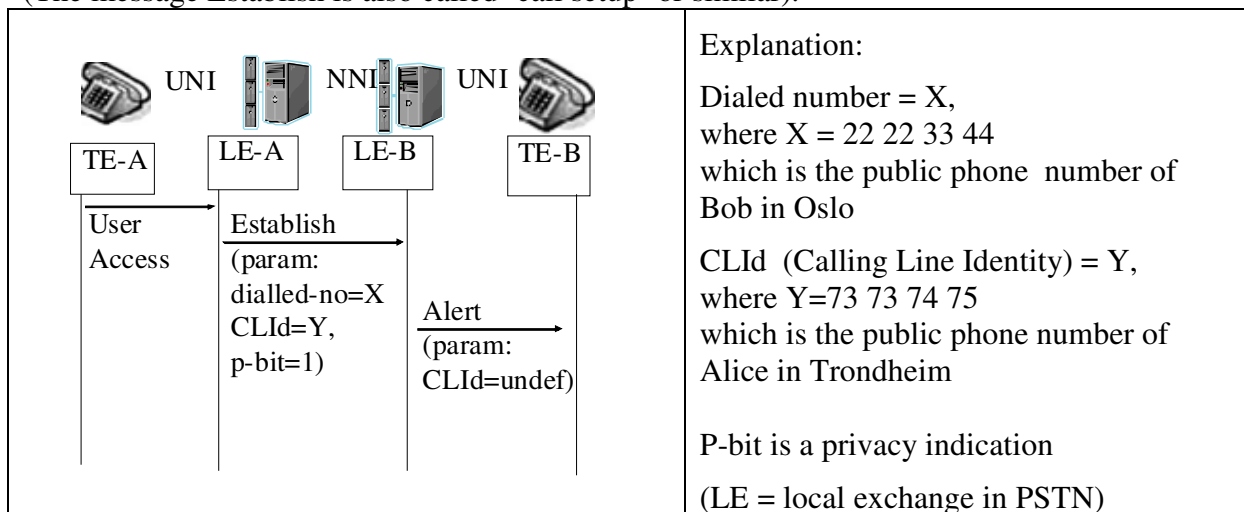


Figur 6 GSM call setup. Note: The details between MSC/VLR and TE (BSC etc.) are not shown here.

The message names are not shown on these figures (You may use names similar to PTSN names if you want). In Figur 6 they indicated the most important parameters related to addressing.

1.2. Authoritative PSTN information

(The message Establish is also called 'call setup' or similar).



Figur 7 A subscribes to CLIR and B subscribes to CLIP. Details of some parameters shown.

1.3. Info on GSM from wikipedia

The **home location register (HLR)** is a central database that contains details of each mobile phone subscriber that is authorized to use the GSM core network. There can be several logical, and physical, HLRs per public land mobile network (PLMN), though one international mobile subscriber identity (IMSI)/MSISDN pair can be associated with only one logical HLR (which can span several physical nodes) at a time.

The HLRs store details of every SIM card issued by the mobile phone operator. Each SIM has a unique identifier called an IMSI which is the primary key to each HLR record.

The next important items of data associated with the SIM are the MSISDNs, which are the telephone numbers used by mobile phones to make and receive calls. The primary MSISDN is the number used for making and receiving voice calls and SMS, (..) Each MSISDN is also a primary key to the HLR record. The HLR data is stored for as long as a subscriber remains with the mobile phone operator.

Examples of other data stored in the HLR against an IMSI record is:

GSM services that the subscriber has requested or been given.

GPRS settings to allow the subscriber to access packet services.

Current location of subscriber (VLR and serving GPRS support node/SGSN).

Call divert settings applicable for each associated MSISDN.

The HLR is a system which directly receives and processes MAP transactions and messages from elements in the GSM network, for example, the location update messages received as mobile phones roam around. **The HLR connects to the following elements:**

The **G-MSC** for handling incoming calls

The **VLR** for handling requests from mobile phones to attach to the network

The **SMSC** for handling incoming SMS

The **voice mail system** (...)

The **AUC** for authentication and ciphering and exchange of data (triplets)

Connected more or less directly to the GSM core network are many other functions.

The **billing centre** is responsible for processing the toll tickets generated by the VLRs and HLRs and generating a bill for each subscriber. It is also responsible for generating billing data of roaming subscriber.

The **short message service centre** supports the sending and reception of **text messages**.

The **multimedia messaging service centre** supports the sending of multimedia messages (e.g., images, audio, video and their combinations) to (or from) MMS-enabled Handsets.

The **voicemail system** records and stores voicemails.

2. Letizia is an Italian GSM user

Letizia is an Italian GSM user with a subscription at Ital-Tel. Letizia is currently roaming into GSM operator Nor-Tel-1 in Norway. She sees an advertisement in a Norwegian newspaper for a premium telemarket [teletorg] service 82012345 at 15 NOK/min. The service is from a Norwegian company called FutureTellingAS. They promise to tell you your future in a selection of 5 European languages. Future-Telling-AS has an arrangement with Nor-Tel-2, the major fixed operator in Norway. Letizia is tempted, and dials 82012345 and presses 'green' on her mobile. She is then offered a menu for the languages, and presses '2' for Italian.

The call is then routed to 7373-1234 or 7373-5678 which are served by two foreign students at ntnu with good language skills earning some extra money.

3. How to do money laundering with GSM and IN

(Information from Norwegian newspaper which may be wrong or insufficient)

(This material is taken from Problem 7 in the problem list.)

3.1. SIM cards ('fact box' from the newspaper)

- SIM card is short for Subscriber Identity Module card.
- It is a type of smart card, or a computer chip, which defines the identity, phone number and alike in a mobile phone.
- The subscriber's phone number is normally not stored on the card, so that one can move the SIM card between mobile phones.
- Every SIM card is equipped with its own unique serial number. When someone calls a mobile phone, a so called "Home Location Register" is checked to find which SIM card number belongs to the respective phone number, and the call is accordingly routed to the recipient.

3.2. More on the case from the same newspaper

Money laundering: By calling expensive international telemarket [Norw.: teletorg] services with stolen SIM cards, Norwegian companies are allegedly being robbed of great sums in an advanced affair where drug debts are whitewashed.

"The entire industry is exposed to SIM card fraud. This is an international problem and has become quite big business," says Talkmore CEO Pål Barth Nilsen.


The mobile operator, owned by Telenor, won't charge companies exposed to SIM card fraud. We act in accordance with our procedures and know with 99 % confidence that the customers are swindled. But we bring it up formally, Nilsen says.

He adds that when SIM cards are ordered online, the mobile operators may be exposed to persons giving out fake identities. "80 % of our orders are placed online," he says. Nilsen thinks there should be requirements to both private individuals and companies about putting locks on their mail boxes.

NSR [National Security Council] have registered tapping of Norwegian companies by the help of stolen SIM cards. The fraud is orchestrated by swindlers who order SIM cards in the name of companies that have a high rating on mobile telecommunication companies' pages. The swindlers then steal the SIM cards when they arrive at the enterprises. The stolen SIM cards are shipped abroad where they are then heavily used to pay for telemarket services. [Norwegian: teletorg tjenester]. NSR thinks the SIM card swindlers pays off drug debts by calling "820-numbers". NSR thinks the fraud is staged by string-pullers with ownership interests in telemarket service companies. The mobile operators then bill the Norwegian companies who stand as the owner of the respective SIM cards.

4. Telio and video telephony (translated and slightly edited)

The following information is taken from www.telio.no and edited and translated.

| Packet 2 | Packet 1 | Price information | Packet 2 | Packet 1 |
|--|----------|--|----------|----------|
|  <p>VIDEO</p> <p>Etablering fra: Etablering fra: Nå kun 499,- Nå kun 499,-</p> <p>Packet 2: With extra handset (2 devices)</p> <p>Packet 1: Without extra handset (1 device: IP3870 videophone)</p> | | Packet without subscription | 1690 | 1490 |
| | | Packet, 12 months binding | 499 | 499 |
| | | Start price | 0 | 0 |
| | | Calls to fixed networks in Norway | 0 | 0 |
| | | Calls to fixed networks Western Europe | 0 | 0 |
| | | Calls to fixed/mobile US | 0 | 0 |
| | | Monthly fee | 159/199 | 159/199 |

Technical requirements to use video telephony Using a video telephone from Telio you may place ordinary calls using voice only or calls with both voice and video. In order to transfer video you need more bandwidth than for voice, and hence we recommend that you perform a check of your broadband speed before you order video telephony. Of course Telio video telephony does not place any requirements on your PC.

Requirementst for good video quality Telio video telephony requires approx. 500Kbit/s (0,5Mbit/s) in speed in both directions (download og upload). Most subscribers with broadband have more capacity down than up, and it is important to measure the speed uplink. In case you have less than 500Kbit/s uplink, you will experience reduced video quality, but you will still be able to place ordinary calls and obtain far better voice quality than before².

Measue your speed here:

We recommend that you try one or more of the following websites to measure your internet speed:
<http://www.itavisen.no/speedometeret/>
[http://www.dinside.no/91179/dinsides-surfometer-\(med-java\)](http://www.dinside.no/91179/dinsides-surfometer-(med-java))
 Remember that you need at least 500Kbit/s up and down in order for Telio video telephony shall function well on your broadband!



Telio IP3870 video phone has the following technical specifications:

- Built in DECT base for up to 3 hand set
- Network port 10/100 Mbit
- Built in 10/100Mbit switch
- Receives signals over wireless network (WLAN) - 54 Mbit b/g
- 355x282 25bps CIF video
- G.722 audio codec offers double sound spectrum compared to traditional telephony

² Valid for phone calls to other Telio subscribers

Candidate number

Course

Sheet number.....of (total)

5. Extra sheet for exercise 1b and 1c (not translated)

You need not consider prepaid and other complicating factors. Use the same level of details in your answer as used in figures in appendix 1.1 and 1.2 (establish/ call setup or similar). Use the space to the right for message names and important parameters if asked for.

1b) (6 %) MS1 places a call to Ph1 when MS1 is roaming. Indicate how CLIR and P-bit are handled in various Establish messages. Mark with H and V on all (relevant) GSM components.

| | |
|---|--|
| <p>The diagram shows a mobile station (MS1) connected to a Base Station Controller (BSC) via a radio link. The BSC is connected to a Visitor Location Register/Mobile Switching Center (VLR/MSC), which is in turn connected to a Home Location Register (HLR). A Gateway MSC (G-MSC) is connected to the BSC and a Public Switched Telephone Network (PSTN). The PSTN is connected to a fixed station (Ph2). Arrows indicate the direction of signaling: from MS1 to BSC, BSC to VLR/MSC, VLR/MSC to HLR, HLR to G-MSC, G-MSC to PSTN, and PSTN to Ph2. A '1' is written next to the BSC, and '(V)' is written above it.</p> | <p>Method number and name (fill in)</p> <p>(0: some radio stuff ++)</p> <p>1: A kind of Establish</p> <p>2:</p> <p>3:</p> <p>.</p> <p>.</p> <p>.</p> <p>X: Establish</p> <p>Z: Alert</p> <p>(fill in the rest + important parameters relating to CLIR)</p> |
|---|--|

1c) (4 %) Ph2 places a call to MS1 when MS1 is roaming. Mark with H and V on all (relevant) GSM components.

| | |
|--|--|
| <p>The diagram shows a fixed station (Ph2) connected to a Public Switched Telephone Network (PSTN). The PSTN is connected to a Gateway MSC (G-MSC), which is connected to a Visitor Location Register/Mobile Switching Center (VLR/MSC). The VLR/MSC is connected to a Home Location Register (HLR). The HLR is connected to another VLR/MSC, which is connected to a Base Station Controller (BSC). The BSC is connected to a mobile station (MS1) via a radio link. Arrows indicate the direction of signaling: from Ph2 to PSTN, PSTN to G-MSC, G-MSC to VLR/MSC, VLR/MSC to HLR, HLR to VLR/MSC, VLR/MSC to BSC, and BSC to MS1. A '1' is written next to the G-MSC, and '(V)' is written above the BSC.</p> | <p>(0: dial digits)</p> <p>1: Establish (in PSTN)</p> <p>2:</p> <p>3:</p> <p>(fill in)</p> |
|--|--|

Candidate number

Course

Sheet number.....of (total)

6. Extra sheet for exercise 2a) and 5 (not translated)

For exercise 2a) (6 %) Show 1, 2 or 3 IN-related entities and add arrows with numbers

| | | |
|---|--|---|
| <p>Fixed (PSTN) IN component(s)</p> <div style="border: 1px solid black; height: 100px; width: 100%;"></div> | <p>GSM IN component(s) (home and visited as appropriate)</p> <div style="border: 1px solid black; height: 100px; width: 100%;"></div> | <p>Method # and name (fill in)</p> <p>0: (radio prodedures)</p> <p>1: A kind of Establish</p> <p>2:</p> <p>3:</p> <p>·</p> <p>·</p> <p>·</p> <p>Y: Alert (fill in in between)</p> |
| | | |

For exercise 5a) (5 %) Show several CSCF entities and more (like HSS) and complete the collaboration diagram (between 3 and z) on the terminating side. Place entities in the right domain. You may ignore GPRS nodes and ICBF/interconnect.

| | |
|---|---|
| <p>UA-A is either at home or roaming</p> <p>Home(-A)</p> <p>Home(-B)</p> <p>Visited IMS+GPRS</p> <p>GPRS</p> <p>UA-B</p> <p>Fixed or wireless access</p> <p>(PC) UA-A</p> <p>3</p> <p>z</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>Shorthands like H for HSS etc (fill in as appropriate)</p> </div> | <p>Method # and name (fill in)</p> <p>1: (not needed)</p> <p>2: (not needed)</p> <p>3: INVITE</p> <p>·</p> <p>·</p> <p>·</p> <p>Z: 183 ringing (fill in in between)</p> |
|---|---|