SMS, the strange duckling of GSM

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Some introductory remarks

It might be appropriate to start with a warning: the reason for writing an article on 'the birth of SMS' is not to reveal a 15 year old story about huge achievements in terms of complex protocols and challenging combinations of radio, data and network design. The reader looking for that will inevitably be disappointed. The SMS or the 'Short Message Service' – as it has been labelled in every corner of GSM coverage – is definitely one of the simplest compounds of the GSM system.

The main reason for writing about the creation of SMS is because it is a story about innovation. SMS was indeed a true newcomer. All the other services of the GSM system – speech, fax and all the variants of circuit switched data – were well-known services, copied from the fixed network, in particular ISDN. SMS, as it was defined in terms of the stable versions of the relevant specifications, was an extremely simple messaging service tailor-made for GSM. It did not have its parallel or predecessor in any other system for offering mobile services to the public. The major part of the GSM community expected the circuit switched data and fax services to be the most important non-voice services, and regarded SMS to be more like an add-on that might increase the attraction of the GSM system without any commercial significance. The years to come proved it to be the other way round.

Books have for many years been published on the European mobile adventure during the last 20 years. A very good – and perhaps the most comprehensive – one is [1]. However, even the most complete volumes cannot cover every task of a huge endeavour like the GSM development. The fact that it covers more of the SMS design work well after the SMS specification was approved than before, gave me the final push to write some lines about just the period of time when I took part in the design work, i.e. from 1987 to 1990.

Background

Mobile communications of Europe and the US in the mid 80s were a true wilderness in terms of technologies and markets. In the area of speech services offered to the public, manual systems were replaced by the first automatic ones, giving 'mobile telephony' almost the same approach as the regular telephony that everybody had been used to. Paging services were steadily improving – both in terms of services and coverage.

In addition to the systems for public services offering, enterprises or organisations were making extensive use of a wide area of PMR systems. In the mid 80s most of those comprised

- A relatively simple radio network of one or a few base stations giving radio coverage to a limited area on a non-cellular basis;
- Medium complex protocol stacks, some offering analogue speech and some data services;
- A software application running on one or several host computers, being the primary fundament of the business itself (taxi companies, dispatch businesses, etc.);
- Interworking with the public networks – e.g. POTS – as a feature within a few of the systems.

At *Televerkets Forskningsinstitutt* – the Research & Development Department of Telenor at that time – I worked for a couple of years (1984–1986) as the project manager of a survey called Mobile Networks for Special Purposes (*Mobilt spesialnett*). The intention of the study was to explore the potential of mobile communications for other services than telephony. The survey comprised many activities – spanning from discussions with manufacturers and users of PMR systems in Europe and the US via an experimental system set-up by Televerket and Norwegian industry partners to specify a mobile messaging system. The system was to be connected to an X.25 network and provide both hosting of PMRs and extension of the X.400 service to mobile terminals. Together with extensive market analysis on mobile non-voice services in general and mobile messaging in particular the study reached a set of conclusions, from which one important was

- Offering mobile messaging within the framework of a public service portfolio may be a good idea since

- Mobile communications and messaging services make a very good match, since mobile users will be frequently out of coverage or turned off;

- Efficient store-and-forward mechanisms will be required to make the mobile terminal the prime target of crucial information to be delivered to the user as soon as possible. In this respect, it will to some extent outdate the fixed phone or the fixed data terminal handling the email.

• Offering mobile messaging jointly to both private and corporate segments may be a good idea since

- Unless attacking huge markets like the American, developing mobile transport services for just a set of business applications is aiming at bankruptcy. Either take this development to the US or make mobile communications for middle-sized markets that may attract both the private and professional segments;

- Enable business viability to new services like mobile messaging by seeking opportunities to bundle those in a flexible and non-complex way with a set of highly acknowledged services like telephony;

- Don't think too rigidly about new services like mobile messaging being for the corporate market and for professional use mainly. It may rather be the other way round; that take-up starts in the mass market and even in the long term supersedes the corporate market.

Start of work in CEPT and later ETSI

IDEG is established

In 1987 the work with the GSM specifications had taken some great leaps forward. The system architecture, the basic services, the characteristics of the radio interface, the signalling package – they all emerged with ever clearer contour. The GSM community had decided to establish three different working parties: WP1 – dealing with the services, WP2 – dealing with the radio aspects, and WP3 – dealing with the core network and the signalling aspects. The main group – or as it was to be called: GSM main body – was the group to a) survey the progress of the whole project, b) assign tasks to the working parties, and c) approve of the solutions produced.

There was but one outstanding domain that lagged behind: the detailed definition and specification of the data services. The responsibility had been allocated to WP3, but that group had its hands full with the huge challenges of establishing a complete package of all signalling functionality that might be required in order to fulfil the needs of the future GSM users. The GSM main body concluded that there was a need for another group to cater for the progress of data services definition. On May 20, 1987, the first meeting of IDEG – the Implementation of Data and Telematic Services Experts Group – was held in the city of Bonn. The group was chaired by Friedhelm Hillebrand from Detecon. IDEG had a somewhat blurred organisational status when created, but it soon became apparent that it was most convenient to give it the status of a working party, and eventually it was renamed WP4[1)].

IDEG soon defined four areas that the group had to concentrate on if it was to have a chance to catch up with the achievements that had been reached in the other three working parties

• Rate adaptation mechanisms;

• The radio link protocol (RLP), i.e. the protocol for carrying data at Layer 2 of the OSI model for the data services;

• The facsimile service within GSM;

• Message handling services that might be part of the GSM service portfolio.

There was allocated a so-called drafting group for each area[2)]. As a matter of coincidence, I was appointed chairman of the fourth one.

The tasks of the 'Draft Group on Message Handling'

GSM WP1 had left IDEG with two crucial specifications: GSM 02.02 [3], an overall description of the 'bearer services' of GSM; and GSM 02.03 [4], an overall description of the 'tele services' of GSM. [3] e.g. contained a variety of circuit switched data services, of which perhaps to some extent only the asynchronous non-transparent 9.6 kbit/s one ever came to practical use. [4] e.g. contained the framework of a set of messaging services: the fax message service, three services on short text message conveyance, and

1) *As the reader may know, naming of the GSM organisational entities within CEPT and later ETSI and 3GPP changed on several occasions. Thereby, e.g. WP4 became GSM4 and SMG4 in synchronism with the corresponding renaming of the other working parties.*

2) *A couple of additional drafting groups were also established, but on a very preliminary basis; one or two meetings only.*

a request that the GSM user should be able to access an MHS system.

The Draft Group on Message Handling – DGMH for short – which I was to chair, was to take responsibility for the short messaging and the MHS access.

The three services on short text messages were in [4] depicted as follows

1. Short Message Point-to-Point Mobile Terminated
2. Short Message Point-to-Point Mobile Originated
3. Short Message Cell Broadcast

The current version of GSM 02.03 listed these three as separate services with different level of importance: 1) – which was the service of carrying a text message through the network to the mobile terminal – was classified as one of the high priority services in GSM. 2) – which was the service of carrying a text message from the mobile terminal and through the network to an entity for further conveyance – should be optional for a GSM PLMN operator. 3) – which was the service of spreading a text message on a broadcast basis to all or a sub-set of the mobile terminals being within radio coverage of one or several base stations in the network – was for further study. It was further emphasized that all three services should exploit the capacity of the signalling channels of the radio path so that they should not face congestion due to ongoing circuit switched traffic – voice or data – of the mobile terminal.

In [4] of that time this was about all that was said about the short message services. Before the establishment of IDEG there had been sketches on architecture and how to accomplish Short Message Point-to-Point Mobile Terminated, but none of those documents were in the pile of the officially and approved guiding documents when the first meeting of IDEG was opened in Bonn.

The directives of [4] for defining MHS access were even scarcer. It merely said that specifications should be provided to allow the mobile user to exploit the services of 'MHS services'. It turned out quite quickly that integrating GSM and MHS did not require further GSM specifications. GSM users could very well access the User Agent of a X.400 MHS via GSM's own data services. A specification specifically on how to access MHS from a GSM terminal might perhaps represent a marginal improvement compared to relying on already established standards, but DGMH did not estimate this to be sufficient for suppliers to adopt this in their production plans. The MHS access activities within DMGH and IDEG were concluded in a technical report, probably the very first TR on data services of GSM. With that report, DGMH was allowed to leave the MHS access issue.

The objective of defining a Cell Broadcast service resulted in the required specifications, [6] and [9], at approximately the same time as the point-to-point services were approved. However, no core network transport mechanism was defined, and the GSM cell broadcast service was then left with an area that had to be based upon proprietary solutions. I think it is fair to say that both in IDEG and in DGMH, there was some hesitation among experts on how to design the broadcast service in a way that would be welcomed by operators. They were not troubled by possible technical problems, but rather by the feeling that it might be hard to find a viable business case. A sparkling contrast to this type of reluctance was demonstrated from Racal/Vodafone's side. It is impossible to touch upon the work with the cell broadcast service in those days without giving the very enthusiastic Alan Cox full credit for cell broadcast ever being defined. However, when the time came to implement the GSM network and its services, the scepticism of the GSM experts had contaminated the product development divisions of the mobile operators. Few operators ever implemented cell broadcast, and hardly anyone made it a commercial success. The destiny of this service is interesting and should give the supporters of e.g. future MBMS something to consider.

For the reasons indicated, I will leave cell broadcast with this and proceed with the mobile terminated and mobile originated service under the common acronym by which they gradually have been identified – SMS.

Items dealt with during the design of SMS

Service aspects – IDEG is given a considerable latitude in the SMS design

As stated above, the spring 1987 version of [4] did not reveal much of the basic perspectives of WP1 on the short message services. Extensive research by historians is outside the scope of this article, but probably there have been somewhat different opinions among the GSM delegations on the use of a text service. The Norwegian delegation e.g. filed a contribution in which it advocated the realisation of a service for telemetry applications, and I think other mobile operators had put forward similar proposals, but aiming at slightly different applications. The text in [4] is probably the result of their efforts to reach a consensus, leaving quite some freedom to the crew of designers.

Architecture

The Service Centre – a necessary entity

The point-to-point short message service – at least the mobile terminated part of it – would obviously be a store-and-forward service, since the mobile terminal might be turned off or out of coverage at the instance of delivery. Since it was explicitly stated that none of the regular network nodes of the GSM PLMN – such as the MSC or the BSC – should offer store-and-forward capabilities, there had to be an extra node with some genuine store-and-forward capabilities. So an additional node with the somewhat generic name Service Centre (SC)[3] was added to the topology of GSM. The concept of the SC had lingered for some time also within WP1 before IDEG came to work, however without any specific characteristics. The procedure of short message transfer should then be SME ⇒ SC ⇒ MS and SME ⇐ SC ⇐ MS. The entity SME, the Short Message Entity, was whatever entity that might be connected to the SC in order to send or receive short messages, including a GSM MS. The last step was important, because it brought symmetry to the service aspects of the two components point-to-point mobile terminated and point-to-point mobile originated, thereby effectively integrating the two. It was therefore finally decided to comprise the two services in one service specification, namely [5].

The debate on why and how to distinguish between value-added services (VAS) and teleservices had been going on in Europe for quite some years, especially in the UK with its pioneering role in bringing market liberalism to the European telecommunications. The rigorous definition of those years implied that one should even say that an information stream was subject to value adding if it was in any way converted – even slightly re-formatted – or stored for some time. The issue immediately came up with the introduction of the SC. Where should it reside, within or without the PLMN? Due to the genuine VAS character of SMS, the UK delegation strongly opposed the first sketches of the architecture, where the SC was included in the PLMN, which they regarded as a platform for teleservices only. The operators of the other countries had at that time no strong opinions and neither had the manufacturers, so it was decided to logically locate it outside the PLMN. Since a more pragmatic view on VAS has gradually replaced the original one, one could question if the architectural design we chose at that time was the most feasible. In many countries, SMS was regarded both by operators and regulators as an add-on to the mobile telephony service and consequently being part of the same market. For the forthcoming standardization 1987–1990, it however resulted in a relaxed attitude towards making a mandatory specification of the interface SC – MSC, which may definitely be ranked as a shortcoming of the SMS standards from those years.

Long distance SMS

Another item of discussion was how the PLMN was to transfer the short message internally. For obvious reasons, the routing principles of a mobile terminated short message as well as a mobile originated short message became identical to the routing principles for a speech or data call set-up. Thus, there might be a long haul transfer MSC – MSC, similar to the connection of a telephone call within one PLMN or between two PLMNs. Should it be transferred by means of well defined mechanisms of user data transport like the X.25, or should one produce a certain operation within the signalling system of GSM – MAP – especially for short message transfer? The question was discussed both within DGMH and SPS/SIG, which was a body in ETSI that had responsibilities over a wide area of signalling tasks within both fixed and mobile networks. Several experts advocated the principal view that transfer of user data should not be mixed with signalling functionality, and recommended X.25 for this particular undertaking. The UK delegation in IDEG opposed that position. The UK operators were – unlike many of the other operators that took part in the GSM project – genuine mobile operators, with no fixed or data network operators within the same corporation. From their business point of view, SS No 7 was a free lunch, whereas X.25 was not. After some consideration, it was decided to base the short message transfer MSC → MSC on SS No 7 by adding an extra operation 'forward_short_message' to the repertoire of MAP operations. Retrospectively, users of the SMS should be grateful to the UK delegation for contributing to a correct decision, even if it might be for other reasons than the one mentioned above: the smooth and uncomplicated interconnect and international roaming on SMS stems from the choice to rely on the in-house capabilities of GSM.

Defining the length of a short message

The choice of MAP as the long haul carrier of the short message brought an end to another discussion that had been going on for some time: how long should the short messages be allowed to get? MAP was based upon TCAP, and thereby on the concept of bilateral operations, which were assumed to carry small weights in terms of user information. To

3) *Later changed to 'SMSC'.*

arrange for MAP operations to carry more load than the standard request – response sequence of TCAP allowed for would be both complex and cumbersome. But being applications based upon a signalling system of global coverage, operations within MAP or TCAP necessarily imply a substantial overhead. When analysing the 'forward_short_message' operation and removing the overhead, we found that there were somewhat more than 160 characters of the alphabet chosen (see below) left for user data. It was decided to round down the figure to the closest decade, and so the number 160 became the eventual size for regular SMS. The WP1 had earlier been leaving 128 characters as some very tentative request for the short message length, but it had no problems of increasing the limit to 160.

The short message over the radio path

But which GSM capabilities were required for sending or receiving the short messages over the radio interface? The answer was pretty much given by the requirement that short messages should flow freely to or from the mobile terminal whether the terminal was idle or busy with an ongoing call: it had to be on one of the signalling channels. I consulted my colleague Knut Erik Walter, who was at that time heavily involved in the work with the very essential [7], if he could take a look at what might be required in terms of specification work to cater for the SMS radio interface. Within a very short time he drafted [8], which was thereafter approved in WP3, and which I think stayed stable and without the need of any change for a very long time.

[8] allocates signalling channels SDCCH and SACCH according to Table 1.

[8] also allowed for the network to keep the signalling resources, e.g. in periods with frequent message traffic: "… the network side may choose to keep the channel and the acknowledged mode of operation to facilitate transfer of several short messages for or from the same Mobile Station. The queuing and scheduling function for this should reside in the MSC".

Reports, Messages_Waiting and some other features

As indicated above, most people outside DGMH seemed to regard SMS as a machine-to-person service mainly, e.g. as the main part of voice mail alerts. In that respect, there would be no need for any type of confirmation or acknowledgement of a short message arriving at its destiny. Fortunately, the DGMH crew appeared to have a perspective also for person-to-person messaging, and to have recognized the usefulness of being offered information concerning if

Channel dependency	Channel used
TCH not allocated	SDCCH
TCH not allocated → TCH allocated	SDCCH → SACCH
TCH allocated	SACCH
TCH allocated → TCH not allocated	SACCH → SACCH opt. SDCCH?

Table 1 The impact that traffic allocation has upon choice of signalling resource to be used for the conveyance of the short message

and when the recipient actually received the message. A question arose at the stage of service definition in the case of a mobile recipient: should the confirmation be given at the event of manual actions taken by the user to display the message, or should it be given at the event of the terminal receiving the message? Picking the second alternative was an easy choice to make. The major challenge is to convey the message over the radio path at a time when the mobile is turned on. When this is achieved, the chance that it will somehow be destroyed before the user may read it is less than marginal.

From [2] I had learned that to make messaging effective for mobile communications, one has to provide for functionality to make the information transfer as swift and easy, meaning e.g. as far as possible to overcome annoyance of the inherent instability of the mobile terminal's contact with the network. I therefore proposed an additional interworking between the SC and the GSM network. When an attempt to transfer a short message to the mobile fails due to the mobile being turned off, the location registers take a note of the event together with the address of the SC that made the attempt. When the mobile user turns on his phone again, the location registers – provided that the operator is applying IMSI Attach / IMSI Detach – are notified and in their turn informs the relevant SC that it might be a good idea to repeat the transfer attempt. The feature was labelled 'Messages_Waiting', and aimed to be particularly useful for those who frequently would turn off their mobiles to reduce battery consumption, attend meetings or events where mobile phone calls were banned, etc

Other features that may be mentioned are

- Validity-Period, period that a short message stored in the SC due to absence of the receiving party should be kept before it might be deleted;
- Service-Centre-Time-Stamp, time when SC receives a short message to be delivered. Always

to be included in the short message delivered to the terminal;

- Protocol-Identifier, identifying which protocol to be performed at the application layer;

- More-Messages-to-Send, a Boolean included in the short message delivered to the terminal to tell if there are more messages in the SC still to be sent to the recipient.

The alphabet

Now, what should be the alphabet of the short message? The WP1 had in [4] made a reference to the ITU and ISO standards of International Alphabet no 5 (IA5), which were designed for what were anticipated to be the text services of the future, in particular MHS. In DGMH, we examined the IA5 standards, which were designed with the objective of providing different regions of the world suitable alphabets within the framework of adequate character lengths, in particular 8 bits. The exercise of finding a suitable alphabet for SMS occurred chronologically just after the corresponding work item in ERMES, who had approximately the same focus as DGMH had at that time: finding a sufficient set of characters for the western parts of Europe spending as few bits as possible. The ERMES alphabet was a result of picking the characters from the most used alphabets while still being able to wrap up the whole thing in a 7 bits notation. We therefore proposed to use the ERMES alphabet as default, but opened up in the protocol for the user to request other alphabets. Both IDEG and WP1 supported this proposal.

A review of the work leading up to approval

It may be worth while to try to summarize what was achieved, and mention the crew that made the results.

Merits and flaws of the SMS design

In my opinion, the merits of the SMS design were the following

- Simplicity, both in terms of functionality and in terms of architecture (e.g. only one SC in any MS → MS messaging);

- Merge of the two original point-to-point services into one service – SMS – with complete reciprocity 'mobile terminated' and 'mobile originated';

- An SMS based entirely upon in-house capabilities, e.g. SS no 7 instead of X.25;

- Reception confirmation for MS to MS messaging;

- Automatic delivery of waiting messages to a recipient just after he had switched on his mobile phone.

On the other hand, some major flaws are retrospectively not hard to pin-point:

- A protocol version number was not allocated at the transfer layer, requiring new versions to be backward compatible. Apparently, none of the DGMH members were well-experienced protocol experts!

- We were not bold enough in terms of exploiting future possibilities for MS to MS conversations, e.g. group chatting. Both address conversion (e.g. E.164 ↔ name@domain) and handling of distribution lists within the SC were discussed, but a number of people clearly expressed that we had gone far enough with our perspectives on SMS conversations!

- The same was the case with message templates, which was an idea inspired by transaction services within the X.400 domain and just very briefly and informally mentioned within the GSM and DGMH community. As with the above ideas, it did not have the necessary support to be pursued. However, it might have boosted SMS as a tool for *m*Commerce!

The 'SMS crew'

No individual expert or company should claim to be the 'father' or 'creator' of any service or major functionality produced during the GSM development. The GSM project was indeed a multi-national collaboration at its best. The cooperative working procedure was the case also for IDEG and DGMH. The latter consisted in my period as a chair of a group varying from 5 to 8 people, all dedicated and contributing to the ongoing work. I would in particular like to mention Alan Cox from Racal/Vodafone (later Vodafone), Kevin Holley from Cellnet and Eija Altonen from Nokia. I would also like to compliment Friedhelm Hillebrand for being an extremely good chairman of IDEG. Most of the IDEG participants in 1987 were not familiar with international collaboration like GSM, but in a very gentle and constructive way Fred encouraged them to immediately join in and do their best. Fred left the chair of IDEG for other GSM appointments in 1989, and was replaced by Graham Crisp from Plessey Networks and office Systems. Graham had chaired the draft group on rate adaptation mechanisms (TAIW, Terminal Adaptation and Interworking), and thus became the first person from industry who took a chair in CEPT. Graham, who had participated in IDEG from its first meeting, had exactly the same exquisite skills in chairing the group as Fred had exposed.

I would also like to appreciate colleagues of my own company – in particular Jan Audestad and Knut Erik Walter for swift responses to our requests on MAP upgrades ([10]) and the establishment of radio interface functionality ([8]), and a series of good advice along the line.

The tricky part: what can we learn from the SMS adventure – if anything at all?

Everyone knows stories about the strange random walk characteristics of business and technology development; the yellow stickers from 3M, the chat line of the Swedish phone company, and so on. Like those examples, many of them derived from internal mishaps and were just accidentally transferred to the production lines. Yet they became great successes.

The birth of SMS was definitely not due to a mishap or accident, even if the perception of SMS in 1987 was – as stated earlier – not very clear. Luckily enough, it was not excluded from the list. The story has a slight resemblance to those of the Norwegian fairy tale character Askeladden, who picks up all kinds of items that he encounters given the presumption that it may come to use some day. In the adventure they always do, resulting in a massive success. In real life, they sometimes pay off – as with the SMS. Trying to figure the same situation today, it is not hard to imagine the average modern executive immediately tearing the SMS concept of [4] into pieces: "When there is no extensive and convincing text of market analysis, there should be no further transfer to a lengthy and costly design and production process". The strange thing is that if one imagines the modern product development filtering on all other services than SMS, they might have passed the checkpoint procedures without difficulties. The speech service was a banker, no one doubted that there was a substantial potential of migrating telephony from the fixed to the mobile networks. The fax service also had a high standing: fax had been a popular service in the fixed networks for years! The circuit switched data service also had its fixed network parallels that made perspectives of a high usage probable. Thus, for all three services it would have been fairly easy to produce convincing arguments in the context of today's product development forums why they should all be profitable. In this way, we can very well envisage a situation where the methods of today would have accepted fax and circuit switched data – the failures – and discarded SMS – the success!

This should not be taken as polemic statements intended to give the impression that the participants of DGMH had some sort of ingenious formula or supernatural gifts that enabled them to see what nobody else saw: the full potential of SMS. Certainly, experience from earlier work and objectives had provided the group a hunch that messaging between mobile users might be a very good idea and worthwhile pursuing. However, no one within DGMH, IDEG or GSM was even close to comprehending the wilderness of applications that is provided by today's SMS. *m*Commerce, the flora of CPA based services, customizing the mobile handset by download of the required parameters, short message as the initiator of push services; none of those applications were thought of even vaguely. They just popped up because SMS was at hand, virtually from the start within and between any GSM network and easy to apply.

Finally trying to conclude, I would say that the success of SMS – unexpected among even the core GSM experts – might be associated with the following key words:

- Abundance and simplicity combined. The willingness to include *some* abundant dark horse that cannot be justified through clear-cut market analysis, but keeping in mind that also for an item of this category the rule applies that market appeal is proportional to simplicity;

- Hunch. The willingness to adopt, trust and support *some* ideas – not all, not even many – that give some elusive perception of great potential that cannot be justified through plain and clear-cut market analysis;

- Risk. The willingness to take *some* calculated risk when deciding upon the design;

- Seeing business in a broad and long-term perspective. The willingness to accept and endorse categories of work that open up vast new business areas, even if they will be available also for one's competitors and even if it may take several years before it pays back.

The development of GSM almost coincided with a huge paradigm shift in the business of telecommunications: leaving the age of monopolies and entering the age of the liberalised markets. The benefits of this transition – e.g. in terms of price reductions, more effective sales and distribution channels, and flexible and customer oriented production lines – have been emphasized ad nauseam, and will be contradicted neither by me nor by anybody else. But no change is entirely good or bad. With the shift mentioned above there was also something lost. The corporate environment that fostered the characteristics listed above for the ability to take substantial leaps forward – e.g. the

cardinal 'hunch' – was far more apparent in the dinosaur-like telcos of the past than it is the streamlined and ever cost reducing operating companies of today.

'Hunch' is what you get when – in between the tightly scheduled tasks of today's demands – you are allowed to stray into areas of terra incognita without almost any other purpose but to explore. The '*Mobilt spesialnett*' endeavour was one such exploration of mine, and it meant a lot to my qualifications for carrying out the objective that we were confronted with. I am sure that the other people involved with SMS – in WP1, IDEG and DGMH – had their corresponding strays, and that those were equally beneficial to them. The previous telco's could afford that luxury. The present ones cannot, and the soil is inevitably less fertile. Thus, today's SMS chatting crowd can be happy that the GSM system definition phase occurred well within the era of the previous regime. I'm not quite sure that the SMS sketches of 1987 would have passed the WP1 examination if its members had possessed the mindset of the operator community of 2004.

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