Implications of Speed Trap Services for Designing Roadside-Location-Dependent Messengers

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***Abstract**: We present a survey of four providers facilitating sharing of speed trap warnings over SMS and the messages they distribute. These messages have three distinct parts: the first warns for a particular activity; the second states the place where the activity is occurring; and the third gives the impact of the activity. This survey covers an existing practice of roadside-location-dependent information exchange and motivates designing a new messenger with a broader scope, not necessarily limited to speed traps. Furthermore, through the analysis work we have learnt five issues designing such messengers. First reporting fits wireless ad hoc peer-to-peer networking. Second, messages may need manual management out-of-location, which also calls for universal access networking. Third, reporting on varied activities requires a flexible format i.e. voice memos. Fourth, position coordinates should be complemented with a human notion of places. Finally, understanding the duration of the activity is useful in removing irrelevant messages.*

***Keywords**: SMS services survey, roadside-location-dependent systems, design implications.*

1. Introduction

We present a survey including four commercially available speed trap SMS services in three countries in Scandinavia: Denmark, Norway and Sweden. In essence, these services organize collecting and relaying reports among subscribers on *speed traps*, which are the manual means in which authorities monitor conformance to speed limits on the roads. This survey should not be seen as an evaluation of the services, as no deeper understanding has been acquired of how the individual subscriber interprets messages, or how successful he or she is at that. Nor have we examined the main organizations behind them i.e. the operators or the police. However, we believe the insights we nevertheless have acquired are valid for drawing useful design implications concerning the design of a new and innovative roadside-location-dependent messenger, which is the ultimate goal of our research.

Furthermore, we have made a survey of the messages these particular services providers distributes. All in all we have collected and analyzed 6140 messages from all of the four providers. We have, for instance, found a common pattern in which the messages are phrased. In general the messages are divided in three parts describing the *activity*, the *place* where it occurs and the *impact* it has that section of the road. Although the activity seems given by the scope of the service, we have found several variations, out of which two did not even concern speed traps, but accidents and other obstacles to traffic flow. The most elaborate part is place descriptions. It seems that speed traps often occur at rather anonymous places and as such are difficult to accurately convey to others. The impact is relatively infrequent and is used in messages concerning accidents.

The text messages of these services constitute examples of what roadside-location-dependant information people in traffic are motivated to share and even pay money to receive and as such they are interesting in their own right. However, the scope of these services limits the exchange to one particular topic. The roadside is embedded in landscape containing an ever-changing scene of other events, hazards and conditions worthy of sharing. The SMS services examined here motivates designing a new messenger service with a broader scope. Such messenger would allow sharing general knowledge, not just speed traps, among drivers. This would include sharing observations of highly transient phenomena, for example, icy sections, elks passing, or children playing.

Through the survey of services and the messages we have found five important issues to address when designing a roadside-location-dependent messenger. The first concerns reporting of messages are made in a manner that fits peer-to-peer computing and limited range wireless ad hoc networking. Second, in order to keep a messenger interesting and to the point, it also needs to support

manually managing the mass of messages, for example removing or adding content out-of-location. This calls for also using a client/server and universal access networking application approach. In order to support both we argue for a hybrid solution. Third although the services we have studied concerns only one topic, many variations in activity descriptions were found. To support such variations, the messenger should include a format supporting many degrees of freedom, yet allowing reporting while driving. Fourth, place descriptions imply that positioning technology is appropriate and may ease the effort in reference making of locations. However, to also support the interpretation of coordinates, the messenger should convert them into phrases referencing and relating to named places e.g. street names, landmarks and signs. Finally, the impact is given, as the duration of the activity is difficult, yet tractable piece of information, to tell beforehand. The duration has bearing on filtering of messages and most prominently when removing irrelevant messages. We believe in several approaches such as a time-to-live duration or out-of-range removal of messages.

This work is relevant to research in HCI and particularly *Mobile HCI* (Kjeldskov et al, 2003). It exemplifies a design proposal grounded in an existing mobile practice, in this case four commercial available services, which is uncommon. More so, it examines existing services and proposes a new one aimed for specifics of mobile life (Chincholle et al, 2002), in this case a truly mobile (Sherry and Salvador, 2002) activity, namely driving.

2. Related work

More specifically, the services surveyed here lie in a genre of location-dependent systems, which has been explored within the fields of augmented reality, wearable and ubiquitous computing. Out of this rich body of work, projects investigating *exchanging* location-dependent information messages are closest, for example, E-graffiti (Burell and Gay, 2002) and GeoNotes (Espinoza et al, 2001). The E-graffiti project concerns investigating the usability aspects of text based location-dependant messages. GeoNotes explores social navigational-based filtering issues in the event of mass use of such messages. Location-dependent systems foremost aimed at personal use like Placememo (Esbjörnsson and Juhlin, 2002), CybreMinder (Dey and Abowd, 2000) etc. also share some common features. First and foremost of these, Placememo is designed for road context and particularly minding design to accommodate driving while performing some of the tasks it facilitates. Consequently, some design suggestions we propose for a new messenger also draw on that work. Specifically, we propose sharing knowledge in the form of place memos, i.e. voice memos associated to geographical positions. Some design suggestions are informed by advances in proximity networking software technology and therefore, the work is also draws on projects demonstrating the specific aspects

of enabling this in the road domain e.g. Hocman (Esbjörnsson et al, 2004) and Sound Pryer (Axelsson and Östergren, 2002). Furthermore, the survey of messages is related to studies of personal expression through bumper sticker decals on automobiles (Case, 1992; Endersby and Towle, 1996). This work investigates what decals people use and their motives for doing so. We also see them as demonstrations of an interest for increasing the social interaction in traffic beyond the rather anonymous maneuvering and co-ordination work drivers engage in mundanely. Finally, investigations and evaluations of SMS technology and particularly SMS services are rather scarce in the literature. There are some studies of vaguely related issues, for instance, how teenagers use SMS messages (Grinter and Eldridge, 2001).

3. Speed trap warning SMS services

The Danish www.razzia.dk and the Swedish www.razzia.nu share some common features i.e. the user interfaces and the message distribution is managed similarly. These service providers let a user sign up for membership by sending a text message with command to a number they operate. This command specifies a local region in which he or she is interested in hearing reports from. A user can only receive messages from one region at the time. Moreover, a user can also specify the total number of messages per day he or she is willing to receive. A user can also further limit the messages rate by specifying operating hours. This is done via editing a user profile accessible via their site. Finally, receiving messages can be paused, started again and terminated by sending SMS messages. If the user wants to report something to others he or she has two possibilities. First, he or she may send an ordinary message, containing the report, to a phone number operated by the service provider. Second, a user may file a report using a web form on the operator's site. In the case of www.razzia.nu a user have one more alternative: a user may call in a report by phoning a call centre operated by the provider. In the www.razzia.dk version a user pays 249 DKK per 400 received messages. The www.razzia.nu service provider charges 5 SEK per sent message and a user is granted 5 free messages if he or she reports a trap. Finally, according to the Swedish web site they claim that the Danish counterpart has more than 35 000 users.

3.1 www.razzia.dk and www.razzia.nu

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3.2 www.polisvarning.com

In the Swedish www.polisvarning.com a user signs up by entering a form on this web site. In return he or she receives a user profile. The service offers three interfaces to this profile: via the web, WAP and SMS. The user profile is used to store information on which regions the user wants to hear warnings from. A user can subscribe to several regions at the same time. A user may also specify the maximum number of messages received per day and the times (week days and hours) when to receive messages. User call in reports to a manned call center where a message is formed distributed to other subscribers. To subscribe to messages a user pays a yearly fee of 298 SEK with the additional cost of 1.85 SEK per message. Finally, in Mars 2004 www.poliswarning.com had about 900 users according to their own statistics.

3.3 www.politiet.net

Finally, in the Norwegian www.politiet.net version a user signs up for the service by sending a command to a dedicated phone number. The user then receives a password, which then can be used to access a profile via the web. In this profile a user may then specify which regions (may be multiple) he or she is interested in, which times and maximum number of messages he or she wants to receive per day. Sending commands via SMS to a number operated by the service a user may also modify this profile. Furthermore, a user may start, stop and terminate service subscription via similar commands. The user is charged 3 NOK per message distributed. Finally, according to statistics on their site, in Mars 2004 this provider had about 7000 subscribers.

3.4 Messages

A common feature of all these sites is that they all post the latest messages distributed to the members. The messages are delayed 30 to 60 minutes, however showing the actual content of what is being sent to the members. The reason for making the messages available in this manner is serve several purposes including: marketing, and proof of concept. Another may be to approach the dubious moral of using (and make available) such service. For instance, on the www.polisvarning.com the following statement was found:

> We play with open cards because we have nothing to hide. This means that we always show the number of members and the number of messages sent. Besides we always show the five latest sent messages in plain language.

4. Method

We wrote a program that downloads each service operator's web page listing the latest messages. As some service providers only display a limited number of messages, the program visits each page on a three-hour interval beginning at 9 am. The download times were chosen after a few days of monitoring the times messages were posted. The program also saves a copy of each downloaded page, making a distinction in what time they were downloaded i.e. a web page downloaded at 12 am does not replace a page downloaded at 9 am. Moreover the program 'strips off' the HTML and inserts all the information that can be extracted from the page concerning messages into a database table. The program created one table for each day and the information comprises of date of posting, time, the area or region that the message concern, and the actual SMS text. Some providers did not include posting date. In this case the program assumes that the posting date is the same date as the download occurred.

Unfortunately this straightforward approach proved to feature some limitations. As some providers present the cumulative messages over a day, many duplicate messages are inserted into the database. Moreover, as a consequence of some them only show the few latest messages, downloading on a three-hour interval, may miss some messages. Finally, some providers do not specify on which day a particular message was sent. This turns problematic when a low number of messages make the list of the latest few messages span several days. This would cause multiple entries in the database. Such entries were identical except for the posting-date field.

In order to reconstruct the original amount and order of the messages a three-step procedure was undertaken. First a database of all messages was created out of tables of each day with a SQL union query:

> SELECT * FROM table-for-day1 UNION ALL SELECT * FROM table-for-day2 ...

Second, then a table with the duplicates removed was created the following SQL query:

> SELECT DISTINCT date, time, region, message INTO distinct FROM union ORDER BY date, time

This query selects only distinct rows from the table storing the result of the union query and inserts them into a table called distinct i.e. all identical rows are removed from the output. Third and finally, the database was sorted in a way, which made the duplicate entries over days adjacent:

> SELECT * FROM distinct ORDER BY year, month, time, message

Sorting the table in this manner made it easy to go over it and remove the duplicates manually. That is, if duplicate rows were found the row containing the oldest date value was kept and the others deleted.

The weakness of using these queries is that the second query assumes original duplicates do not exist. Original duplicates come from the service provider intentionally (or perhaps unintentionally) sent a message twice and thus the same message is repeated on their home page. Obviously, this is different from assuming that they are caused from being downloaded twice by our program. However, deliberate duplicates were very uncommon and only observed in a few cases. Thus it is assumed they are of limited significance and can be ignored without hampering the validity of the study. Furthermore, this method does not capture messages that are syntactically different although semantically equal i.e. reports on the very same activity. This may occur with the messages from the Swedish providers.

In this manner 6140 messages were collected over a period of roughly five months from 10th of October 2003 to 3rd of Mars 2004. Out of these, we examined and classified the formulation of the 416 first messages, which corresponds to eight days. The classification scheme evolved from working with the material. The number of messages classified in this manner was chosen with reference to the claims we are making.

5. Message Analysis

The message analysis is divided in three parts: statistics on the timing and geographical distribution of messages; the source of knowledge; and the formulation of messages. First, the numbers of messages, collected in this manner, distributed over the hours they occur, are shown in Figure 1 below. As noted earlier the messages are delayed before they are shown on the providers web pages, yet accumulating the number of messages as in this manner seem

seems to yield a pattern when messages occur. The messages are most frequent between 9 am to 6 pm and there are two distinguished peeks before and after 12 pm. The message frequency seems to decrease from about 6 pm to vanish altogether at 4 in the morning. The distribution seems correlate to daytime work hours with an increased intensity at about lunchtime.

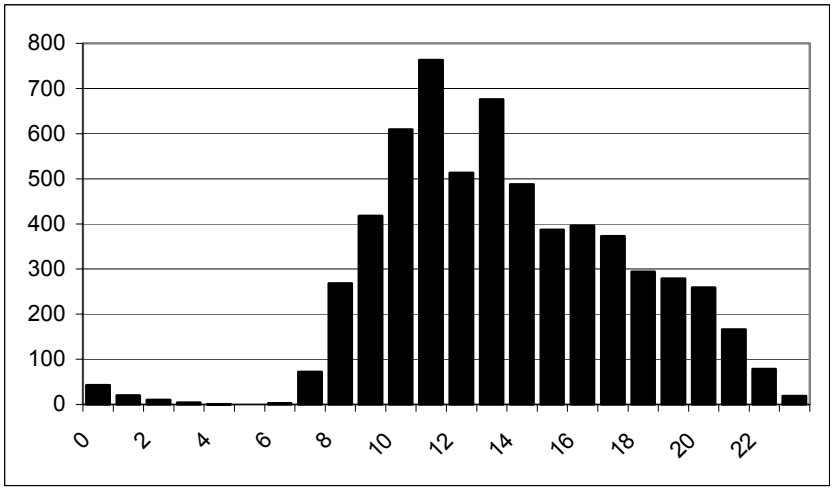

Figure 1. *Message count (Y-axis) grouped by hour (X-axis).*

Figure 2 shows the number of messages group by the day they occur. The number of messages varies with the weekdays and holidays. There is a clear dip on weekends and around Christmas and New Years. There is a peek at February 6th, which is due to an increased activity at the Danish provider. The average number of messages collected per day is 42 and the standard deviation is 23.

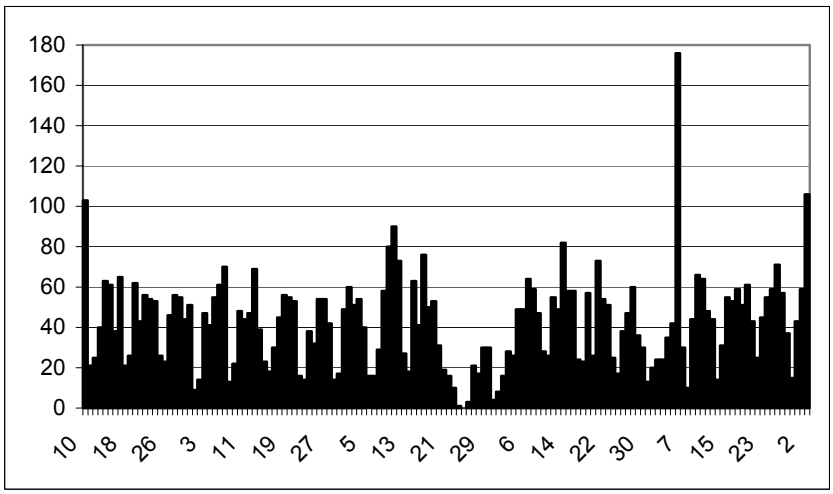

Figure 2. *Message count (Y-axis) grouped by date (X-axis).*

Figure 1 and Figure 2 tells that most messages occur during work hours in weekdays. This is, of course, mainly due to the working hours of the police, but

the messages distribution seems to also yield a pattern of the subscribers. We believe that the majority of the subscribers are people working on the roads, for instance, in transportation or logistics. We cannot entirely rule out commuters, however, given that the messages are most frequent during the working hours they seem less important. A dominating population of commuters would have yielded peeks in the morning and in the evening.

We also note that the messages are distributed over no less than 644 regions. The average number of messages per region is 9 and the standard deviation is 20. This is due to the messages are unevenly distributed over larger regions as the top 20 regions have about 31% of all the messages. In the very top we find regions corresponding to larger cities in Scandinavia: Bergen / Hordaland (198), Göteborg (186), København (170), Stockholm (154) and Trondheim / Sør-Trøndelag (141). It may seem surprising not find Oslo in the top 5, after all it is the largest city, in terms of population, in Norway. The reason is the Norwegian provider has divided it into smaller regions. Accordingly, there are at least six regions for it and together they had 173 messages. In conclusion, the timing and geographical distribution of messages gives a coarse picture of a target group that potentially would be interested in a roadside-location-dependent messenger. That is, it is constituted of foremost people working in transportation or logistics in the main cities of Scandinavia.

Second, although service providers emphasize subscribers themselves reporting messages we have reason to believe this is not always the case. Judging from the wording of some messages it seems that the messages may come from some other source, someone with a more holistic view of the situation, and that they are entered at the centers. The service providers have many incentives for actually entering information on behalf of the subscribers. First, obviously they make money out of it. Second, in doing thus they guarantee that there is some content available, which makes it less prone to be ignored (again which would hurt business in the long run). Here follows an example of such messages:

> Trafikolycka på Rv50 mellan Östergötlands/Örebro länsgräns och Sänna, vägen kommer stängas av helt

This message says an accident has occurred at highway 50 between the county border of Östergötaland and Örebro and the city of Sänna and that the road *is going to be* blocked. Here, it seems unlikely that a subscriber would have definite knowledge of future events.

Third, we have examined the formulation of 416 messages and roughly a message is divided in three broad parts. First, a message contains a description of the *activity* being reported. Second, it contains *the place* where this activity occurs. Third and finally it sometimes also contains a description of the *impact* the action has.

5.1 Activity

Generally, the activity part of the message contains what activity or action that occurs at the reported location. In our analysis of the message we have found six important variations with varying frequencies. The first variation tells that an *inspection* is happening. These messages only briefly state the activity and were encountered in about 44% of the cases. For example:

> KONTROLL PÅ RV47 VED BYGNES LIKE FØR KOPPERVIK.

This particular message tells that an inspection is taking place at highway 47 at the village of Bygnes, before the village Koppervik.

The second variation is more specific and yields the particular *instrument* the authority is using. In this variation we include phrases such as 'laser,' 'car,' or 'radar.' This occurred in 27% of the cases. For instance:

> HØJE-TAASTRUP FOTOVOGN VED HØJETÅSTRUP STATION PÅ TORVET

The message tells that in the region of the town Højetåstrup there is a 'fotovogn' i.e. car equipped with speed measuring device. This car is at the square, by the railway station, in Højetåstrup.

Third, a related term we label tells what instrument (or what method) being applied and also gives some *attributes* of it, for instance, describing the color of the under-cover police car. This occurred at 7% of the messages. We have,

> civil polisbil vit minibuss på Väg 11 mellan Veberöd och Sjöbo

The message tells there is an under-cover police car - a white minibus on road 11 between the towns of Veberöd and Sjöbo. In this message the car is the instrument and the 'under-cover', and 'white minibus' are the attributes.

The fourth variation states the *objective* of the inspection i.e. what rule or law the police is inspecting conformance to, e.g. speed limits, cargo weight, or safety belt. This occurred in 6% of the messages. For example:

> BELTEKONTROLL I STOKKABAKKEN.

This message tells that the authorities are checking drivers are using their safety belts in Stokkabakken.

The fifth variation is somewhat surprisingly not a speed trap warning. Rather it is tells the receiver he or she should beware of an *accident*. Such messages were found in 12% of the cases. This is a surprisingly high rate. Members subscribe with the intention of only hearing speed trap warnings, they are probably reluctant to a receive messages diluted with other kinds of information. A message reporting an accident typically looks like:

> Trafikolycka på Lv239 vid Trafikplats Toria Korset, i riktning mot Hejdröset,riksgräns Norge

This message tells that an accident has occurred at regional highway 239 at a junction called Toria Korset. The accident affects one lane and the lane is specified with the direction towards a landmark called Hejdröset at the border of Sweden and Norway.

Finally, in about 2% of the cases the activity was missing in the messages. This is possibly sometimes due to mistakes when an activity is reported or dispatched at the operating center. Some messages were also of informative nature similar to accident reports i.e. warning for nasty weather conditions or traffic flow disturbances such as in:

> långa köer på e4 södergående i höjd med botkyrka

This message says there is a long car queue on highway E4 in lanes going southwards in level of Botkyrka.

5.2 Place

Naturally, the intent of this category is to specify where the activity is occurring. We have found a pattern in how place is formulated in these messages. It consists of seven parts: region, road, preposition, location and lane. The *region* tells the rough whereabouts of the activity. *Road* gives along which road it occurs. The *preposition*, e.g. telling this particular place coincides, together with a *location*, e.g. a well-know regional landmark, gives where along this road the activity is. Finally, the *lane* says in which lane the speed trap concerns.

5.2.1 Region

About 42% of all the messages had a prefix specifying the region. The region is often given by the vicinity to the principal town within some region, or by naming a county. However, investigating this per service provider we found that we find that a 100% of the messages from www.razzia.dk specified region. Similarly, www.razzia.nu had 99% of their messages included region. However, www.politiet.net and www.polisvarning.com only had 2% and 9% respectively of their messages with a region specification. This is a little contradictory as the first two service providers only allow subscribing to one region at the time. That is you would expect that there would be little risk of forgetting which region a user currently selected. However, in the case of the later two services, a user is allowed to subscribe to messages in several regions. Thus there would be an obvious risk of confusing locations or make it harder for the user to disregard messages not concerning the region where he or she is currently located.

5.2.2 Road

Most prominently roads were described with a *number* i.e. a series of digits or combination of letters and digits. Such combinations usually denote highways i.e. larger roads outside habited areas in Scandinavia. Messages specifying road in this manner occurred in 45% of the time.

The second most common way of telling the road was giving the *official name* of the road. Usually this denotes a street name, that is roads inside or close to habited areas such as cities, town or villages. This happened in about 22% of the messages.

Correlating the messages containing a number and the country in which the service provider targets (i.e. Denmark, Sweden, and Norway) we see that in Sweden 60% messages concerned roads specified with a number; in Norway this number is 50% and in Denmark it is only a 8%. However, 62% of the Danish messages include official name. The cause for this may come from geographical discrepancies in the road networks. The Swedish and Norwegian roads are dispersed in much wider area than the Danish. Roads in uninhabited areas tend to be referred to with numbers. Denmark, on the other hand is crowded in comparison and their roads tend to always be close to developed areas and therefore they have names.

The third most common case is to give *multiple*, i.e. at least two, references to the same road. Such messages were found in 8% of the cases. A common combination is road number and an official name referencing larger streets or highways in cities.

In a minority of the cases (only 2%) road was given by a description, e.g. 'the highway', 'the old road to', rather than by number or official name. Probably this road is a prominent or well known in the region and easily distinguished even with vague references.

Finally, in as many as 22% of the times the message was lacking references to roads altogether. In such cases, often a location, i.e. a village or a landmark is adequate to tell where the activity occurs.

5.2.3 Preposition

The preposition together with location gives where along a particular road the activity takes place. There are two important variations: the spot where the activity takes place could be *relative* or *coinciding* with a location. It could also be given by a combination of the two. As such a relative term captures how the spot is relatively displaced from some location. For instance, we include phrases such as 'five km north of,' 'between,' 'before,' here. The coinciding terms tells the place is within some location. Phrases such as 'at,' 'outside,' 'next to' are included. However, the preposition (in a grammatical sense) that precedes the road specification is not. The reason for this is that these prepositions are not

used to specify a location on the road, but rather telling which road the message concerns. For example:

> HOLBÆK FOTOVOGN PÅ ROSKILDEVEJ I VIPPERØD LIGE VED TANKSTATION 100-150 METER INDENFOR BYSKILT

This message tells: in the vicinity of Holbaek there is a police car on Roskildevej road in Vipperröd at the gas stations 100-150 meters before the city sign. As such this message contains two coinciding phrases 'in' and 'at' and one relative '100-150 meter before'.

Very few messages, about 4% use no relative and no coinciding terms. The road descriptions in such messages are dominated by official name. Perhaps such messages concerns inner city streets where the activity would dominate the scene and therefore not need further explanation. Conversely, relatively few, or 11%, use both relative and coinciding terms in the same message. Finally, the average number of relative phrases per message is 0.31 and for coinciding phrases it is 0.86.

5.2.4 Location

Location together with preposition tells where on a particular road an activity is occurring. There are three important variations of locations. The first concerns a *town or district*, i.e. the name of a village, town or city or an inner-city district. The second concerns *landmarks*, i.e. references to easily recognizable or well-known buildings such as, gas stations, shops of a particular brand, or churches. This variation also includes other constructions such as, named highway service areas, bus stops, and bridges as well as easily distinguishable features of the countryside such as lakes. Third, the last variation of location corresponds to *road features*, i.e. terms that specify unnamed road infrastructures such as, exits, or roundabouts. Finally, a message can also include any combination such phrases.

The average number of town or district phrases per message is 0.64. Correspondingly, for landmark this number is 0.50 and road feature it is 0.18. We found that town or district phrases are predominately used in messages where roads are specified with number i.e. in about 29% of all the messages. Furthermore, out of these, 76% where marked using at least one coinciding term. The conclusion is, about a quarter of all the classified messages referred to an activity occurring at a road given by with number. This spot then was phrased as coincided with town or district. For example:

> Laser på E4 i höjd med Bölesjön

The message tells there is a laser, i.e. a speed trap where the police use a laser instrument to tell the speed at the highway E4 in level of (i.e. coinciding with) the town of Bölesjön.

5.2.5 Lane

In many instances, the reported activity only concerns one of several lanes. The dominating feature of roads in Scandinavia is that they usually have two lanes (one in each direction) and an activity may only affect one of them. In about 50% of the messages lane was specified. We found five variations on how this was done. First, in about 20% of the messages the lane was given by the absolute heading *towards a town* or village. For example:

> KONTROLL PÅ E39 CA 2 KM ETTER SØYLANDSKIOSKEN RETNING STAVANGER.

This message tells there is an inspection occurring at road E39, about 2 kilometers after the kiosk at Søyland, in the lane heading towards Stavanger.

Correlating with road reveals that specifying lane (just one or both) in this manner is predominately used when road is specified with number i.e. on highways. Second, a lane was in 14% of all the messages specified with the *compass heading* of the traffic in that lane. Third, in 6% of the message the direction is given in the message by *descriptive* phrases understood by the context such as:

> KONTROLL I FJØSANGERVEIEN RETNING UT AV BYEN.

This message tells there is an inspection at the Fjøsanger street in the lane heading out of the village.

In about 6% of the cases the message stated that the activity occurs in *both* lanes. Finally, the direction was also sometimes (about 3% of the cases) given by direction towards a building, such as a shop, petrol station, or some other named distinguishable *landmark* by the road.

5.2.6 Impact

In about 10% of the cases a message contained a description of the impact of the activity. Such messages exclusively concerned accidents. We found four variations of advice telling which impact the reported activity has on the accessibility of that particular section of the road. This information could be explicitly stated or conveyed by describing the scope of the activity. As such it can be used to determine the duration or spreading of the activity. The first variation concerns whether there is a passage passed the spot where the accident occurred. Such message explicitly states that *one lane is blocked* or closed. Similarly, a message could also tell the entire road or *both lanes are blocked* or closed. Third, a message could tell that passage a particular stretch of road is marred by *slow passage* and that the activity caused some sort of disruption in the traffic flow and passage is difficult. Finally, a message sometimes contains a description of the *scope* of the activity. As such the consequence in terms of the road being blocked or passage slow could be

understood from the context. Finally, an example of a message including impact is:

> Västerås: Olycka E18 vid Trafikplats Västjädra väg avstängd välj annan väg. Mot V-ås välj v553 från V-ås v 553 via Skälby. Tipsa på 08-4100 96 90

The message tells: in the vicinity of Västerås there has been an accident on the road E18 by highway service area Västjädra and that the road is closed. If going towards Västerås choose road 553, if leaving Västerås take road 553 via Skälby.

6. Implications for design

From our understanding of the services we draw two implications concerning the subscriber-to-subscriber feature of message reporting; and that a roadside-location-dependent messenger should support centralized editing of content. Moreover, from the survey of messages we also conclude the following design issues: a format suitable for reporting activity must yield many degrees of freedom and yet accommodate reporting while driving; place may be determined by positioning technology, but should also support easy interpretation of the particular coordinates they deliver; and finally, impact implies the duration of the activity.

6.1 Message reporting

In the speed trap services we have examined, reporting is possible by all subscribers and addresses all other subscribers taking interest in the same region. We see subscriber-to-subscriber feature as a strong indication that the messenger may be designed as a peer-to-peer concept. Yet, distribution of roadside messages only concerns a particular region. More so, we note that reporting a place dependent message and receiving it is highly related. Theoretically, the sender and the receiver are in proximity not only of the position in question but also each other. This is not always the case as the original sender and some receiver approaching this position may be separated by time or heading. Still, proximity networking allows *epidemic* distribution [13] of messages. By indirect delivery, that is, a message may hop from one car to the other; messages may be delivered to cars out of proximity. For instance, in the case of a wide caravan of cars, a meeting car would carry the message from a car in front to the back of it. This approach has affects our choice of underlying networking technology. We suggest the messenger be designed having similar peer-to-peer and wireless ad hoc networking technology to Hocman (Esbjörnsson et al, 2004).

6.2 Editing content

On the other hand, to avoid ploys and spam and keep the service interesting, the collection messages may need a manual looking-over. Furthermore, having our discussion on source of messages in mind, some useful messages may need to be added independent of location. In any case, adding and editing of content is most practically achieved using client/server networking, where messages are kept at a common repository. Using such we may also increase probability of receiving a messages by for instance, users uploading some messages for others to download. Also centralization also gives means to let user communicate in addition to the core exchange of message, for instance, commenting on a particular message in a chat style. A centralized approach best fits universal access networking, such as GPRS. However, relying on centralized computing alone, the messenger would quickly run into issues of retrieving, filtering and problematic mass accumulation of messages. As such, we believe combining pure peer-to-peer proximity with centralized and universal access networking into a hybrid solution, where the first would complement the latter and vice versa.

6.3 Flexible reporting format

The messages show that even in the case of a service that concerns only one specific activity many variations are used to describe it. And as the messenger is aimed at supporting any topic concerning roadside knowledge it needs many degrees of freedom in the reporting format. Furthermore, reporting via graphical user interfaces such as texting SMS messages or entering forms on WAP or web pages as demonstrated by these services goes against design recommendations for in-vehicle interfaces (European Commission, 1998). We believe an appropriate reporting format capture the reporter's voice. Audio allows any topic and seems better fit with driving. Reporting and hearing a message does not compete with the visual cognition that driving undoubtedly requires.

6.4 Positioning technology and place descriptions

As we have seen much effort has been put into the place descriptions and they constituted the larger part of the messages. We strongly believe in combining activity descriptions in the form of voice memos with the position, where the memo was recorded, into a *place memo* (Esbjörnsson and Juhlin, 2002). Furthermore, these positions may be accurately pinpointed with modern positioning technology, such as GPS. More so, using positioning and tracking the users current location, we may filter the messages and only play them immediately prior to coincide with its associated position. This is obviously and improvement from the SMS services, which deliver messages regardless of the

subscribers' positions. On the other hand, coordinates are rather difficult to interpret. A string of digits denoting longitude and latitude they are not obviously coupled to our traditional notion of places. As such they are hard to include in route planning or communicating by other means. We will therefore investigate several approaches to this issue. First, naturally voice memos also accommodates place descriptions i.e. a spoken description of the place. However, as such they would be also obscured and a user would have to listen to the message to learn it. Second, obviously the messenger may draw the corresponding coordinates of the place memos on a map. However, similar to GUIs for reporting messages, maps are not optimally aligned with driving. Finally, there is also a possibility to extract information from digitalized maps concerning the context in which the place memo is embedded and perhaps automatically produce a simple textual phrase describing the place in terms of geographical and named locations. In principle, this would work similar to a "reversed" gazetter (Hill, 2000), that is, the reverse process of finding geographical meaning (postal address, or coordinates) of textual descriptions of locations.

6.5 Removing messages

SMS is a best-effort medium and such it gives no guarantees: a message may arrive; arrive late, or not at all. Furthermore, when a message has left the provider there are no means to undo it and take it back. This means a subscriber may be flooded with irrelevant messages i.e. reports on events that long ago has ended. This is particularly acute in the case when a subscriber has limited the number of receptions per day. For example, if the subscriber turns on the mobile phone mid-day he or she could en up with only receiving warnings from the morning. We believe the impact is given in the messages to cope with some of these deficiencies. By including it, the user is helped in determine irrelevant messages. This yields an interesting design challenge also for a new messenger and it is an open question on how to best approach it. We may try several strategies to automate this; the messenger may simply include some function that let user to specify the time-to-live duration. Another possibility is to remove place memos when they are far from where they were reported.

7. Discussion

The implications for design will yield a system different than approaches encountered in the related work. The E-graffiti system is based on textual information and similar to the interfaces of the services in this survey. Reading and entering textual information is not optimal for in-vehicle use. GeoNotes explores filtering issues in location-dependent systems. Accordingly, filtering may well be an issue with a large deployment of messengers. On the other hand,

the statistics we have gathered on the timing and geographical distribution of messages seems that filtering is a subordinate concern. On average the number of messages per time and region is low. Splitting geographical scope into several smaller locations, which is demonstrated by the Nowegian provider, can always lower an unmanageable number. Furthermore, the messenger combines location-dependant computing with proximity networking. As such physical movement of cars will work as a filter and effectively limiting burden of unrelated messages irrelevant to the user's current location. It will on the other hand also decrease the probability of successfully distributing place memos in time prior to other users coinciding with that location. If the messenger is to rely only on direct and indirect distribution using proximity networking yet working as intended, the concept needs a certain level of deployment.

This study demonstrates an interest in communicate while driving with other drivers potentially in the close proximity. The bumper sticker surveys also yields insights in this matter. However, decals on bumpers of automobiles work on an inherently different level. Compare the effort, incentives and objections in sending an SMS text message with gluing a decal on the bumper. Certainly there is seems to be more aspects at stake in the latter. Also the decals are personal expression, the practice studied here concerns transient location-dependant knowledge. You may argue both contain similar aspects of declarations and reinforcements of community membership, but speed trap reporting requires repeated work. Furthermore, the studies of teenagers' use of SMS messages are inherently different from the practice we outline here. Again, these services do not enable personal expression. More so, given the timing of messages the subscribers are probably adults working in logistics or transportation. Finally, in line with this, given that SMS is largely accessed through mobile phones, this study also demonstrates a case of personal mobile technology that accompanies their users into their working practice and more interestingly: into their cars.

8. Conclusion

We have presented a survey including four speed trap SMS services in three countries of Scandinavia and the messages they distribute. The survey motivates designing a roadside-location-dependent messenger with a broad scope including reports on all sorts of activities. Furthermore, through them we have learnt five issues to address in designing such service. These issues concern: message reporting; editing content; flexible reporting format; positioning technology; and removing of messages.

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