eCall Discussion Paper

Executive Summary

eCall is an automatic in-vehicle emergency call service developed in the European Union. An eCall-equipped vehicle has a terminal with satellite positioning, wireless communications and sensors for detecting crash, rollover and fire. When an accident has occurred, the terminal will dial the **public safety answering point,** ("The 112" Emergency response centre in Finland) hereafter referred to as **PSAP.** The terminal sends the PSAP information on vehicle position and type of accident and opens a voice connection between the vehicle occupants and PSAP operator.

An incoming eCall is recognised automatically at a PSAP, and the included data set is decoded. The PSAP operator gets the vehicle location and accident details visualised on-screen when the telephone call to the vehicle is opened. Even if the occupants in the vehicle are unable to speak, information on the accident has been received. The emergency response can be initiated and necessary emergency response units are sent to the accident scene immediately. When the eCall system has been implemented EU-wide, annual savings are estimated to be at least 2 000 less road fatalities, and about 20 billion euros less on health and societal costs each year.

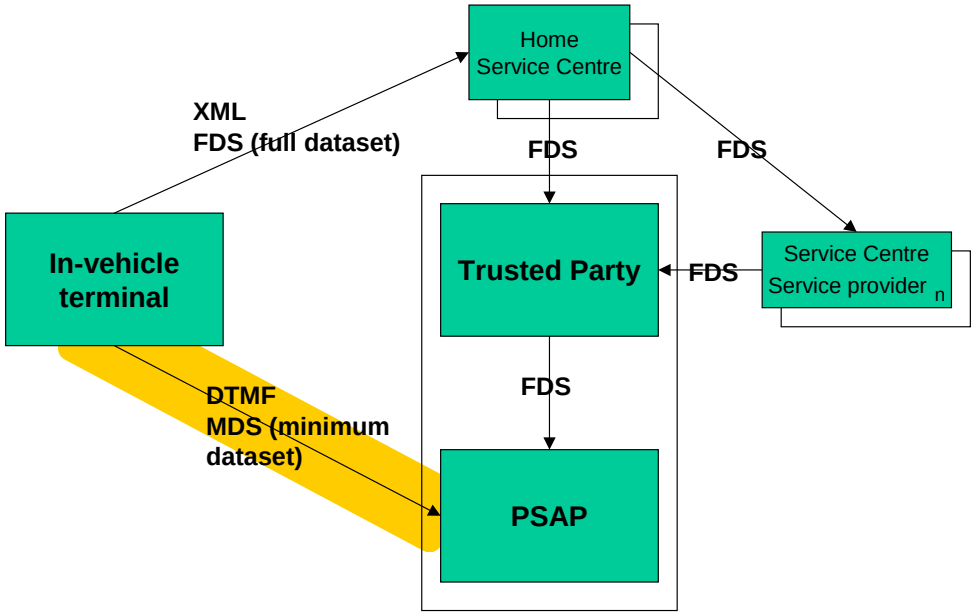
The message sent within the emergency call contains a **minimum data set (MDS)**: location, speed, driving direction, vehicle type, cargo type and a vehicle terminal identifier. The terminal can send a larger set of data via mobile data connection (e.g. GPRS) to a **service centre**, which is able to reroute the **full data set (FDS)** to the PSAP.

Finland has an excellent opportunity to implement the eCall interfaces at the emergency response centres simultaneously with the emergency response centre renewals. The Finnish Emergency response centre information systems are being upgraded, and this will enable nation-wide eCall coverage within the next couple of years. VTT Technology Research Centre of Finland has implemented an eCall test bench to support equipment manufacturers with testing their terminal communications capabilities before the eCall service has been officially implemented. eCall activities are supported by the Ministry of the Transport and Communications and Ministry of the Interior.

Finland strongly supports the rapid implementation of pan-European eCall. Finland sees in eCall both significant societal impacts as well as export opportunities for the local business. To reach the goal, the following principles are set by the Finnish eCall experts:

1. Vehicle to PSAP communications are implemented using existing communications technologies, networks and standards
2. Service centre to PSAP messaging is secure and, at the same time, enables free EU-wide competition of service centre business
3. EU-wide interoperability of terminals is ensured by creating an EU-level terminal certification procedure
4. EU member states agree on a rapid EU-wide interoperable implementation of eCall at PSAPs
5. eCall terminal will be made mandatory on all vehicles in a rapid schedule

1. Vehicle to PSAP communications are implemented using existing communications technologies, networks and standards



In order to rollout eCall services in 2-3 year time scale, all required telecommunications need to be available now

> *The EU-wide GSM network already offers means for emergency messaging. Finland is proposing DTMF coding for MDS delivery, already supported by current telephony networks and GSM terminals. The EU process recommends use of UUS-service.*
>
> ***The Finnish eCall experts support the use of DTMF and prefer its use to the implementation of UUS.***

Both technologies set certain limits for message length (MDS length of 20-30 bytes) in order to keep message delivery time short (20 byte message using DTMF can be delivered in 5-7 seconds).

DTMF –messaging: Short description

DTMF (Dual Tone Multi Frequency) is a technology used for delivering short messages from a telephone to a receiving service or a mobile services switching centre. DTMF is used in various telephony services (”Dial 1 if you wish to contact help desk”, “please type in your PIN code”). DTMF is delivered in signalling channel from a GSM-terminal to a mobile services switching centre, thus making it extremely reliable messaging within a GSM network. DTMF is already implemented and available in all GSM networks and thus does not require new standardisation or technology. This makes using DTMF for eCall cost-efficient and quick to implement EU-wide.

DTMF messaging from a vehicle terminal to a PSAP system has been successfully trialled in Finland. The pilot used the following 19-byte minimum data set:

Bytes	DTMF Signals	Content	Description
1	1-2	Header	Message type (5 bits) + version (3 bits)
2	3-4	Situation	Status (5 bits) + vehicle type (3 bits)
3	5-6	Cargo	Cargo code
4-10	7-20	ID	MSID (IMEI, IMSI or MSISDN)
11-13	21-26	Latitude	WGS84 latitude in degrees (decimals)* 2^16 (Signed -90 90)
14-16	27-32	Longitude	WGS84 longitude in degrees (decimals)* 2^15 (Signed, -180 180)
17	33-34	Speed	Km/h (0-254 and 255 when v>= 255)
18	35-36	Heading	In degrees * 255 / 360
19	37-38	Checksum	CRC-8

It is recommended that a 20th byte would be reserved in the message for further / optional use.

The individual bytes in each of the MDS data elements are converted to two DTMF signals using the following table.

	1st DTMF signal															
2nd DTMF signal	0	1	2	3	4	5	6	7	8	9	a	b	c	d	#	*
0	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
2	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
3	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
4	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
5	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
6	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111
7	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127
8	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143
9	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159
a	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175
b	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191
c	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207
d	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223
#	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239
*	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255

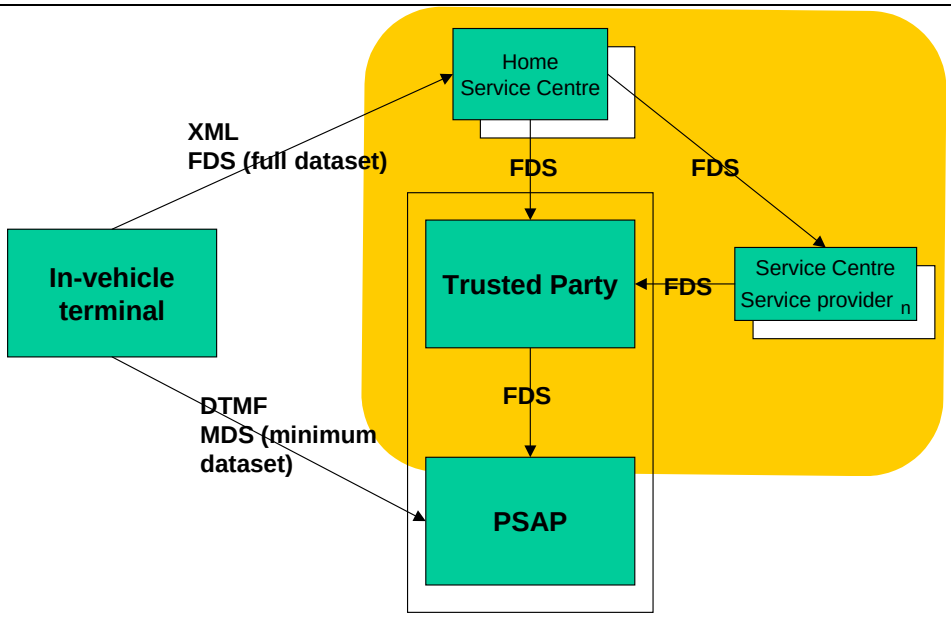
UUS-messaging: Short description

An ISDN value-added service UUS1 (User to user signalling) enables a two-directional limited length message (UUI) delivery from a terminal to another during the call setup. UUS is standardised for both fixed networks and GSM.

UUS service has not been implemented in all EU member states. The main reasons have been the lack of commercial need and fear of fraudulent use. The current GSM standards for emergency call setup message do not include a UUI field, so implementing UUS for eCall requires altering current GSM standards.

EU-wide implementation of UUS for eCall would take several years. Implementation requires telecom operators investing in telecommunications network infrastructure.

2. Service centre to PSAP messaging is secure and, at the same time, enables free EU-wide competition of service centre business



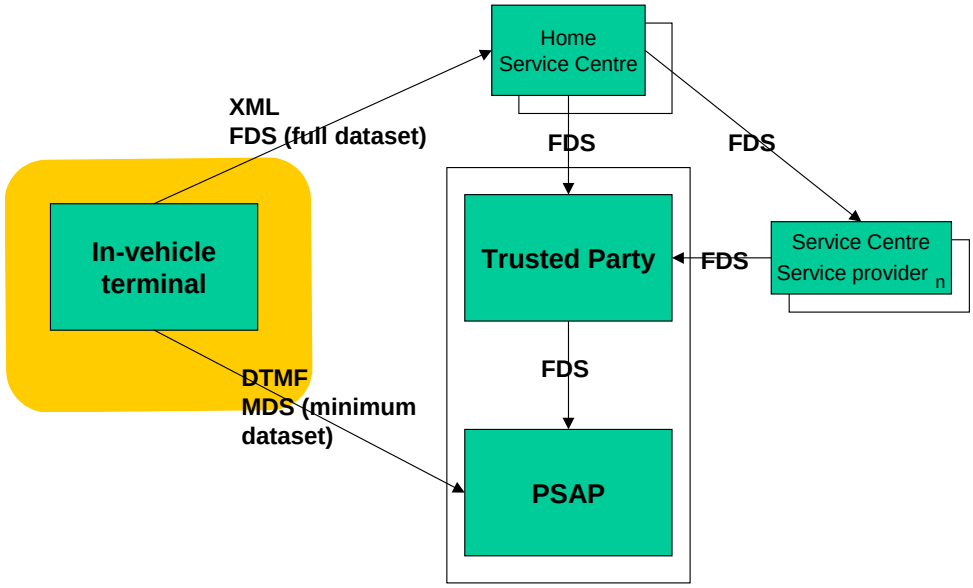
Trusted-party principle

The solution must guarantee safe operation of PSAP systems and interfaces. It is essential that mechanism for delivering the MDS to the correct service centre and PSAP is agreed upon. A common solution must also be reached for reliable recognition of information exchange actors. Information exchange to a PSAP must only be allowed for a trusted party. The trusted party may send (push) a full dataset to the PSAP, or the PSAP can request (pull) an FDS from the trusted party using an eCall terminal identifier.

> *The solution can be implemented in Finland simultaneously with the renewals of emergency response centres. Nationally the simplest solution is to create a single national trusted party to cater for information exchange between multiple service centres and national PSAPs.*

For secure operation of a PSAP it is essential that allowed communications mechanisms (service provider addresses, login details, encryption protocols et cetera) are strictly pre-determined. On national levels this can be easily agreed upon. In an EU-wide implementation, all European PSAPs must have capability of receiving both the MDS messages directly from the terminals as well as FDS messages rerouted form service centres via a trusted party.

3. EU-wide interoperability of terminals is ensured by creating an EU-level terminal certification procedure



An EU-wide certification procedure makes consumers more aware and confident towards the eCall service. The certification also lowers the barrier for authorities, insurers and other parties to offer incentives that enable more rapid rise in terminal penetration rate.

The Finnish eCall comms test bench is a step towards a test facility for the European eCall terminal certification procedure. A more comprehensive test facility requires an EU-level decision, and member states co-operation. The task is too large to be taken up by a single member state. The certification procedure needs to be taken into account in the eCall implementation plan.

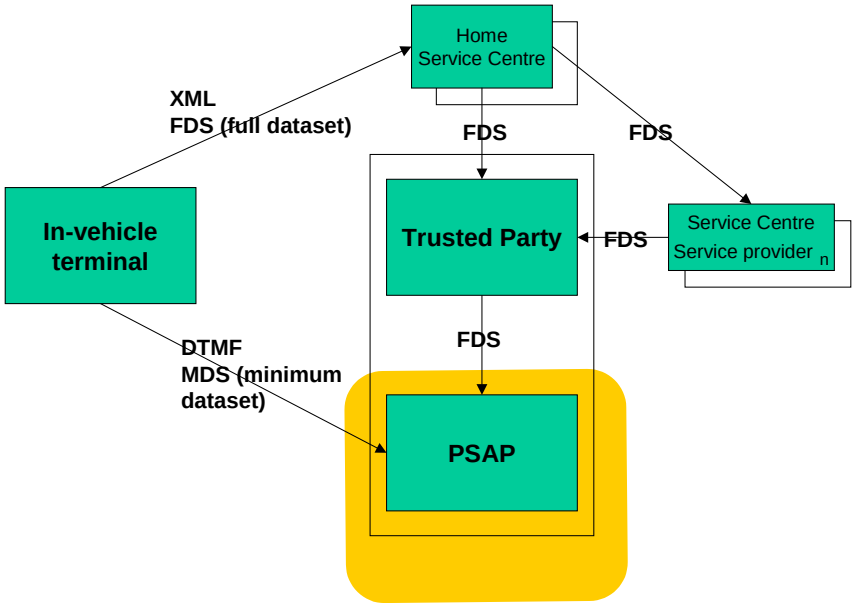
The certification procedure needs to be based on existing standards and procedures. The procedure must certify the eCall terminal operates according to the criteria set for the certification. The procedure can be based on the following stages:

1. **Pre-certification**
   - EMC & interior safety approval (1995/54/EC and 74/60/EC)
   - When applicable the following terminal interface specifications
     i. Antennas, external sensors, vehicle bus
     ii. Vehicle installation matrix
   - Technical description of the eCall terminal for pre-certification approval

2. **Application tests**
   - Test runs carried out in real vehicle environment
     i. **Manual initialisation** of the eCall function
     ii. **Manual initialisation** of the eCall function with an additional all resources consuming application running in the same terminal
   - Laboratory environment tests for the following mandatory eCall functions
     a. Airbag detection
     b. Rear impact detection
     c. Side impact detection
     d. Frontal impact detection
     e. Rollover detection
     f. Temperature rise (fire) detection
   - Vehicle installation quality + documentation

3. **Environmental tests**
   - Test runs carried out in laboratory environment (successful transmission of 10 MDS & FDS messages + voice connections during the environmental test) for following conditions:
     a. High ambient temperature
     b. Low ambient temperature
     c. Loss of external power source
     d. Impact resistance
     e. Vibration resistance
     f. Temperature and humidity cycling
     g. Mobile data services not available

4. EU member states agree on a rapid EU-wide interoperable implementation of eCall at PSAPs

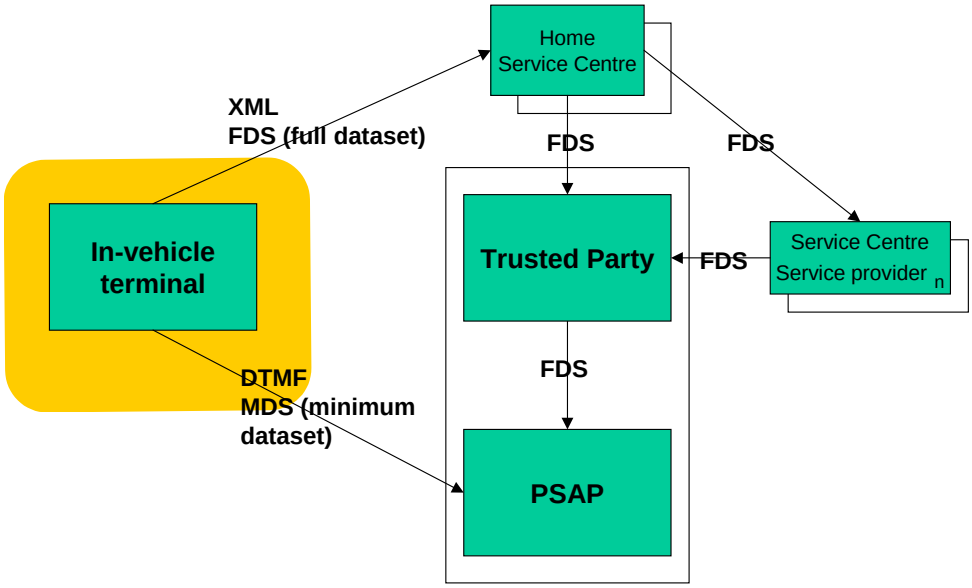


Only an EU-wide market will offer the users affordable mass-market terminals. Finland, or other small countries, will not create large enough market potential for true mass-market terminals, and would only result in unaffordable terminal costs for the masses, and danger the benefits of eCall. eCall MOU needs to be signed by the ministries or other relevant public authorities responsible for PSAP operation in all EU member states by the end of 2006.

> *The public infrastructure and services implementations required by eCall in Finland are closely linked with the emergency response centres renewal process, planned to be completed nation-wide within the next couple of years.*

All the EU member states need to upgrade their PSAP functionalities for the E112 implementation. However, the largely different implementations of PSAPs in Europe hinder EU-wide implementation of eCall if a high-level agreement between member states is not reached.

5. eCall terminal will be made mandatory on all vehicles in a rapid schedule



If eCall is introduced only to new vehicles, reaching full penetration of eCall terminals will take over 10 years. Significant societal costs however only occur at high penetration rates. Vehicle owners should be encouraged to purchase terminals to used vehicles (after-market devices).

Finland is investigating the societal costs and benefits of rapid eCall implementation and economical possibilities in financially encouraging the consumers to purchase eCall after-market devices

This discussion paper has been produced by:

Tuomo Eloranta *Finnish Road Enterprise*
Raine Hautala *VTT Technical Research Centre of Finland*
Mikko Weckström *Indagon Ltd.*
Antti Raino *ITS Finland*
Reetta Jokinen *WSP LT Consultants Ltd.*