ISITEP
D7.1.4 – FINAL DEMONSTRATOR TEST RESULTS

Document Manager:	Jens Petter Johansen	DNK	Editor

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Project Coordinator:	LEONARDO
SP Leader:	MOT

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Prepared by:	Jens Petter Johansen (DNK)
Approved by (WP Leader):	Marianne Storrøsten (DNK)
Approved by (SP Leader):	Steen Petersen (MOT)
Approved by (Coordinator)	Paolo Di Michele (LDO)
Security Approval (Advisory Board Coordinator)	Etienne Lezaack (BFP)

CONTRIBUTING PARTNERS

Name	Company / Organization	Role / Title
Michel Duits	DNK	Contributor
Marianne Storrøsten	DNK	Contributor
Jens Petter Johansen	DNK	Contributor
Anita Galin	MSB	Contributor
Magnus Bergqvist	MSB	Contributor

DISTRIBUTION LIST

Name	Company / Organization	Role / Title
Marianne Storrøsten	DNK	WP71 participant
Anita Galin	DNK	WP71 participant
Steen Petersen	MOT	WP71 participant
Jaakko Saijonmaa	ADS FI	WP71 participant
Dimitris Androutsopoulos	NETFI	WP71 participant
Federico Frosali	LDO	WP71 participant
Etienne Lezaack	BFP	WP71 participant
All Company Project Managers	All involved companies	Members of the Steering Committee
Elina MANOVA	EC DG REA	EC Programme Officer
General Public	NA	NA

REVISION TABLE

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V0.1	14/10/15	All	All	Initial version
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Publishable extended abstract

This deliverable documents the technical results of the second demonstrator run (Multi Agency demonstration). The demonstrator final run was conducted as part of a live cross-border exercise 16. November 2016 in Meråker/Storlien area. The exercise was run on ISI interconnection between the live networks of Nødnett and Rakel. The deliverable documents the technical setup and traffic data from the exercise.

CONTENTS

1. INTRODUCTION

WP 7.1 aims to demonstrate the feasibility of a multiagency cooperation scenario using the ISITEP framework: bilateral agreement, cooperation procedures and migrating terminals functionality enabled by network interoperability. Specific objectives include:

- Verification of ISITEP procedures and processes for cooperation and communication cross border

- Evaluation of cross border communication services available through TETRA interoperability (group calls, one to one calls, short data message communication) for all involved radio users.

- Detailed measurements of the traffic and services used during the demonstration

- Evaluation of all ISITEP developed items (procedures, processes and template agreement)

- Evaluation of the implemented TETRA ISI solution and the ISITEP Functional model with the fleet map configured in the networks

In deliverable D7.1.1 the demonstrator plan and requirements were described. In deliverable D7.1.2 the scenario design, test procedures, scenario technical design and security configurations were documented. In D71.3 the test results for the demonstrator first run (First ISI Group Call, test session Strømstad and test session Charlottenberg) was described.

The work of the task to be documented in this deliverable D71.4 are similar to the task to the first run (task 7.1.3):

- Event organization and dissemination activities

- Verification of supporting tools (training, dimensioning tool, business evaluation tool)

- Scenario network

- Implementation and preparation

- Scenario terminal implementation and preparation

- Scenario services implementation and preparation

- Technology pre-test

- Evaluation of performances

- Scenario execution

- Test results

Most of the task activities are preparatory activities to ensure the live exercise. This deliverable documents the results of the second run test (live end-user exercise in Storlien 16. November 2016) and is focused on the technical outcomes. References are made to D71.1 Demonstrator Plan and Requirements and D71.2 Demonstrator Design for descriptions on the second run scenario, participants and technologies involved.

References are also made to D71.3 Demonstrator Implementation and Test First Run, D31.1 PPDR Framework Standard Model and Template Agreements, D31.2 Norway-Sweden Agreement, D32.1 Functional Model and D33.1 Handbook of PPDR Procedures for input deliverables to make this final demonstration possible.

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2. DEMONSTRATOR SCENARIO

2.1. Background

The demonstrator final run aimed to showcase the interconnection of the two live TETRA networks Nødnett (Norway) and Rakel (Sweden). The ISITEP demonstrator was a real field exercise for the end-users conducted on the border between Trøndelag, Norway and in Jämtland, Sweden on November 16, 2016. In the exercise the technology as well as procedures for a joint operation between public safety agencies from the two countries were played out. This was a real field exercise for the end users using Norway and Sweden operational TETRA networks, terminals, control rooms and real end-users capabilities (fire trucks, police cars, ambulances, helicopters with full set of rescue equipment). The added value of TETRA ISI was tested in a real major accident exercise.

In the following sections the technical set-up, technologies involved, scenario and traffic data results are presented.

2.2. Technical setup for the demo

TETRA ISI architecture in the WP7.1 Norway-Sweden cross border collaboration exercise is the basic ISI case of connecting two operative networks, as shown in figure 1.
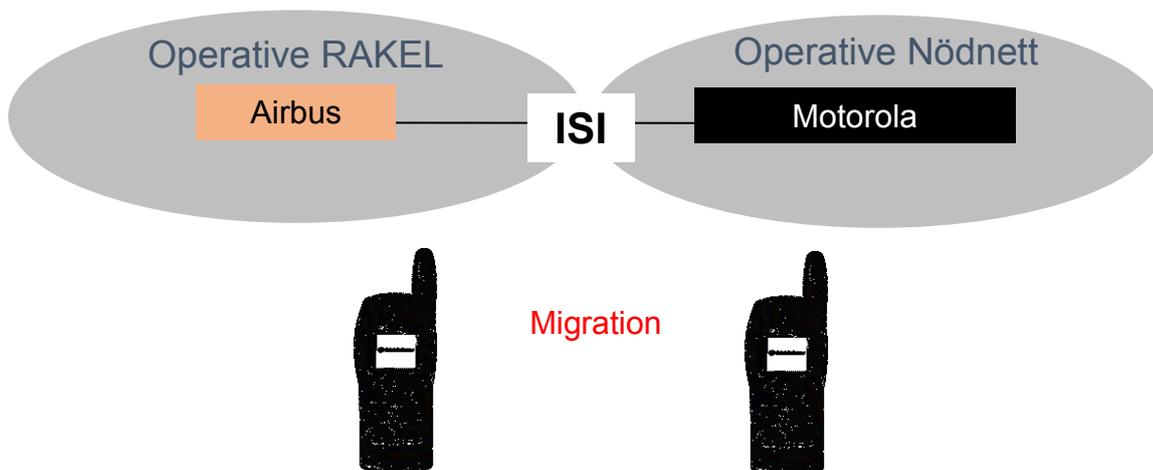

Figure 1 : Interconnection setup for Norway-Sweden ISI

The ISI requirements of the Norwegian and Sweden users were extensively studied during the ISITEP project in 2013-2015, matching the functionalities and way of use of RAKEL in Sweden and Nödnett in Norway. Consequently, a specification for the interoperability was agreed between the two operators and two manufacturers.

The ISI solution was implemented, tested and verified between the manufacturers in scope of WP 47.

An official IOP session with ISCOM was conducted on October 2016 between Airbus and Motorola, (also as part of WP 48). For the referred ISI functions included in the IOP session, see figure 2.

The implemented ISI solution between the operative networks Nødnett and Rakel has been extensively tested by DNK and MSB and emergency service end-users before the solution was

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decided as ready for training and demonstration in a cross-border field exercise. Key preparatory activities, overview of the three test events and test results are described in D71.3.

IOP function	Use case between Norway and Sweden
Migration	Terminal migration to/from foreign SwMI
Individual Call	Individual call between any terminal located in any SwMI
Telephone Call	Inbound telephone interconnect for visiting foreign terminals Outbound telephone call handled locally by visited SwMI
Individual Short Data	Send SDS from terminal to terminal/fixed host: from any terminal located in any SwMI
Group Short Data	Send SDS from terminal to local linked group (with limitations)
(Individual Status)	Show rejection of Individual status messages
Group Status	Send Status from any terminal to local linked group
Group Call	Group call between any terminal located in any SwMI
Group Combining	Patching of homed talkgroups to linked talkgroups
Emergency Call	Emergency Group Call between terminals and dispatchers in any network
Authentication	Authentication of visiting terminals
Encryption	Delivering key material for Air Interface Encryption

Figure 2 : ISI functions included in the IOP session

Further descriptions and aspects of the network interconnection setup for the WP 71 demo will be found in the following ISITEP deliverables:

- D32.1 Functional Model
- D41.3 Procedures for Interoperability testing and prototype test reports
- D42.3 E1 ISI Tetra gateway prototype for demonstrations, final release
- D47.4 Test report of integration and testing of network interconnections
- D48.1 Procedures for testing interoperability and test reports
- WP 71 planning documents
    - o D7.1.1 Demonstrator Plan and Requirements
    - o D7.1.2 Demonstrator Design
    - o D7.1.3 Demonstrator Test Results first run

- D76.1 ISITEP demonstrations joint internal assessment report, first version

The ISI IOP certificate between Motorola and Airbus is available at the TCCA homepage: http://www.tandcca.com/interoperability/22310-2/

2.3. Use cases included in final demonstration

The final demonstrator run included several testing several features in one single exercise. The deployed ISI network functionalities that were successfully used in the demonstration were:

- Provisioning of visiting users TETRA terminals with the needed rights to communications services in visited networks

- Migration and home authentication key support for terminals, migrating between TETRA networks

- Migrated TETRA terminal continued connection and use with home control rooms while migrated into foreign network

- Migrated TETRA terminal communication in joint international talk groups with foreign terminals in foreign and home TETRA network as well as with other home terminals in home and foreign TETRA network

- Control centers cross border and national NCP´s to communicate in joint multinational groups and with operational users in the field

The final run of the Multi Agency Demonstration was a live field exercise. For the purpose of the exercise, a subset of ISI functionalities were in use during this event:

- Group calls: Talk group communication in static linked talk groups (both multi-agency and agency specific talk groups).

- Migration of radio terminals: Air Interface Migration

This implies that while most of the use cases were a part of the live exercise in Trøndelag, some technical features of ISI were not tested during this event (for example SDS, individual call, emergency call, status codes). The results on the specific use cases during the exercise are listed in the table below:

Number	Use case	Success / failed	Comment
1	End-users from Norway and Sweden within the same agency can communicate in agency specific ISI talk groups. This communication must work:	Success	
1a	When end-users are in two different countries (and different networks)	Success	
1b	When end-users are in the same country (same network)	Success	
2	End-users from Norway and Sweden from different agencies can communicate in multi-agency	Success	

	talk groups	
2a	When end-users are in two different countries (and different networks)	Success
2b	When end-users are in the same country (same network)	Success
3a	Swedish end-users can migrate with their Rakel-radio terminals to Nødnett (both by automatic and manual migration)	Success
3b	Norwegian end-users can migrate with their Nødnett-radio terminals to Rakel (both by automatic and manual migration	Success
3c	Users who have migrated to the other country can communicate back to their home control room dispatcher.	Success
4a	Norwegian control room dispatcher can group-combine/patch national talk group with the international ISI talk group	Not part of final demonstration
4b	Swedish control room dispatcher can group-combine/patch national talk group with the ISI international talk group	Not part of final demonstration
5a	When Swedish end-users press the emergency alarm in Norway, the alarm and their position will be sent to their home control room or to the nearest agency control room	Not part of final demonstration
5b	When Norwegian end-users press the emergency alarm in Sweden, the alarm and their position will be sent to their home control room or to the nearest agency control room	Not part of final demonstration
6	End-users from Norway and Sweden can make individual calls. This communication must work:	Success
6a	When end-users are in two	Success

	different countries (and different networks)	
6b	When end-users are in the same country (same network)	Success

Figure 3 Use cases included in the multi agency demonstration

2.4. Cross-border exercise and scenario

The ISITEP demonstrator was part of a full-scale field exercise conducted on the border between Trøndelag (Norway) and in Jämtland (Sweden) on November 16, 2016. This implies that personnel from both countries participate in a realistic scenario for cross border collaboration in this region. The local end-user organizations planned the scenario and playbook in detail. The scenario mainly consisted of two incidents along the E14 at Meråker in Norway and across the border in Sweden:

- Two busses with many passengers have been pushed off the road, one overturned, on the Norwegian side of the border.

- It is later discovered a car which has overturned on the Swedish side of the border where the drivers have escaped from the scene – initiating a search and rescue mission.

The incident involves the Swedish emergency services coming into Norway and that Norwegian emergency services are going to Sweden. Swedish units were asked to respond across the border to assist in the rescue of passengers, traffic control and to limit material damage. Both Norwegian and Swedish units were called to participate in the search and rescue mission.

The exercise scenario was based on a detailed playbook planned by the local end-user exercise group. Below is an excerpt of the playbook at large with the estimated times of the main events in the scenario, and the means of communication (telephone/ISI talk groups).

Time	Events	Communication
11:01	Message about a stolen car in Stjørdal, Norway	Phone
11:05–11:15	Message from witness to a bus crash. Two buses involved. Triple warning to Norwegian emergency services (police, fire/rescue, health/ambulances) Requests for assistance from Swedish emergency services (ambulances, fire/rescue, police)	Phone Phone All go to NOSE-EM-5
11:17-12:15	Transport and arrival of emergency units First unit on site ETA 11.25 First Norwegian helicopter ETA 11.35 First Swedish helicopter ETA 11.45 (diverted due to other urgent mission)	NOSE-EM-5
	Rescue activities continue till the end of the exercise	NOSE-EM-5 - commanders NOSE-P-5, NOSE-H-5, NOSE-F-5 NOSE-H-7 patient info
	(Guests/observers arrive 11.20, depart 12.25)	

12:30	Request for Norwegian assistance in searching for people in Sweden	NOSE-P-3
13:00-14:00	Search for missing people in Sweden	NOSE-CO-6 NOSE-P-3
14:00-15:00	End of the exercise	

Figure 4 : Time « script » for the exercise

Trial environment

The full-scale exercise was executed near the E14 border crossing between Norway and Sweden. This is in the middle of the two countries as show in the map below.

Figure 5 : Map of Norway and Sweden. The red star marks the exercise area

E14 is the main road connecting the two countries in the Trøndelag/Jämtland area and there were two incident areas on this road; one on the Norwegian side of the border, and one on the Swedish side. The drone photo below shows the incident scene before the exercise started.

Figure 6 : Drone photo from exercise location before execution

Participants

Main agencies involved in the cross border exercise were the Swedish police, health, fire and rescue services, customs as well as the associated control room (SOS Alarm and police control room). From Norway representatives from police, health and fire and rescue participated. In addition the helicopter rescue service (which is important contributors in the Norwegian rescue service) participated in the exercise. In addition local county representatives participated.

Figure 7 below shows number of vehicles that participated in the cross-border exercise:

Norwegian units/vehicles		Swedish units/vehicles	
Fire rescue Meråker	2	Fire/rescue Storlien	2
Fire rescue Stjørdal	1	Fire/rescue Åre	2 + 1
Health Helicopter	1	Health Järpen Ambulance	1
Health Levanger Ambulance	2	Health Krokom Ambulance	1
Health Meråker Ambulance	1 + MD	Health Helicopter	1
Health NLA Helicopter	1	Health Östersund Ambulance	1
Health Stjørdal Ambulance	2	Police Östersund	8
Health Trondheim Ambulance	2	Police Åre	2
Police Stjørdal	3	SOS alarm (112) Östersund	Control room
Police Stjørdal (IL)	1	Police RLC Umeå	Control room
Fire/110 Namsos	Control room		
Police/112 Steinkjer	Control room		
AMK/113 Namsos	Control room		

Figure 7 : Number of units/vehicles during the cross border exercise

3. TEST RESULTS AND CONCLUSIONS

3.1. Evaluation scheme

DNK and MSB had prior to the final demonstration developed a comprehensive evaluation scheme to cover all aspects of the final demonstrator run. The multiple evaluations methods reflects the ISITEP ambition to cover all aspects of interoperability – not limited to technical interoperability.

Evaluation methods:

- *Technical evaluation:* DNK and MSB will conduct a technical evaluation of how the system worked during the final exercise.

- *Traffic data*: As a part of the technical evaluation DNK have recorded traffic data of the base stations covering the incident area of the exercise.

- *User evaluation*: A short survey was issued to the exercise participants one hour after the demonstration was finished. The objective of this survey was to capture the overall experience of how the functionality worked. In addition the survey addresses the added value of the ISI functionality and new procedures.

- *Evaluation events*: A "hot wash-up" was conducted with all exercise participants after the demonstration. This was a one-hour event to capture the immediate responses of how the scenario had played out and how the functionality worked. The day after the demonstration the Swedish and Norwegian end-users in the ISITEP working group had a one-day workshop to evaluate the exercise and address eventual remaining issues within the ISITEP framework.

- *Scenario evaluation*: The multi-agency demonstration was also a live exercise from the local end-user organizations. Each organization had their own exercise goals regarding how to solve the bus-accident scenario. A dedicated group of local end-users worked as controllers during the exercise, taking notes on how the personnel achieved these goals. The scenario evaluation is a local activity that will become a dedicated report finalized in 2017.

- *Analysis of communication practices*: A group of researchers from Nord University and Mid Sweden University was involved in the exercise and listened and recorded all communication on the NOSE talk groups. The research group will use this material to analyze the communication practices between Norwegian and Swedish emergency services. Reports on this worked will be published in a parallel EU-project GSS2 (INTEREG program).

Note that only the technical evaluation, use case results and high-level traffic data is covered in this deliverable. For end-user feedback and general evaluation on the 7.1 work package as a whole, see D71.5 Demonstrator Final Report.

3.2. Statistics from ISI gateway – number of calls during exercise

DNK have gathered statistics from the network to analyze network behavior during the Multi Agency Demonstration (final run).

Number of calls during the cross-border exercise:

- 2361 calls between Rakel and Nødnett
  - 1667 calls originating in Nødnett
  - 694 calls originating in Rakel

The figure below shows number of calls per hour over the ISI gateway during the exercise:
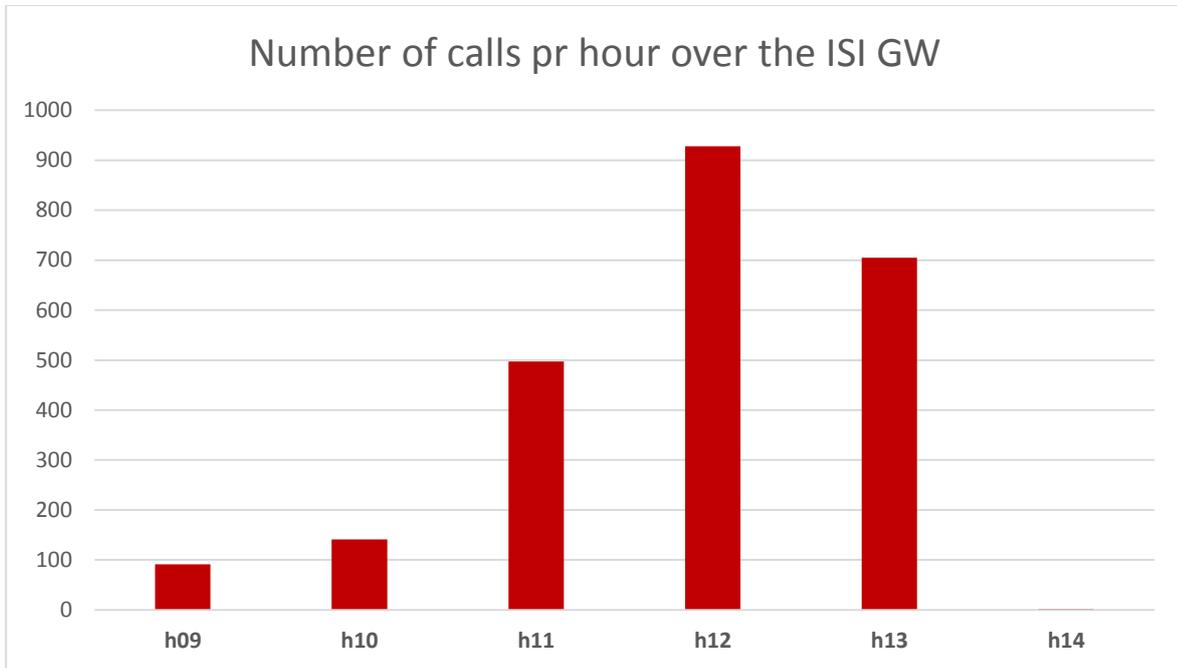

Figure 8 Number of calls per hour over the ISI gateway

The figure below visualize the load per hour on the most active base station covering the exercise area. The blue bars represent the load during the cross-border exercise, compared with the average load the last 6 Wednesdays on the base station (orange bars). Even though capacity used was much higher than regular, there was no recorded block of communication in talk groups or because of capacity in the network. Nødnett handled the exercise load without interruption.
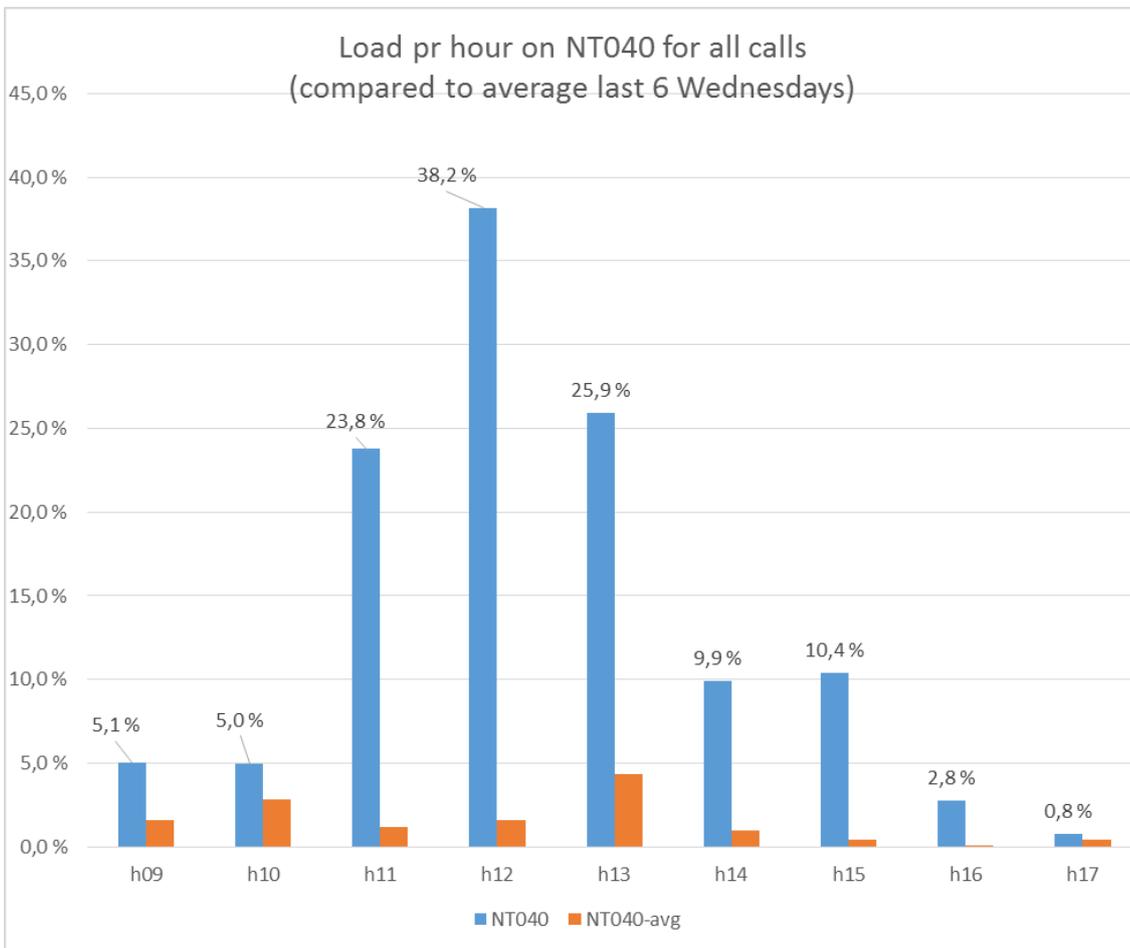

Figure 9 Load per hour on the nearest basestation to the exercise ground

4. REFERENCES

ISITEP reports:

D23.2 End-user requirements document final release

D31.1 PPDR Framework Standard Model and Template Agreements

D31.2 Norway-Sweden Agreement

D32.1 Functional Model

D33.1 Handbook of PPDR Procedures

D41.3 Procedures for Interoperability testing and prototypes test reports

D42.3 E1 ISI Tetra gateway prototype for demonstrations, final release

D47.4 Test Report of Integration and Testing of Network Interconnections

D48.1 Procedures for testing interoperability and test reports

D71.1 Demonstrator Plan and Requirements

D71.2 Demonstrator Design

D71.3. Demonstrator Test Results first run

D71.5. Demonstrator Final Report (end-user outcomes)

D76.1 ISITEP demonstrations joint internal assessment report, first version

Other documents:

Radio terminal requirements for ISI, developed by DNK and MSB
http://www.dinkom.no/Global/Dokumenter/Radio%20Terminal%20Requirements%20for%20ISI.pdf

The ISI IOP certificate between Motorola and Airbus is available at the TCCA homepage:
http://www.tandcca.com/interoperability/22310-2/