

# ISITEP

## D7.1.3 – DEMONSTRATOR TEST RESULTS FIRST RUN TEST

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## REVISION TABLE

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V0.1	14/10/15	All	All	Initial version
V1.0	09/01/2017	All	All	Final version

## **Publishable extended abstract**

This deliverable documents the phases and activities of the first demonstrator run before the Multi Agency demonstration and the test results. The demonstrator first run was conducted in three separate events; the first ISI live group call in June, end-user testing in Strømstad in August, and a rerun of end-user testing in Charlottenberg in September. All tests were run on ISI interconnection between the live networks of Nødnett and Rakel. Between the tests there were technical tests and fixes to make the interconnection stable and to provide full functionality for Norwegian and Swedish end-users before the Multi Agency demo in November 2016.

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## 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. The work of the task to be documented in this deliverable D 7.1.3 is described in the DOW as follows:

- 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

This deliverable sums up the phases and activities of the first demonstrator run of the Multi Agency Demonstration and the test results. The first section provides an overview of the technologies involved in the demonstrator first run. The demonstrator first run consisted of three separate events

1. First ISI Group Call
2. End-user testing Strømstad
3. End-user testing Charlottenberg

This deliverable sums up the key preparatory activities, overview of the three events and test results focusing on the end-user use cases.

ISITEP deliverable D4.2.3 describes the technical setup of the E1 ISI Tetra gateway. Specific test results of the technical performance of the systems references are made to D4.7.4 Test Report of Integration and Testing of Network Interconnections.

This deliverable is also based on D3.2.1 Functional Model, D7.1.1 Demonstrator Plan and Requirements, D7.1.2 Demonstrator Design. This deliverable as well as the test results feeds into D7.1.4. Demonstrator Test Results Final which focuses on technical outcomes of the Multi agency demonstration, and D7.1.5. Demonstrator Final Report which mainly focus on the end-user outcomes of the Multi agency demonstration.

## 2. TECHNOLOGIES INVOLVED IN DEMONSTRATOR FIRST RUN

The demonstrator “first run” consisted of several activities for end-to-end testing on the live networks Nødnett and Rakel. The objective was to ensure that the system would work as an end-to-end service including:

- The ISI gateway on live networks with transmission
- Radio terminals using air interface migration (AIM) with full ITSI and service provided by visiting SwMi
- Control rooms connected to the network
- Static linked talk groups

The different technologies gateway, radio terminal software and control room software had already (and in parallel) been tested separately by the respective vendors (Phase 1, 2 and 3 in D7.1.2 Demonstrator Design). The demonstrator first run was an end-to-end test session with end-user organizations. The updated ISITEP framework model illustrates the technical concept and interoperability of the Norway-Sweden ISI solution as of the demonstrator first run.

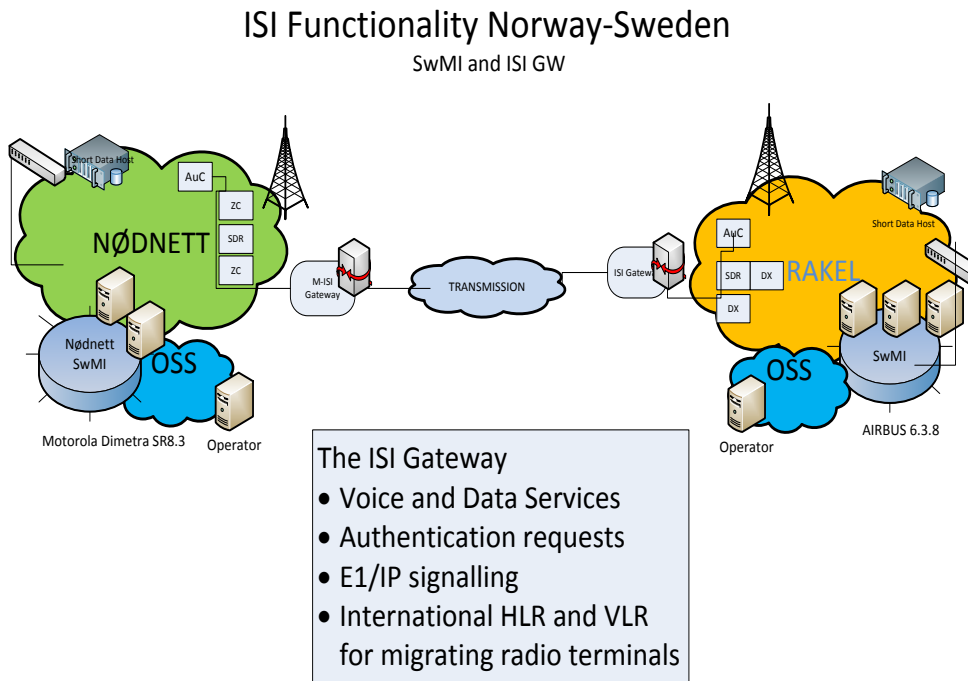
### 2.1. ISITEP Framework Model: Status as of demonstrator first run

	Norway	Sweden
<b>Core network</b>	Nødnett – national 2015 Motorola Dimetra 8.3	Rakel – national 2010 Airbus release 6.3.8.
<b>ISI Gateway</b>	To be delivered with Dimetra 8.3	Delivered with Airbus release 6.3.8
<b>Transmission</b>	sTESTA secure IP network (TESTA-ng) / E1	
<b>Control rooms</b>	ISI compatible software to be delivered Q3 2016	ISI SW upgraded in Swedish control rooms – to be tested
<b>Radio terminals</b>	RT ISI SW development in beta stage 100 RT received for testing/ demonstration	Loan of RT ISI SW
<b>Functional model</b>	Norway-Sweden fleetmap implemented in live networks	
<b>User implementation</b>	Version 1 of procedures and communication guidelines delivered	
	Training material under development	
<b>Legal aspects</b>	Norway-Sweden agreement to be signed 16.11.2016	
	End-user agreements	End-user agreements

**Figure 1 Norway-Sweden Framework Model: Status as of demonstrator first run**

## 2.2. Networks and ISI gateways

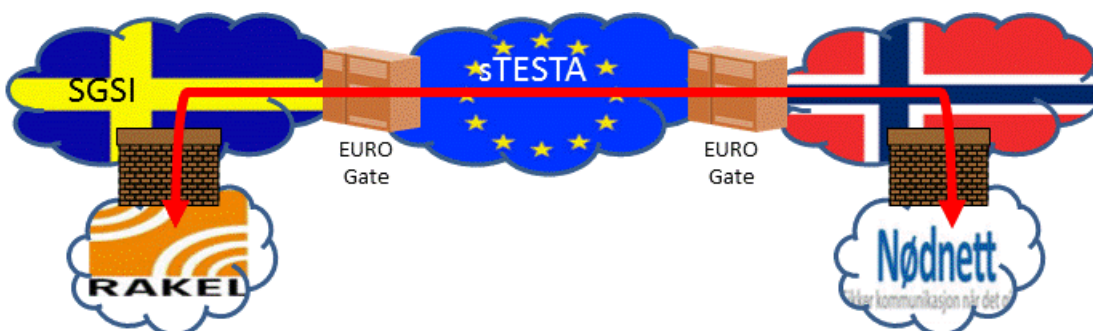
The figure shows the overall concept of the ISI functionality between Norway-Sweden:



**Figure 2 Norway-Sweden networks and ISI gateways**

## 2.3. Transmission between ISI gateways

Transmission between ISI gateways in Norway and Sweden has been implemented. The figure illustrates how the transmission will function over the sTESTA network:



**Figure 3 Norway-Sweden ISI transmission**



As will be explained later it was discovered during the first run testing that sTesta did not deliver required capacity and QoS. Thus, the second and third parts of the first run were using dedicated E1 lines for transmission between Nødnett and Rakel.

## 2.4. International talk groups

Cross border communication is based on static linked international talk groups (TG) providing group call capability using multiple permanent TG's covering both countries.

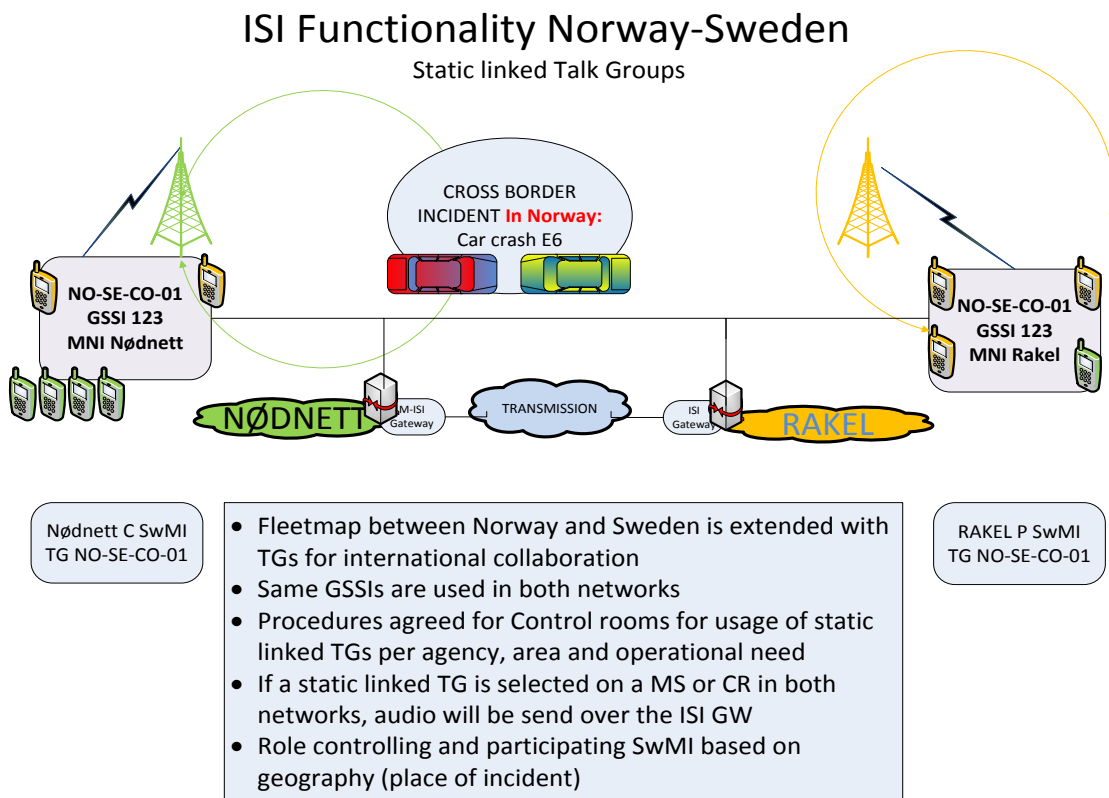


Figure 4 Norway-Sweden static linked talk groups

## 2.5. Norway-Sweden talk group structure

The following talk group structure is developed to be used over the Norway-Sweden ISI gateway:

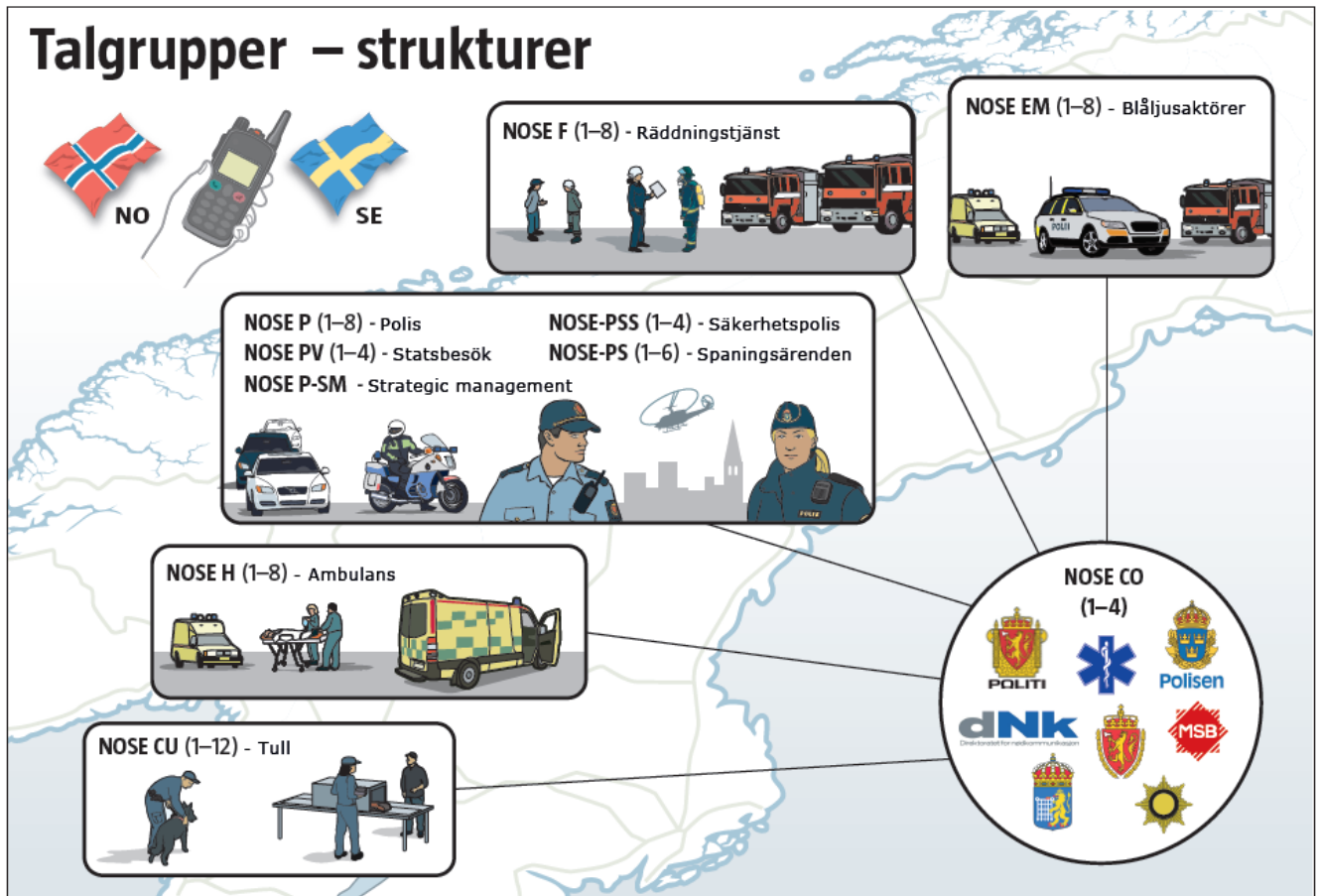


Figure 5 Norway-Sweden international talk groups

Paired NOSE talk groups residing in Nødnett and Rakel will have the same GSSI. Each of these talk group pairs will have a number of groups available and are named NOSE-P-N, where N is a number and the regular police talk groups have up to 8 groups available. All NOSE talk groups will all have national coverage in both networks.

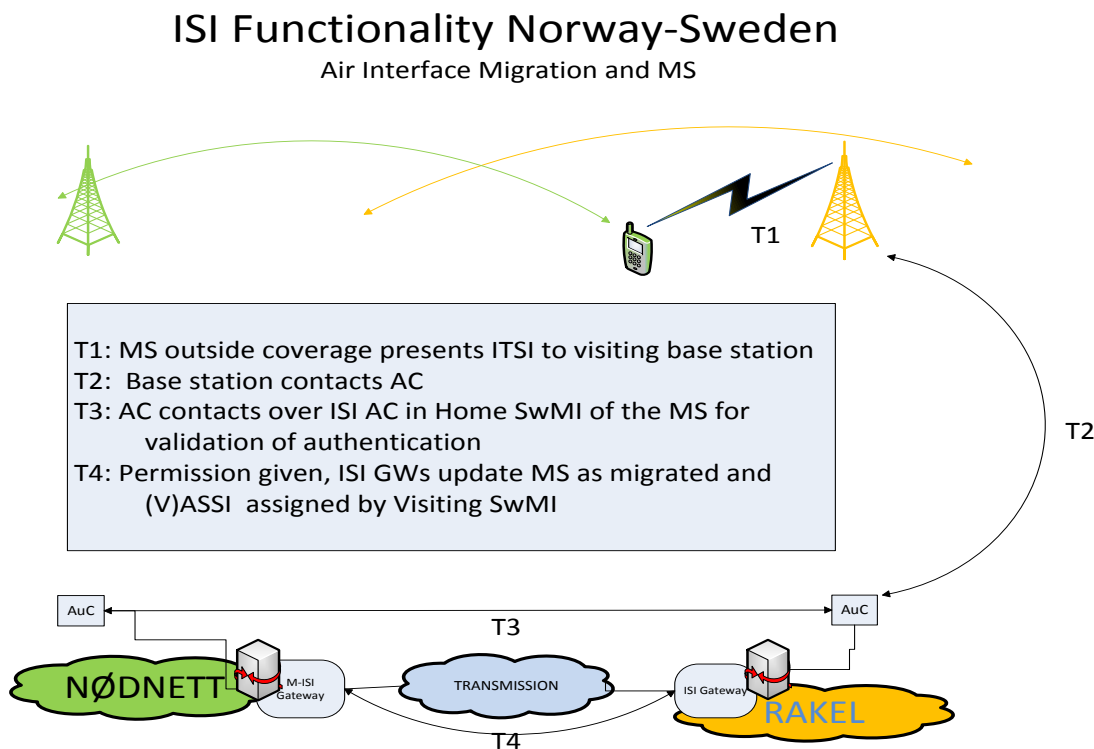
Assignment of talk groups will be made by the Swedish national point of contact, but can be requested and reserved by Swedish and Norwegian national and local control rooms through a common website. Deliverables in WP3.2 Functional Model elaborates on the functional model for Norway-Sweden as well as the website solution for allocation talk groups in more detail.

For the purpose of the demonstrator first run only a subset of the NOSE talk groups was in use for testing. This to provide easy system overview to monitor the test sessions.

## 2.6. Radio Terminals and Air Interface Migration

Cross border mobility is based on Air Interface Migration for the Mobile station (MS) with full ITSI (TCCA TIP TTR 001-06). Some additional terminal functionality defined in the radio procurement document<sup>1</sup>.

Authentication is done in the Home network for the MS after request from the Visiting network; when approved for migration the visiting network assigns an (V)ASSI to the foreign ITSI



**Figure 6 Norway-Sweden AIM**

The following radio terminals and software versions were in use during end-user testing:

Motorola: MTP3250 - SW Beta MR16  
Sepura: STP9000 – SW Beta 10.19  
Airbus: TH1n – Beta 7.71 – E – 005

<sup>1</sup> <http://www.dinkom.no/Global/Dokumenter/Radio%20Terminal%20Requirements%20for%20ISI.pdf>

### 3. DEMONSTRATOR FIRST RUN EVENTS

The first-run for the Multi-Agency Demonstration consisted of three separate sessions. This was because of the scope of the final demonstration had no margin of error since this was a large live field exercise.

1. First ISI Group Call
2. End-user testing Strømstad
3. End-user testing Charlottenberg

Originally only one end-user test session was planned in Strømstad. Due to discovered problems during this event, failures needed fixing and work-around solutions had to be implemented. A second end-user test event had to be planned to get the necessary “thumbs up” to start training and education activities for the participants in the final demonstration (documented in D7.1.4).

#### Use cases tested in first run

The interconnection between two live public safety networks represents new functionalities in regards to gateways, radio terminals and control rooms, and it is a strong requirement for end-users to collaborate with their counterparts in the neighboring country. End-user organizations created their specific test-cases before the test events in Strømstad and Charlottenberg (both locations are close to the Norway-Sweden border). The end-user test cases were based upon the supported use cases (also described in D3.2 Functional Model) as below:

- End-users from Norway and Sweden within the same agency can communicate in agency specific ISI talk groups. This communication must work:
  - When end-users are in two different countries (and different networks)
  - When end-users are in the same country (same network)
- End-users from Norway and Sweden from different agencies can communicate in multi-agency talk groups
  - When end-users are in two different countries (and different networks)
  - When end-users are in the same country (same network)
- Migration of radio terminals
  - Swedish end-users can migrate with their Rakel-radio terminals to Nødnett (both by automatic and manual migration)
  - Norwegian end-users can migrate with their Nødnett-radio terminals to Rakel (both by automatic and manual migration)
  - Users who have migrated to the other country can communicate back to their home control room dispatcher.
- Combining talk groups
  - Norwegian control room dispatcher can group-combine/patch national talk group with the international ISI talk group
  - Swedish control room dispatcher can group-combine/patch national talk group with the ISI international talk group

- NB: The same international ISI talk group cannot be combined with local talk groups in both countries at the same time
- Emergency alarm
  - 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
  - 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
- Individual call
  - When end-users are in two different countries (and different networks)
  - When end-users are in the same country (same network)

All of these use cases will have to find corresponding procedures that take into account the available cross border functionality in the Norway-Sweden ISI solution. The use cases will be tested in test scenarios developed by the end-user groups, and corresponding procedures will be adjusted according test results in live ISI connection.

### 3.1. First ISI Group Call

Date: 24.06.2016

Participants: DNK & MSB

Scenario: First ISI Group Call on ISI interconnection between live networks of Nødnett/DNK and Rakel/MSB.

The first ISI group call was the first important milestone proving that the two live networks had been successfully interconnected, the static linked talk groups were functional and sound quality satisfactory. The group call was conducted by personnel in MSB from Stockholm and DNK in Norway and the test was successful.

- Setting up group and individual calls from a radio terminal and a dispatch in the Nødnett TG which is part of the static link with a RAKEL TG and backwards.

### 3.2. End-user testing Strømstad

Date: 22-24.08.2016

Participants: DNK, MSB, Norwegian and Swedish emergency services (Police, Fire and Rescue, Health Services, Custom), Vendors

Scenario: Free end-user testing to discover early-problems

The end-user testing session in Strømstad was a 3-day event and was comprehensive in regards to participants. From the end-user organizations both operative (field and control room) as well as

technical personnel were present. Also radio terminal vendors were invited to present the software and assist with the programming.

Full list of end-users and number of participants for the Strømstad event:

Organization	Number of participants
<b>DNK</b>	6
<b>Norwegian Fire and Rescue</b>	5
<b>Norwegian Health Services</b>	7
<b>Norwegian Police</b>	7
<b>MSB</b>	5
<b>Swedish Fire and Rescue</b>	3
<b>Swedish Health Services</b>	3
<b>Swedish Police</b>	4 + 3
<b>Customs</b>	2
<b>Swedish Control Room</b>	1
<b>Terminal vendors</b>	13

**Figure 7 Participants in Strømstad end-user test event**

Technical personnel from DNK and MSB and the network operators were monitoring the testing and technical personnel from terminal vendors were present to explain features and assist with radio terminal programming.

Key functionality to be tested in Strømstad:

- Group calls in static linked talk groups
- Group combining of national talk groups with statically linked talk groups for international cooperation.
- Migration between the networks
- SDS / Status codes
- Emergency alarm

The table below shows the status of the end-to-end use cases after Strømstad. In the test session in Strømstad several early issues were discovered. The totality of these made it impossible for the end-users to go systematically through their test-cases since many of them failed early on. The test-cases are therefore described on a high-level in this document.

Number	Use case	Success / failed	Comment
<b>1</b>	End-users from Norway and Sweden within the same agency can communicate in agency specific ISI talk groups. This communication must work:	Partly	
<b>1a</b>	When end-users are in two different countries (and different networks)	Failed	
<b>1b</b>	When end-users are in the same country (same network)	Success	Sound quality satisfactory
<b>2</b>	End-users from Norway and Sweden from different agencies can communicate in multi-agency talk groups	Partly	
<b>2a</b>	When end-users are in two different countries (and different networks)	Failed	
<b>2b</b>	When end-users are in the same country (same network)	Success	
<b>3a</b>	Swedish end-users can migrate with their Rakel-radio terminals to Nødnett (both by automatic and manual migration)	Partly	Some problems due to configuration on Nødnett BS
<b>3b</b>	Norwegian end-users can migrate with their Nødnett-radio terminals to Rakel (both by automatic and manual migration)	Success	
<b>3c</b>	Users who have migrated to the other country can communicate back to their home control room dispatcher.	Failed	
<b>4a</b>	Norwegian control room dispatcher can group-combine/patch national talk group with the international ISI talk group	Not tested	Will only function locally, not over ISI gateway. Not properly tested.
<b>4b</b>	Swedish control room dispatcher can group-combine/patch national talk group with the ISI international talk group	Not tested	
<b>5a</b>	When Swedish end-users press the emergency alarm in Norway, the alarm and their position will be sent to their home control	Not tested	Not properly configured for testing

	room or to the nearest agency control room		
<b>5b</b>	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 tested	Not properly configured for testing
<b>6</b>	End-users from Norway and Sweden can make individual calls. This communication must work:	Success	
<b>6a</b>	When end-users are in two different countries (and different networks)	Success	
<b>6b</b>	When end-users are in the same country (same network)	Success	

**Figure 8 Use cases after Strømstad end-user test event**

Successful test cases:

- Talk group communication when radio terminals are in the same SwMi worked well.
- Sound quality when two terminals were in the same network was considered very good by end-users.
- Air Interface Migration and migration testing between Nødnett and Rakel (both manually and automatically) worked well. Although there were some problems due to missing configuration of admission rights to some base stations in Norway.
- Individual calls between end-users in different networks and between home and visiting end-users in the same network.

Failed test cases:

- Problems with communication in static linked talk groups when radio terminals were in different SwMi.
- The Swedish users also had problems migrating to certain areas across the border due to missing configuration in Norwegian base stations.
- Unstability made it impossible to systematically test case SDS, emergency call and status codes.

Other:

- Method for ITSI addressing varies between the different radio terminal types (network + country code and placement of additional 0's to reach 15 digit ITSI). End-user feedback is that this lack of standardization will make it problematic to use operationally.
- Group combining was not tested in Strømstad due to the problems with static linked talk groups in different networks.



- Emergency alarm was not tested in Strømstad.

#### Discovered early issues and work-arounds:

Several early issues were discovered during the Strømstad session. Especially the change of transmission from sTesta IP to E1 illuminated underlying issues. sTesta only provides 4 timeslots and no QoS. Shortly before the Strømstad event transmission was changed to E1 between Nødnett and Rakel. The increase of service due to the new dedicated transmission illuminated early issues that had not previously been visible.

The errors and failures discovered in the Strømstad test event and test logs became the subject of analysis between the Motorola, Airbus, DNK and MSB technical experts. The technical group identified some early issues that were assessed and solved permanently or by implementing a work-around solution (with a long term solution to be implemented later).

#### Four issues were investigated further:

- Different interpretation of the ESN (External Subscriber Number). It was discovered an early issue that the two systems used different ESN (9 vs 12 bit code). This was solved temporary on the Nødnett side with a software upgrade to be ready in time for the Multi Agency Demonstrator. A longer term discussion was required to agree on the way forward on ESN and 9bit vs 12bit. Both Motorola and Airbus have produced software workarounds for this issue.
- Transmission B-channel blocking issue. Timeslots were blocked and had to be manually reset. Dependent on the timeslot which is blocked it could stop all new call requests from Norway. Blocking occurs when two timeslots are reserved for the same call. Hang timers were adjusted and aligned in the two systems and a temporary solution was approved for the Multi Agency demonstration. A long term solution requires software updates and must be deployed before the release of ISI-service 17.3.2017.
- Time sync/frame slips on E1-link. There were frequent frame slips on the transmission. A thorough analysis of the two networks indicated that this was a non-issue, but monitoring was continued.
- SDS report. Short report returned over ISI instead of Standard report when sending SDS-TRANSFER from Motorola to local Airbus MS in Rakel network. Testing has confirmed this issue is triggered by the way the different manufacturer's terminal respond to SDS. The terminals can be configured to prevent this issue occurring which can allow the ISI activities to proceed to plan. A short term solution will be to turn off the acknowledgement in the RT.

The ISI interconnection between Norway and Sweden is configured to optimize the load over the gateway when there are no active users on the other side of a talk group. A work around solution was to keep all TGs active on a dispatch in Nødnett. This was used until a permanent fix was in place. In addition to these the test session was impacted by some missing configuration on the Nødnett side that caused migration problems for Swedish users. This was corrected immediately.

### 3.3. End-user testing Charlottenberg

Date: 20.09.2016

Participants: DNK, MSB, Norwegian and Swedish emergency services (Police, Fire and Rescue, Health Services)

Scenario: Free end-user testing to verify work-arounds and give thumbs-up for final ISITEP demonstrator (live exercise).

The test session in Charlottenberg was a 1-day event with the intention of following up the Strømstad event due to the failed test cases. The use cases to be tested were the same as in Strømstad. Several pre-activities were necessary between the testing events in Strømstad and Charlottenberg:

- Assessing failed test-cases in Strømstad (DNK, MSB, Motorola, Airbus)
- Implementing work-around solutions (DNK, MSB, Motorola, Airbus)
- Coverage and migration testing in Charlottenberg prior to event (DNK)
- Event activities (invitations, agenda)

Participants:

Due to short notice on the Charlottenberg session all Swedish end-users were performing the tests from around the country (Strømstad, Jämtland). However this was a good opportunity to ensure that the solution and the work-arounds worked nationally. The test cases for the Charlottenberg event were the same as for Strømstad (see description above).

Organizations	Participants
<b>DNK</b>	6
<b>Norwegian Fire and Rescue</b>	4
<b>Norwegian Health Services</b>	2
<b>Norwegian Police</b>	4
<b>MSB</b>	4
<b>Swedish Fire and Rescue</b>	2 (testing in Jämtland and Strømstad)
<b>Swedish Health Services</b>	1 (testing in Jämtland)
<b>Swedish Police</b>	4 (testing in Jämtland, control room Umeå)
<b>Customs</b>	2
<b>Swedish Control Room</b>	1 (control room Östersund)

**Figure 9 Participants in Charlottenberg end-user test event**

Status of use cases after Charlottenberg:

After Charlottenberg all important use cases were successfully tested by the end-user organizations. While some issues still were open (most relevant for the Multi Agency Demonstration was the talk group combining) this was considered good enough to continue with the live exercise in November.

Number	Use case	Success / failed	Comment
<b>1</b>	Agency group calls: End-users from Norway and Sweden within the same agency can communicate in agency specific ISI talk groups.	Success	
<b>1a</b>	When end-users are in two different countries (and different networks)	Success	
<b>1b</b>	When end-users are in the same country (same network)	Success	
<b>2</b>	Multi agency group calls: End-users from Norway and Sweden from different agencies can communicate in multi-agency talk groups	Success	
<b>2a</b>	When end-users are in two different countries (and different networks)	Success	
<b>2b</b>	When end-users are in the same country (same network)	Success	
<b>3a</b>	Swedish end-users can migrate with their Rakel-radio terminals to Nødnett (both by automatic and manual migration)	Success	
<b>3b</b>	Norwegian end-users can migrate with their Nødnett-radio terminals to Rakel (both by automatic and manual migration)	Success	
<b>3c</b>	Users who have migrated to the other country can communicate back to their home control room dispatcher.	Success	
<b>4a</b>	Norwegian control room dispatcher can group-combine/patch national talk group with the international ISI talk	Not tested	Will only function locally, not over ISI gateway. Not

	group		properly tested.
<b>4b</b>	Swedish control room dispatcher can group-combine/patch national talk group with the ISI international talk group	Success	
<b>5a</b>	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 tested	Not configured properly for testing
<b>5b</b>	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 tested	Not configured properly for testing
<b>6</b>	End-users from Norway and Sweden can make individual calls. This communication must work:	Success	
<b>6a</b>	When end-users are in two different countries (and different networks)	Success	
<b>6b</b>	When end-users are in the same country (same network)	Success	

**Figure 10 Use cases after Charlottenberg end-user test event**

Successful test cases:

- Air Interface Migration functioned *successfully* with all radio terminal types.
- Static linked talk groups functioned *successfully* both locally and across networks.
- Individual calls functioned *successfully*.
- New software on Norwegian control room could visualize Swedish radio terminals and address radio terminals with full ITSI.

Other:

- Due to old versions of software in Norwegian control rooms (fire, health) only static linked talk groups controlled by Nødnett SwMi could communicate with live Norwegian control rooms. This was not an issue in the Norwegian police control room with upgraded software.
- Status codes and emergency alert are not configured in radio terminal or control rooms – not tested

Modifications and recommendations before final run:

In addition to the work-around solutions implemented before Charlottenberg a set of methodological choices were made to ensure a smooth final run:

- Only NOSE talkgroups controlled by SwMi Nødnett will be used.
- Emergency alert, SDS and status codes will not be used.
- Group combination will not be used.
- Individual call can be used.

All recommendations for the final run were communicated to the end-user organisations and implemented in the training material for the live exercise in Meråker, Trøndelag.

## 4. REFERENCES

ISITEP reports:

D4.2.3 E1 ISI Tetra gateway prototype for demonstrations, final release

D4.7.4 Test Report of Integration and Testing of Network Interconnections.

D3.2.1 Functional Model

D7.1.1 Demonstrator Plan and Requirements

D7.1.2 Demonstrator Design

D7.1.4. Demonstrator Test Results Final (technical outcomes)

D7.1.5. Demonstrator Final Report (end-user outcomes)

Other documents:

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