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Open Call Deliverable OCN-DS1.1 Final Report (MEAL)

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Abstract

This document is an "all-encompassing" deliverable of the MEAL project. It provides a holistic overview of the process, the drawbacks encountered and the decisions taken.

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Executive Summary

This deliverable provides a holistic view of the results obtained within MEAL, a project that was co-funded in the context of the open call program of GEANT.

The MEAL project explored the creation of an eduroam-like mechanism for federating network access based upon the Long Term Evolution (LTE) data connectivity. In doing so, it addressed the challenges resulting from the involvement of third party commercial network operators in multiple countries. The objective of the MEAL project was to use LTE as an alternative radio access network for Wi-Fi in the context of federated connectivity provision. The motivation for this project stems from the fact that education and research activities increasingly take place at locations where Wi-Fi is not available: outside institutional buildings and off-campus. LTE is seen as the key candidate to realize public mobile communication networks. The challenge is integrating the LTE and Wi-Fi protocols in such a way that they offer a transparent service at any location, any time, and via any device, which results in supporting new ways of learning and increase in the flexibility in doing research.

The approach chosen was to start the national LTE activities of SURFnet and Jisc independently from one another. The local (national) LTE infrastructure was then used to gain access to the network infrastructure of each participating NREN, Jisc in the UK and SURFnet in NL, to get access to Internet and intranet. The next step envisioned was roaming between the countries, meaning that a Dutch subscriber can use the network in the UK in the same way as an English subscriber. A side condition of the solution's design was that traffic would always break out locally. The design to realize this was worked out together with mobile operators in the UK and in NL. As a result of decision of one of the commercial mobile operators to pull out of the project, this last step could not be implemented.

1 Introduction

The new ways of learning and working have influenced students, teachers and researchers. As a result, education and research activities take increasingly more often place at locations where Wi-Fi is not available: outside the borders of institutional buildings and off-campus. LTE was selected as the technology candidate to complement Wi-Fi at locations where Wi-Fi is not available. LTE was commercially launched and used in many 67 countries, making itself the fastest growing mobile technology in history. The MEAL project utilised the possibility of positioning Wi-Fi and LTE as complementing access networks. After all, many institutes have invested much money to accomplish a proper Wi-Fi infrastructure which functions well as an indoor wireless access network. The objective of MEAL was to use eduroam-like mechanism to get access to LTE as an alternative radio access network for Wi-Fi beyond institutions' premises. This was realized by studying how NRENs can incorporate the mobile operator's 4G infrastructure as a mobile exchange.

Two alternative approaches for realizing a mobile exchange were studied: via an Mobile Virtual Network Operator (MVNO) construction and through an Access Point Name (APN). Technically, these approaches can be compared with having a mobile exchange on layer 2 (MVNO) and layer 3 (APN). Not all NRENs are the same and the conditions per countries differ. This justifies exploring both options. A prerequisite for NRENs to become MVNO is ownership of a SIM. Ownership of the SIM basically means owning a mobile network code (MNC). If an MVNO does not have its own MNC, all SIMs in phones/tablets/machines must be swapped for another SIM when the NREN decides to make use of a different mobile network operator. Changing SIMs is an expensive activity. The MEAL project explored the possibilities for NRENs to share an international MNC.

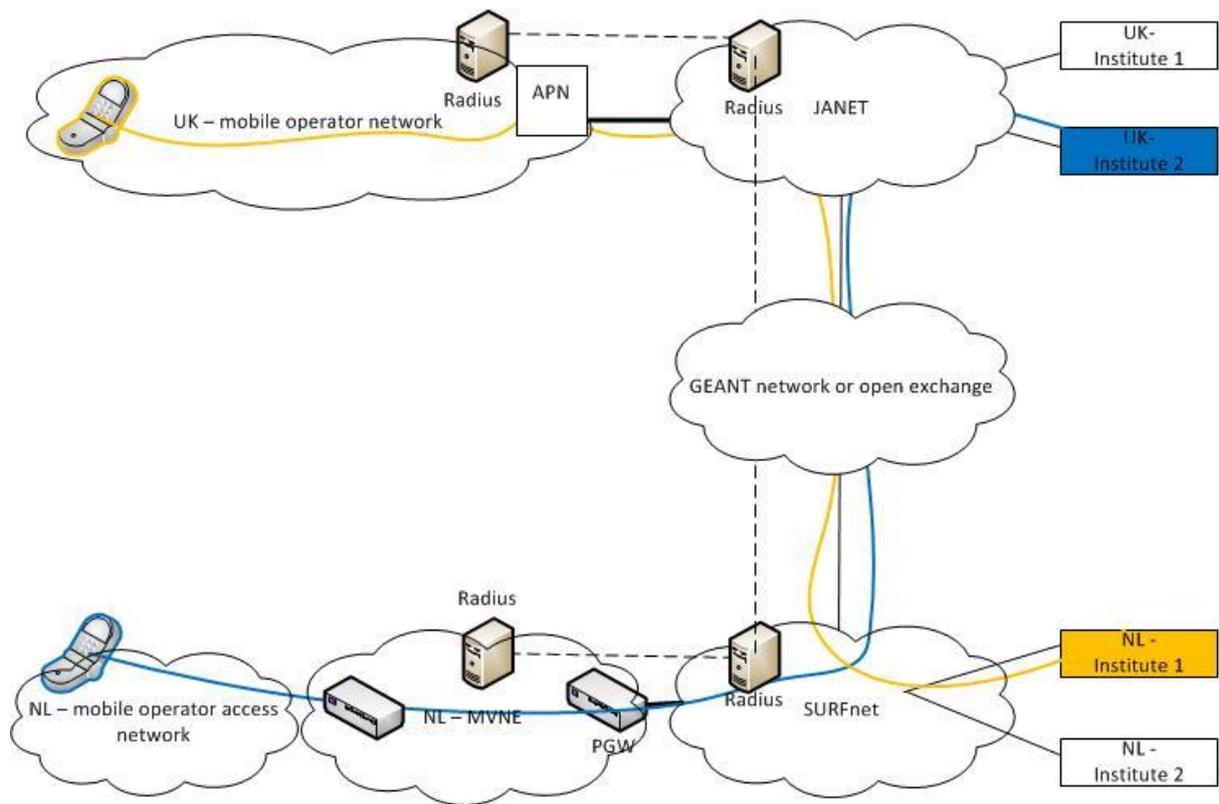


Figure 1.1: Mobile exchanges that were envisioned to test and evaluate within MEAL

2 Overview

Section	Description of Contents
Methodology	Both partners implemented independently the agreed design and tested its performance as a national 4G mobile exchange. The design was built such that it allowed interworking (and roaming users). Chapter 3 describes the work plan and the methodologies used to achieve the results.
Results	The results achieved include: national deployment plans of mobile exchange for NRENs in both UK and NL, dissemination of the results, design of international roaming between countries and the approval of mobile operators for the design, initiation of plans to obtain an international MNC for the NREN community. Chapter 3 reveals how the project was organized and discusses the paths followed to obtain the results.
Observations	We tried to use the mobile networks of national operators to achieve our goals, without including these mobile operators in the project. Although the design to realize roaming between the operators was made in close cooperation with these operators, one of the operators was reluctant in implementing the design. We refer to Chapter 3 for more details.
Recommendations	NRENs need to work together in develop a base-line mobile strategy. A mobile exchange is an essential part of this. Technically, the mobile exchange could be realized in various manners. The realization may depend on local decisions and local strategies. Close cooperation with mobile network operators is essential in the testing and the realization of the decisions and concepts. In our experience, it is best to include the mobile operators as partners in the project.

Table 2.1: The various sections and their contents

3 Methodology followed

3.1 Work plan and approach

The project partners worked together to examine the issues around LTE-based international roaming, and agreed a deployment design that identified the challenges. Both partners implemented independently the agreed design and tested its performance as a national 4G mobile exchange. The design was built such that it allowed interworking (and roaming users). When both regional deployments are working and tested, a programme of tests and demonstrations of international roaming could take place.

The following work plan was planned and used:

- WP1 Management
- WP2 Multi-domain design
- WP3 SURFnet national deployment
- WP4 Janet national deployment
- WP5 International roaming
- WP6 Dissemination

3.2 Activities per work package

3.2.1 Management

With a small project with only two partners, management was not too difficult. Weekly scheduled meetings were organized to discuss progress. Often Skype was used as a conference call. Face-to-face conversations took place during GEANT meetings/workshops or during conferences.

3.2.2 WP 2 multi-domain design

As written in the project proposal, Janet suffered from a lack of technical staff. Due to an internal hiring process within Janet, the initial technical progress appeared to be challenging. In March 2014 this was resolved by hiring a new technical staff.

SURFnet wrote an extra MEAL deliverable that describes the design and the implementation of their APN with mobile operator KPN. This resulted in a not foreseen MEAL deliverable [1]. It was envisioned to use this deliverable to speed up the implementation in the UK. A technical meeting was envisioned to discuss the technical approach that was followed by SURFnet. A draft version of milestone 2.2 was released. Although Janet had the official support letter from EE expressing their willingness to collaborate on this project, EE weren't able to organise a technical meeting. EE was carefully selected, because of the roaming agreement with KPN, the mobile operator SURFnet contracted. As a back-up plan, Janet took the work forward through a data telephony specialist consultancy named Neptune. This company was already under contract with Janet for consultancy work. Neptune as a consultancy company in the UK understands the local mobile market and helped Janet in selecting the appropriate mobile network operator. This resulted in re-establishing the relationship with EE. The milestone M2.2 was revised considerably, containing a proper description of the multi-domain design [6].

The issues with hiring technical staff and the contact with EE resulted in delays of milestones M2.1 and M2.2.

3.2.3 SURFnet national deployment

SURFnet aimed at implementing a mobile exchange commonly used by mobile virtual network enablers (MVNEs). An MVNE is an organization that provides business infrastructure solutions to mobile virtual network operators (MVNO). Services include billing, administration, operations, base station subsystem support, operations support systems and provisioning for back-end network elements. There are several MVNEs in the Netherlands. The strategy was to select an innovative MVNE, exploring together several related challenges. Another criterion was that the MVNE was active in the UK such that roaming agreements would not be a showstopper. This resulted in several discussions with Telena. Telena expressed interest in the cooperation with SURFnet. One of the additional items agreed to study was the challenges arisen with handover between Wi-Fi and LTE. One of the rationales is that the 3GPP architecture was designed from an operator perspective where Wi-Fi is considered as minimal (and additional) traffic as compared to UMTS/LTE/GSM traffic. For NRENS, Wi-Fi traffic is the major component and the number of LTE and voice packets are marginal when compared to Wi-Fi. This raises conflicts in design and the way to cope with scalability. The topics were also discussed with Alcatel-Lucent, the vendor Telena selected for their mobile backend. There were mutual interests to continue. Unfortunately the activities coincided with negative development of the wholesale prices compared to the retail prices, resulting in a situation where MVNO business models coped with declining markets. Telena was not able to put sufficient priority and staff on the project. The result was that a high budget - far beyond the budget available within MEAL - was needed to install and test the mobile backend with Telena. This situation was discussed with the GEANT project officer and technical coordinator. It was decided to restrict the mobile exchange to a solution where both the UK and the Netherlands use an APN as the anchor point to connect mobile devices. This resulted in a change of the project proposal. SURFnet's national deployment in the Netherlands was successfully implemented with mobile operator KPN. The results of various tests and performance are described in [2].

Another activity carried out within this work package was the exploration to obtain a mobile network code (MNC) for the worldwide NREN community. This MNC is a number that is used in combination with a Mobile Country Code (MCC) to uniquely identify the user's mobile network operator. The MCC-

MNC tuple is stored on a user's SIM card. Together with the mobile subscriber number, they form the IMSI. Many NRENs serve a closed community and as a consequence, policies forbid regulators to grant an MNC to these NRENs. The SIM serves as an identity. Ownership of MNC comes with the ability to make and distribute SIM cards that can be validated. This opens many opportunities, including indoor 2G/3G, easier and more secure access to eduroam, two factor authentication for federated service and offering mobile services without swapping SIMs if the NREN decides to choose another mobile network operator than before, and also possibility of offering bespoke packages for community needs such as free/discounted rate call between community (e.g., students from same university).

The aim was to explore the ability to obtain an international MNC. ITU-T grants iMNCs that are even more scarce than the national MNCs. SURFnet attended ITU-T's Telecom's 2013 world congress and discussed the iMNC with the director of SG2.

Countries are members of the ITU. SURFnet discussed the need for an iMNC with Ministry of Economic Affairs of the Netherlands. SURFnet convinced them to vote yes for granting the NREN community an iMNC. It became clear that in order to be successful, the support of more countries is needed. As the iMNC requires an international effort with the NRENs, the concept of the iMNC was presented multiple times to the global CEO platform. In 2015, the CEO platform supported the idea. A group with NRENs from various continents was created. This work exceeds the duration of the MEAL project. It was successfully initiated within MEAL and accepted as a working item in GN4. It will continue in SA7 of GN4.

3.2.4 Janet national deployment

After finding the correct people within mobile operator EE, the contract for carrying our MEAL activities was relatively quickly signed. Together with an e-mail from the head of the mobile department of KPN, this finalised milestone M2.2, Formal Support to Realise Plans. Quickly after the contract with EE was signed, the national deployment plan for the UK was implemented. The mobile exchange for the UK was implanted through an Access Point name, MEAL. It was designed, implemented and tested, as reported in [3].

The tests of the joint national deployments were described in [4].

3.2.5 International roaming

MEAL focus with roaming on personal mobility, meaning that a Dutch subscriber can use its mobile device on the network in the UK in the same way as an English subscriber can do this (and vice versa). As an additional requirement, we demanded that traffic would break-out to the network of local NREN. This in contrast with normal APNs where the visited operator forwards all traffic to the home operator. Meetings with Janet, SURFnet, and mobile operators KPN and EE resulted in a design to implement the roaming plans. Although KPN reviewed this design, approved it and claimed it had implemented it, KPN was not willing to test the solution in the context of MEAL. In spite of the fact that this issue was escalated to the level of directors (and discussed with the board of KPN), KPN refused to implement and test this design within the context of MEAL. Since the UK part implementation for

local-breakout is ready to start, the project was held until Surfnet could find an alternative mobile provider for KPN.

3.2.6 Dissemination

Although it was officially foreseen that this task would start at month 7, in reality dissemination started at the beginning of the project. By opting on expected results, we managed to present results from e.g., national deployment plans in e.g. a presentation at TNC 2014. Various other dissemination activities were carried out, as reported in [5]. The project plan planned a peer-reviewed article. As described in [5], this paper was not written. For a proper article in a peer-reviewed journal, we envisioned the realization of the complete set-up as including roaming between NL and UK. A paper that describes both the international roaming and how traffic can breakout locally. A description of this situation forms a good base for a peer-reviewed paper. A description of the solution without an actual implementation is considered insufficient for a peer-reviewed paper. The national deployments in NL and UK were described in various other publications enumerated in [5].

Other section headings and their contents will be determined by and specific to the nature of the document and the subject matter.

4 Conclusions

In the task to explore the possibilities for NRENs to incorporate a mobile exchange in their network infrastructure, the MEAL project came a long way. The MEAL project dealt with drawbacks: in hiring people, in the declining of the wholesale prices of MVNOs such that a trial with a mobile backend became too expensive, in the motivating mobile operators to work along and in motivating mobile operators to implement a design that was created in close cooperation with them. In spite of these drawbacks, the MEAL project delivered various results: a coherent deployment plan, plans for national deployments in the UK and in NL, the successful implementation of the national deployment plans in both countries, support at the global from of NRNE CEOs for the plans to opt for an international mobile network code for the NREN community and continuing with the idea in an international setting with NRENs of each continent. The single thing that could not be accomplished was a realization of international roaming between the national deployments of mobile exchanges in the way that was envisioned. It could have been reached easily by lowering the bar and not supporting the situation that traffic from UK users must breakout to the SURFnet infrastructure when these users visit the Netherlands (and vice versa). In spite of the fact that the design for the roaming with local breakout was worked out in close collaboration with mobile operators who have roaming agreements with one another in place, one mobile operator was reluctant to implement and test international roaming as envisioned in MEAL.

Before the MEAL project started, SURFnet had a good collaboration in place with KPN. This project allowed exploring various research activities. Although KPN agreed both orally and by e-mail that they agreed to add international roaming as a sub activity of that collaboration (and contributed to the design that should realize this), they refused to test and implement this design. Janet had to sign the contract with their local 3G/4G operator. They managed to realize this and the UK operator was willing to implement the international break-out design. Escalating this to topic to CEO and CTO level did not help. We tried to change the Dutch mobile operator for another operator but the process of interconnecting with SURFnet and realizing roaming agreements was too time consuming for the duration of the MEAL project.

Could these problems be prevented? Perhaps if the mobile operators were official partners in the MEAL project or if the international roaming would have taken place earlier in the collaboration between KPN and SURFnet. Nevertheless, the MEAL project revealed an interesting lesson that in dealing with mobile operators sometime non-technical issues such as finding the right person in their organisation, providing enough motivation for them to join and enforcing them to keep their promises can cast their shadows on the project success. In results achieved clearly had an impact: based on the conversations that took place, people showed interest in the results gained during the MEAL project. The interest is based from both a technical and from a commercial point of view. The quantifiable result that we know stems from UNINETT, The Norwegian Research & Education Network. They received MEAL deliverables and consider implemented the APN solution in the way that was realised

in the national deployments as implemented within the MEAL project. In addition, the activities on the iMNC resulted in support of the global CEO forum and in an intercontinental activity to obtain an international MNC for the NREN community. The European work will be executed in GEANT SA7 T4.

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Glossary

MNC	Mobile Network Code
MVNO	Mobile Virtual Network Operator
MVNE	Mobile Virtual Network Enabler
APN	Access Point Name
LTE	Long Term Evaluation