Professional report no. 2-2017

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RFID in Society
- Preparing for the Internet of Things
Case Criteria & Selection

(deliverable 1 of 4)

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Summary

This is the first of four reports from the RCN-financed project RFID in Society – Preparing for the Internet of Things (2010-2017). In addition to articles, conference papers, an exhibition, presentations, media contributions and a project website , the project has published the following reports: Del. 1 of 4: "Case Criteria & Selection"; Del. 2 of 4: "Case Analyses & Evaluation"; Del. 3 of 4: "Handbook of Methods"; and Del. 4 of 4: "Final Report & Summary"

This first report addresses the first research task of the RFID in Society project, namely to identify and map what types of technology/systems/applications (and related products/services) the project should focus on. This was necessary since the "RFID/IoT territory" was relatively unchartered at the time of project initiation (2010). The approach followed an exploratory/descriptive "multiple case-study" design of people-centric RFID/IoT-services. As part of the mapping process, the research team needed to identify criteria for both selecting cases and for organising them. This was done in a partly grounded fashion, including literature study of existing cases from academic studies, desk research of cases using various search engines/search specifications, and through several workshops/deliberations discussing relevant aspects.

In this way, the project group managed to identify a range of criteria for organising relevant cases. Then a process of selecting relevant criteria followed, through an iterative process of adding/excluding criteria, and specifying these in a tree-shaped structure. This exercise started with user roles (related to relevant technologies/applications), then generic activities, specific activities/services, and eventually functions/benefits were added. Based on the structure and ideas generated from these iterations, the next step in search for relevant cases was to narrow down our focus to specific cases in the Norwegian context. Hence, the project group first gathered information about relevant cases at that time (primarily in the period around 2010-2012), showed diversity with respect to different aspects (public/commercial, pilots/implemented, small-scale/large-scale, simple tech/larger system, etc.).

Initially, 20-30 different cases were explored. Through a funneling approach we gradually eliminated potential cases one by one, as they were found to be incompatible with our design. From this iterative investigation and exclusion process, we ended up with 13 cases to be explored further. All cases were first arranged in a simplified template, where only a few key criteria were used (in order to provide an accessible introduction to the cases). By following the simplified template, and adding insights from the previous iterative tree-structuring process, we developed an extended template for case description. Finally, information about the 13 cases were filled in the table system of the extended template.

Keywords

RFID, Internet of things, IoT, case studies, consumer, pervasive technology, privacy

RFID in Society – Preparing for the Internet of Things. Case Criteria & Selection (Del. 1 of 4)

by

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2017

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Acknowledgements

This report is the first deliverable in a series of four project reports. It reflects the first phase of the RCN-financed project «RFID in Society – Preparing for the Internet of things». The project was initiated in 2010, with a project period of three years. Due to unforeseen circumstances at two of the research facilities partaking in the project, the finalisation of the project has been delayed several times, with final completion in September 2017.

Hence, this first report focuses on the work conducted by SIFO and project partners around 2010-2012. The project group decided that even though much of the work has been carried out in different time-periods, the project reports (deliverable 1 to 4) should be published at the same time. In this way, minor and major alterations could be implemented along the way in order to make the reports as connected and up-to-date as possible. This is particularly important when exploring new and evolving technologies and paradigms such as RFID and the Internet of Things.

Oslo, September 2017

Forbruksforskningsinstituttet SIFO
Høgskolen i Oslo og Akershus

Content

Summary

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Del. 4 of 4: "Final Report & Summary"

The first research task of the *RFID in Society* project, which is the topic of this report, was to identify and map *what types of technology/systems/applications* (and related products/services) the project should focus on, as the "RFID/IoT territory" was relatively unchartered at the time of project initiation (2010). The approach followed an exploratory/descriptive "multiple case-study" design of people-centric RFID/IoT-services. As part of the mapping process, the research team needed to identify *criteria* for both *selecting* cases and for *organising* them. This was done in a partly grounded fashion, including literature study of existing cases from academic studies, desk research of cases using various search engines/search specifications, and through several workshops/deliberations discussing relevant aspects.

In this way, the project group managed to identify a range of criteria for organising relevant cases. Then a process of selecting relevant criteria followed, through an iterative process of adding/excluding criteria, and specifying these in a *tree-shaped structure*. This exercise started with *user roles* (related to relevant technologies/applications), then *generic activities, specific activities/services*, and eventually *functions/benefits* were added. Based on the structure and ideas generated from these iterations, the next step in search for relevant cases was to narrow down our focus to *specific cases in the Norwegian context*. Hence, the project group first gathered information about relevant cases at that time (primarily in the period around 2010-2012), showed diversity with respect to different aspects (public/commercial, pilots/implemented, small-scale/large-scale, simple tech/larger system, etc.).

Initially, 20-30 different cases were explored. Through a *funneling approach* we gradually eliminated potential cases one by one, as they were found to be incompatible with our design. From this iterative investigation and exclusion process, we ended up with 13 cases to be explored further. All cases were first arranged in a *simplified template*, where only a few key criteria were used (in order to provide an accessible introduction to the cases). By following the simplified template, and adding insights from the previous iterative tree-structuring process, we developed an *extended template* for case description. Finally, information about the 13 cases were filled in the table system of the extended template.

1 Introduction

This report is the first of four deliverables stemming from the RCN-financed project *RFID in Society – Preparing for the Internet of Things* (2010-2017). In addition to articles, conference papers, an exhibition, presentations, media contributions and a project website[2], the project has published the following reports:

Del. 1 of 4: "Case Criteria & Selection"
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Before presenting the content of this first report, we will first provide a brief background of the main project itself.

1.1 Short introduction to the *RFID in Society* project

The project *RFID in Society – Preparing for the Internet of Things. Researching Opportunities and Obstacles in RFID innovation (or short: RFID in Society)* is funded by the Research Council of Norway (RCN) under the VERDIKT programme. VERDIKT (*Kjernekompetanse og verdiskaping i IKT*) has had a total budget of 1.2 billion NOK in the period 2005-2014. In mid-2010, 204 million NOK was awarded to 21 projects within the areas of social networks, Internet of Things (IoT) and mobile internet. The *RFID in Society* project received funding as a "researcher project" (*forskerprosjekt*) under this call. SIFO[3] has been leading the project, and TIK (UiO)[4] and IMK (UiO)[5] and SNF (NHH)[6] has been project partners. The project commenced in 2010, involved a two master projects (TIK, NHH) and a post-doc position (TIK), and was completed in September 2017 (delayed due to unforeseen circumstances).

The backdrop for this project is the rapid growth in applications for RFID[7] and sensor technology, and the emerging vision/paradigm of a future *Internet of things* (IoT). IoT has recently become a central theme in European and Norwegian ICT research politics, while RFID and other enabling technologies (sensors, actuators, etc.) are considered to be key components in a global IoT system. Advocates project vast economic opportunities and societal gain from IoT-development, while critics see enormous challenges (privacy, security, disruption, social effects, etc.) inherent in this technological move.

[2] Cf.: https://rfidsociety.wordpress.com/
[3] SIFO – Forbruksforskningsinstituttet, Høgskolen i Oslo og Akershus: http://www.hioa.no/Om-HiOA/Senter-for-velferds-og-arbeidslivsforskning/SIFO
[4] TIK – Senter for teknologi, innovasjon og kultur, Universitetet i Oslo: http://www.sv.uio.no/tik/
[5] IMK – Institutt for medier og kommunikasjon, Universitetet i Oslo: https://www.hf.uio.no/imk/
[6] SNF – Samfunns- og næringslivsforskning, Handelshøyskolen i Bergen: http://www.snf.no/
[7] RFID – Radio-frequency identification

Hence, the aim of the project was to address this situation. It set out to study how novel technologies (such as RFID) and emerging paradigms (such as IoT) can affect individuals/consumers and community/society. This implied a focus on "people-centric" applications of relevant technology and policy, while addressing both opportunities and challenges when such technology enter everyday life. SIFO had already, in late 2000, addressed the emerging consumer aspects or RFID/IoT in conferences (Slettemeås 2007a), to policy/government (2007b) and journal articles (Slettemeås 2009). At the time of project initiation, research (in particular in the Norwegian context) on individual/societal consequences of RFID/IoT was scarce, and had so far not properly addressed the socially complex and many-faceted nature of this type of technology and its relationship to social environments.

Hence, the project proposed that new approaches where needed in order to understand the role and function of RFID/IoT in society, and how this technology in the future may radically affect economic and social life. The aim was to develop several methods for studying such innovations from different practical and theoretical perspectives, primarily by identifying relevant cases to be studied (pilots, actual applications, future visions). The outcome of this research aspire to support future Norwegian research/innovation as well as policy/organised interests when manoeuvring in the RFID/IoT field.

1.2 Background for this report (Deliverable 1 of 4)

The purpose of the report is to explore a *variety of cases*, involving *RFID or similar technology*, which to some extent have a connection to *citizens/consumers* in the *Norwegian context*. Whereas early implementation of RFID centred on manufacturing, logistics and the supply-chain, recent RFID implementation has "advanced closer to the consumer" (although this was far less prevalent in 2010 than in 2017). The proximity of RFID systems to users reveals a range of opportunities and obstacles that are not as prevalent in traditional industry/business applications (unless employees are directly involved in the process). There is thus a need for research to investigate the effects of this relationship between "communicating objects and environments" and consumers/citizens. For this purpose, the report will identify and explore a variety of cases of emerging RFID services/systems (or similar).

The idea has been to identify implemented systems with a long track record, as well as novel systems that have recently been implemented, and those still on the conceptual level (pilots). The reason for picking cases at several levels of maturity is both due to practicalities (available cases) and to include the aspect of different "life phases" of systems.

Hence, early in the project the research group found it necessary to identify and map *what types of technology/systems/applications* (and related products/services) the project should focus on, as the "RFID/IoT territory" was relatively unchartered at that time (in particular in the first phase of the project – 2010-2012). Key criteria for selecting systems was that they needed to be framed within the overall research aim of the project, which was to study:

- …commercial or piloted products/services, which involved *RFID or other enabling technologies*, with or without the potential of "going IoT".

- …RFID-enabled (or similar) products/services *already introduced in the Norwegian market* or that were *being piloted in Norway*, by Norwegian or foreign innovators/suppliers.

- …*people-centred applications* of RFID-enabled (or similar) technology, implying that applications needed to have a direct/indirect impact on "people" as *consumers/citizens*.

Hence, technology employed in manufacturing, the supply-chain or similar, with little relevance to ordinary people or society, where left out[8].

- …potential *technological futures*, where people would (voluntarily or involuntarily) be exposed to RFID-enabled products or to pervasive IoT-systems.

As part of the mapping process, the research team needed to identify *criteria* for both *selecting* cases and for *organising* them. Hence, it was decided to hold several workshops at an early stage where cases and criteria could be deliberated.

* * *

The inspiration for this case selection and subsequent case evaluation stems partly from the work commissioned by the *European Technology Assessment Group* (ETAG)[9], in particular the report "RFID and Identity Management in Everyday Life" (ETAG 2006). This report sets out to document the field of RFID and ID management, by exploring cases involving *actual experiences* and the *perspective of the citizen/consumer*. This was done by clustering the various identified cases under *daily events* related to everyday life. Some examples where transport, car driving, going to work, shopping, amusement, border-crossing, and receiving treatment (ETAG 2006, p.2). This way of categorising RFID and related technologies/systems is intuitive and a good was to organise cases, rather than by for example technological features/functions.

This report will work in a similar fashion, although the cases and the indicators/criteria for assessing the cases will be somewhat different. Furthermore, the report will use a similar method to that of the ETAG study (a funnel approach), first exploring a wide range of cases, then reducing these in terms of how relevant and typical they are for the constructed categories.

1.3 A note on technology

In order to delimit this study it is crucial to identify the technologies that appear to be relevant for this purpose. So far, and in the project application process, we kept a relatively narrow focus on RFID (as this has been the most prevalent technology during the first decade of 2000, and the enabling technology that has symbolized the shift towards IoT). In recent years (2010 onwards), attention has shifted to include other relevant technologies. Hence, we have used the term *AIDC (automatic identification and data capture)* – a more general term – interchangeably with RFID.

The term AIDC implies systems that identify objects automatically, gather information from these, and finally enter and interpret these data in computer-aided systems. The key enabler for data exchange is some sort of data transfer technology. The most common of these are barcodes, QR[10]-codes (2D barcodes), OCR[11], RFID/NFC[12], BLE, in addition to biometrics, magnetic and smart cards, as well as iris and voice recognition[13]. While barcodes and QR-codes need to be scanned (e.g. with a mobile camera and integrated/downloaded scanning software), RFID and NFC implies automatic data transfer when relevant devices are within reading

[8] People engaging with RFID/IoT as producers/employees were also excluded, except in the post doc study of the apparel industry.
[9] Report prepared by the Rathenau Institute, The Netherlands.
[10] Quick Response
[11] Optical Character Recognition
[12] Near Field Communication
[13] Cf. Wikipedia: https://en.wikipedia.org/wiki/Automatic_identification_and_data_capture

range[14]. AIDC is also relevant in the Norwegian context, due to the application of this reference in the standardisation work in this area. SIFO, the project manager, became a member of the Standards Norway[15] committee *"SN/K 178 – Automatisk identifikasjon of datafangst"*[16] during the project period. This is a "mirror committee" for standardisation projects in *CEN/TC 225 Automatic Identification and Data Capture (AIDC) Technologies and Applications* and in *ISO/JTC 1/SC 31 Automatic identification and data capture techniques.* The group mandate was also to address the relationship between AIDCs (with primary attention on RFID) and other wireless and sensor technologies and networks. In addition, the group mandate was to relate this work to standardisation work within global unique identifiers and the future internet of things (IoT).

There are also other terms that embody practically the same types of technologies and functions. Still, much literature on the transfer of data from real life objects to digital systems have concentrated on radio-frequency technology. Hence, RFID has in many ways (until a few years ago) ended up as a "collective concept" for a range of resembling technologies. RFID is widely recognised and used internationally in academic, media and public debate. More recently, NFC has attracted attention as this technology has been implemented in new smartphone releases (i.e. for contactless payment and other service where smartphones are used for activating services in the proximity of the user). NFC is based on RFID technology, and data transfer can be automatically activated when reader (smartphone) and tags or other mobile NFC-devices are within a certain distance from one another. NFC demands a short reading distance and usually practical for services that have higher demands in terms of security.

More recently focus has shifted from these enabling technologies to IoT. A 2016 report by Rathenau Instituut[17] ("Beyond control: Exploratory study on the discourse in Silicon Valley about consumer privacy in the internet of things"), addressing the "hyper-connected consumer", lists the key technological elements of IoT[18]:

- *sensors* (give things context awareness, ability to collect data)
- *actuators* (enable things to perform actions in the physical world)
- *processing units* (on chip, give things capability to do small computing on collected data, operate without human intervention)
- *unique identifier* (ensures that things can be identified and found in the network)
- *communication and network technology* (connecting things to the internet, or to local network/gateway device between thing and internet)

In the *RFID in Society* project, we will mainly focus on RFID and NFC[19] (in addition to QR-codes and GPS), as well as IoT as an overarching technological system that employs these enabling technologies.

[14] Bluetooth Low Energy
[15] http://www.standard.no/en/
[16] https://www.standard.no/standardisering/komiteer/sn/SNK-178/
[17] Cf: https://www.rathenau.nl/en/publication/beyond-control
[18] Cf. p. 4: https://www.rathenau.nl/en/publication/beyond-control
[19] NFC has been relevant in terms of the *NFC City* project that has run in parallel with the *RFID in Society* project, and in which SIFO has also been a project partner.

2 Criteria for identifying and structuring cases

One crucial element of the explorative phase reported on in this deliverable has been to deliberate on the *relevant criteria for selecting cases for further analyses* and *which parameters to organize them by*. A range of selection factors were discussed through several dedicated workshops in the early stage of the project. As an overall guide for identifying the relevance of key cases and criteria, we have looked at; a) the main research questions posed in the project proposal (e.g. Norwegian context, people-centric services), b) the ETAG report which has inspired this mapping method (citizen/consumer perspective, daily events), and c) visions posed in policy documents that relate to a future IoT paradigm (privacy, connectedness, degree of agency, pervasiveness/omnipresence, controversies, etc.).

As mentioned previously, the inspiration for how to conduct case selections, and the subsequent case evaluation, stems partly from the work commissioned by the *European Technology Assessment Group* (ETAG)[20], in particular the report "RFID and Identity Management in Everyday Life" (ETAG 2006). This report explored *actual user experiences* and the *perspective of the citizen/consumer*. The case study approach used in our project, worked in a similar fashion, although the cases and the indicators/criteria for assessing the cases turned out somewhat different. The study also used a similar method to the ETAG study (a funnel approach); first exploring a wide range of cases, then reducing these in terms of how relevant and typical they are for the constructed categories.

Then the process *of selecting relevant criteria* followed, through an *iterative process* of adding/excluding criteria, and specifying these in a *tree-shaped structure*. The next step in search for relevant cases for more extensive studies, was then to use the structure and ideas generated from these iterations, and further narrow the focus to *specific cases in the Norwegian context*. Hence, information about relevant cases was gathered and the researchers initially explored ***20-30 different cases***. These were tested against the various specifications in the structuring approach. Potential cases were gradually eliminated, one by one, as they were found to be incompatible with the design, or for practical reasons due to too little information available.

This iterative process of investigation and exclusion, resulted in ***13 cases*** to be explored further. All cases were first arranged in a ***simplified template***, where only a few key criteria were used in order to provide an accessible introduction to the cases. By following the simplified template, addressing the 13 cases and adding insights from the previous iterative tree-structuring process, an ***extended template*** for case description was developed. Then, lastly, information about the 13 cases were entered into the table system of the extended template (of which 9 were explored further, as described in the second report [del. 2 of 4]).

As methodological framework, we here followed a *case study approach*. Yin (2006) concludes that compared to other methods, the strength of the case study method is its ability for in-depth examination of a case within its real-life context. Case study research enables investigation into novel topics and cases, e.g. by illuminating particular situations, or in our case "products" or "services" (the units of analysis) to get a better understanding of these. It should not be considered a pure data collection tactic or mere design feature, but as a research strategy (Yin 1994).

[20] Report prepared by the Rathenau Institute, The Netherlands.

The case study method can refer to either single- or multiple-case studies. One may have chosen to study a unique or revelatory case. In our case we focussed on specific services with a particular technology, or set of technologies, either embedded or attached. It is suggested that a formal case study screening procedure should be conducted, which was done in our case; starting from a simple set of criteria for choosing cases, then expanding the criteria through an iterative process, while at the same time reducing the potential cases to study. Hence, it can be specified as a *multiple-case study*, as all cases are described separately, but within the same research design goal.

Furthermore, our case study research strategy can be labelled "exploratory" or "descriptive", rather than "explanatory" (Yin 1994). The goal is not to test or derive theory, but rather to acquire systematized insight for later selection and analyses. But even exploratory case studies, leaning on modest existing knowledge, should still be guided by the following; what is to be explored, the purpose of exploration, and the criteria for judging the success of the exploration.

Selecting the proper cases (if many are available) is a critical issue. The *case selection or screening* goal is thus, according to Yin (2006) to avoid the scenario whereby, after having started the actual case study, the selected cases turn out not to be viable or to represent an instance of something other than what you had intended to study. Hence, this initial phase of the research process is important, both to get valid cases as well as to secure efficient use of project resources.

Below we present in detail the first steps of the case study strategy, from the *workshop deliberations*, to the *tree-structuring*, the *simplified template*, the *extended template*, and eventually the *final template* with case descriptions.

2.1 Workshop deliberations

2.1.1 First deliberation

The first workshop produced the following criteria and specifications for evaluating RFID-related cases:

Case X:

- *Sector type:*
  - Government, security, surveillance, retail, healthcare, transport, hospitality, entertainment, library, home management, etc.
- *Service/product type (main function):*
  - Lock/unlock, theft prevention, toll collection, ticketing, entrance pass, enhanced information, marketing, etc.
- *RFID type:*
  - Passive, active, integrated, attached, etc
- *Related technologies:*
  - Sensors, GPS, etc.
- *RFID relevance to product:*
  - Significant, moderate, peripheral, etc.
- *Proximity to individual:*
  - On individuals, on belongings, on service-related objects, etc.
- *Individual agency:*
  - Alternatives (avoidable – e.g. garments/retail)
  - No alternatives (forced – e.g. government introduction of Passports)

- *Data collection/profiling:*
  - Part of service
  - Future potential
  - No collection of individual data (personal, location, action/behaviour data)
- *Degree of controversy:*
  - Media exposure, public discourse around technology (prior to or after introduction).
- *Degree of pervasiveness:*
  - High, medium, low (+ explanation)
- *Duration of use:*
  - Temporary (e.g. hotel-service, skipass, etc)
  - Permanent (e.g. Passport)
- *Level of maturity:*
  - Full implementation – large scale
  - Full implementation – local
  - Pilot
  - Concept/vision
- *Other elements:*
  - Privacy invasiveness (present-day)
  - Potential for function creep (being applied to future services unforeseen today)
  - Potential for "Internet of things" (possibility of being connected to a wider open/closed internet-of-things-system)

2.1.2 Second deliberation

The second workshop emphasized other aspects and qualities that may pertain to RFID-applications that were not (or only partly) addressed in the first deliberation:

<u>General characteristics of RFID-enabled applications:</u>

- Automation
- Improved efficiency / predictability
- Cost control / cost reduction
- Self-service / management
- Real-time data exchange / interpretation
- Reduction of human intervention / human error
- Personalisation of services
- Increased security
- Integration of (heterogeneous) services

<u>Specific functions pertaining to RFID-enabled applications:</u>

- Individual / specific product identification / verification
- Physical access
- Surveillance / control
- Point-of-Sale / check-out
- Individual tailoring
- Location-based services / marketing
- On-site information retrieval / information display / communication
- Contactless payment / loyalty

<u>Relevant aspects pertaining to users:</u>

- Trust

- Risk
- Usefulness
- Ease of use
- Convenience
- Safety, security
- Cost-benefit evaluations
    - E.g: Trade-off between personal data exchange (privacy, security) vs optimised, integrated services (benefit, convenience)
- Control / agency (technology/system determination vs. personal determination)
- Personal data proliferation
- Universal design issues

Relevant roles in application use:

- Citizen (public services)
- Client (public or private services)
- Consumer (shopping, leisure activities)
- Employee (work situation)

Visibility of RFID as technology:

- Is the core service/product that is reflected in the case study *perceived as a technology* – or is the technological component *perceived as invisible/irrelevant* to the user?
- Is the product/service a concrete *tangible product* that the user can relate to conceptually, or is it *part of a "system"* that the user does/or cannot relate to as a whole?
- To what extent are RFID-enabled products/services "made visible" in user environments through signs, labels, information/awareness raising?
- (These aspects are relevant when choosing the analytical approach – e.g. whether technology acceptance models or domestication/appropriation of technology perspectives should be applied).

The concept of data:

- The way *data is conceptualised* (i.e. private, behaviour, log, transaction data, etc.) is critical for how one approaches data retrieval / data exchange in an RFID-based system.
- Example 1: will data collected be on an *aggregated level*, does it involve specific *personal data* about the user/user behaviour, or does it involve context-retrieved data, such as *location, position and time references* of movements (location data, movement logging)? In a strict conceptualisation of the latter data capture is not considered "personal data", but on a different level it is highly relevant in privacy terms (cf. ETAG 2006: 22). What is the potential for re-identification/de-anonymization of aggregate/anonymized data?
- Example 2: Movement logging/location data can be perceived in different ways according to purpose. In one instance, this can be experienced as highly invasive and people may feel subject to surveillance and lack of control (e.g. extensive logging of behaviour in retail). In other instances the same logging/data transfer may be the key element of a service, e.g. monitoring dementia patients in their own home for safety purposes.

2.1.3 Third deliberation

I the third deliberation the project group returned to a more contextual focus of daily events/ people-centric technology applications:

Near/on/in user:

- Services enabled by smartphones with NFC-capacity
- RFID-tags on apparel/clothing
- RFID-tags on personal items (IDs, passports, travelcards, paycards, keys)
- Wearables (foot-band, wristband – for training, health monitoring, leisure/festival arenas, etc)
- Implants (for health-monitoring, or subdermal chips for ID/payment)

Domestic life/at home:

- Range of smart home services (with RFID solutions)
- Smart home consumer electronics (fridges, washing machines, etc that communicate with "inserted" objects (food, clothes)
- Safety alarms
- RFID-tags on pets (ID)
- Access-cards/keys to front door
- Tracking of people at home (incl. GPS, for i.e. dementia patients, or home-imprisonment)

Transport:

- Car keys
- Travel cards for public transport
- Toll road
- Public posters/commercial ads (also QR-codes)
- ID/Passport

Retail/commerce:

- Smartphone solutions (using, QR-codes, NFC or BLE, for payment, information, marketing, etc)
- Grocery stores – for supply-chain tracing/tracking of food. Potential for enhanced consumer information services.
- Retail/clothes stores – for supply-chain tracking of clothes, theft alarm, "smart receipts/complaint handling, and potential for "smart clothes" communicating with washing-machines, etc.
- Consumer electronics; supply-chain management, theft-alarm, anti-counterfeit, "smart receipts", etc.

Leisure:

- Festivals (wristbands; tickets/entry, ID, payment)
- Stadium arrangements (wristbands/NFC-phones; tickets, access, ID, payment, loyalty)
- Amusement parks (wristbands; tickets/entry, ID, tracking, enhanced services, payment)
- Swimming halls/gyms (wristbands; tickets/entry, lockers, payment)
- Ski resorts (smartcards, skipass/ticket, tracking, enhanced services)
- Running events (relay batons/wristbands; ID/registration, time-taking/tracking)

Public services:

- Libraries (smart check-out of books, theft control, enhanced services)
- Hospitals (tracking of garments, babies, patients, health-monitoring)
- Retirement homes (tracking/caring for elderly, dementia patients)

2.2 Case structuring – roles, activities, functions

By using the various criteria from the three above-mentioned deliberations, we produced a more intuitive case structuring logic – a hierarchy of roles, generic activities, specific activities/services, and functions/benefits, which can be used for the selecting and organizing the various RFID-cases later in the project. The idea was to start with the citizen-consumer roles (including the roles of client/customer, while the employee role is partly downplayed in this structure) – then adding activities and functions in a tree-like structure. This structure then provided us with a better foundation for designing a template and for selecting cases to be further explored.

The tree-structure is presented below: *1) Roles, 2) Add: Generic activities, 3) Add: Specific activities/services, 4) Add: Functions/benefits.* It is important to note that what is identified below does not give a complete picture of all relevant RFID-enabled services, but provides and overview based on project priorities and availability of information at a given point in time (primarily the period 2010-2012).

2.2.1 User roles:

- Consumer
- Citizen

2.2.2 Add: Generic activities:

- Consumer:
    - Shopping
    - Private transport
    - Public transport
    - Accommodation
    - Leisure activities
    - Home
- Citizen
    - Travelling abroad
    - Public services
    - Health-care

2.2.3 Add: Specific activities/services:

- Consumer:
    - Shopping
        - Apparel
        - Groceries
        - Consumer electronics
        - Marketing
        - Payment
    - Private transport
        - Toll station passage
    - Public transport
        - Ticketing and information services
    - Accommodation
        - Hotel check-in and room access

  - Leisure
    - Stadiums/concert arena services
    - Amusement park/gym services
    - Ski resort services
    - Running event services

- Citizen
  - Travelling abroad
    - Passports
  - Public service
    - Libraries
  - Health-care
    - Patient support
    - Employee/hospital support/efficiency

2.2.4 Add: Functions/benefits:

- Consumer:
  - Shopping
    - Apparel
      - Tagging clothes (theft prevention, anti-counterfeit, enhanced shopping experience, point of sale efficiency, future claims [receipt]).
    - Groceries
      - Tagging individual products, scanning (for enhanced/additional information [origin, contents, handling], in-aisle companion, marketing, point of sale efficiency).
    - Consumer electronics
      - Tagging items (theft-prevention, anti-counterfeit, future claims [receipt]).
    - Marketing
      - Loyalty services, location-based marketing (tailored on-site/just-in-time marketing activities, through RFID-, NFC-, BLE/beacon-based data transfer to users [and their smartphones, smart device]).
    - Payment
      - Contactless payment by cards/smartphones (point of sale efficiency, security [reduced money handling], loyalty services, value-added services).
  - Private transport
    - Toll station passage
      - Toll collection (automated payment, driver convenience, improved traffic flow, time-location registration [police investigation, driver cost-management]).
  - Public transport
    - Ticketing services

- Contactless ticket purchase and verification (easy purchase and verification of ticket, reduced need for money handling, value-added services).

- Accommodation
  - Hotel check-in and room access
    - Mobile booking and check-in, contactless keys, loyalty/marketing potential.

- Leisure
  - Stadium/concert/festival arena services
    - Access, payment and enhanced information services (RFID-enabled wristbands [access, ID, payment, event info])
  - Amusement park/gym services
    - Access, payment, locking, tracking services (RFID-enabled wristbands [accessing facility, paying for products, locking/unlocking lockers, tracking children at premises]).
  - Ski resort services
    - Access, payment, tracking of movement (RFID-enabled smartcards [access to ski-resort and ski lifts, payment of services, tracking activity, enhanced services]).
  - Running event services
    - ID, tracking of runners (RFID-enabled wristbands, relay batons [timing services, runner ID control, aggregated time services]).

- Citizen
  - Travelling abroad
    - Passports
      - Enhanced ID capabilities (RFID, biometrics)

  - Public services
    - Libraries
      - Tagging individual items for improved ID, management, tracking, theft-prevention (freeing employees of labour intensive book-handling, efficient check-out through self-service, potential for fully "automated" libraries [100% self-service]).

  - Health-care
    - Patient support
      - Hospital efficiency / patient safety / improved health services (enhanced ID, patient/child tracking, increased data retrieval of body functions)
      - Assisted living – services for municipal or private smart home facilitation (appliance automation/steering, people tracking, alarm functions, surveillance).
    - Employee/hospital support/efficiency
      - Identification and tracking/logging of hospital products and employees (time-use, location, garments, etc.).

3 Cases to be selected for further investigation

So far our deliberations and mapping exercises have been guided by themes and priorities already set in the project description, as well as negotiated through extensive desk research on available implementations and pilots, both internationally and in Norway.

In this next step searching for relevant cases to study more extensively, we sought to narrow our focus to *specific cases in the Norwegian context*. Hence, the project group first gathered information about relevant cases at the time (time period around 2010-2012), and organised these according to a simplified template, and with the idea of variation with respect to the aspect referred to the in the previous chapters.

3.1 Simplified template – first case selection

Below we present an overview of 13 cases that were selected for further description and investigation. In this first simplified template we apply just a few key criteria as a way to provide an easily accessible introduction to these cases:

Key criteria:

- User context
- RFID proximity to user
- RFID type (RFID, NFC, QR, etc. – short range/long range)
- Maturity level (long-time implementation, recent implementation, conceptual)
- Function(s)
- Challenges/controversies

At the start of this work we had many potential cases listed in the simplified template, but several of these were taken out as they did not fit the core idea of the project, or they proved to provide too little information to work with.

Some of the cases/examples that were identified and explored but later left out were; solutions for stadium arrangements (such as Norwegian provider Buytec with "smart stadium" solutions for ticking/access control, e-cash and loyalty systems); training devices (such as Nike/iPod) for monitoring/tracking of consumers; RFID-enabled hotel locks (such as Choice Hotel in Oslo and the provider Ariane solutions); hospital solutions for tracking babies (such as A-hus) and tracking garments (St Olavs Hospital); pilot systems for home imprisonment using ankle bracelets as electronic control (through GPS or RFID); and more generally systems such as tagging money, RFID-enabled car keys, etc.

In addition we explored RFID-solutions for consumer electronics (such as the Elkjøp pilot that was discontinued), as well as solutions for the grocery sector (involving Smarttrack/Fri vareflyt/RFID-huset, GS1 Norway, NLP Nortura/Norsk Lastbærerpool, Matiq, HRAFN, Telenor

and LEXIT). Finally, as SIFO was involved in the RCN-financed project *NFC City*, we considered doing additional case studies on the NFC trial cases, but concluded that this would involve too much overlapping work.

Hence, after an iterative process of exploration and exclusion, we ended up with the 13 cases listed in the simplified template below:

Overview of 13 RFID cases selected for primary investigation (per 2010-2012)

No	Case	User Context	RFID proximity to user	Anticipated RFID technology	Maturity	Function(s)	Challenge/controversy
1	Autopass – toll road collection system	In cars	Attached to car window	RFID , long-range	Long- time	Toll collection/payment	Surveillance potential, privacy, function creep
2	Skien Fritidspark – indoor waterpark	In pool area	Attached to wristbands	RFID, short-range	Recent	Access, locker key, payment	Little
3	Deichmanske bibliotek/Oslo universitetsbibliotek – public/university libraries	In library	Attached to books	RFID, short-range	Recent	Efficient loans and services / cost, labour management / theft prevention	Little
4	Flexus/Ruter – Oslo/ Akershus public transportation	In public transport vehicles	Smartcard in wallets, pocket	RFID, short-range	Recent	Payment, identity check	Security, surveillance/tracking, privacy
5	Oslo Vinterpark/SkiPass – alpine skiing resort	In ski resort	Smartcards in pockets, ski card holders	RFID, short range	Recent	Access, payment	Little
6	Oslo Marathon – running event	In race	Footband	RFID, long-range	Long-time	ID/runner number, timing	Little
7	Dyreidentitet – tagging pets with ID chips	At home on pets	Subdermal chips	RFID, medium-range	Long-time	Tracking, ID	Little
8	Coop ShopExpress – scan and pay for groceries	In grocery stores	On grocery packages / smartphone	QR, Barcode, smartphone	Conceptual, partly implemented	Scanning goods, Payment, exit/security	Privacy, segmentation
9	Slottsfjell – music festival contactless access/payment	At festival area	Wristband	RFID, short-range	Recent	Access, enhanced info, payment	Little
10	Trondheim clothing stores – item-level RFID	In apparel industry/ clothes stores	On clothes	RFID, short-range	Recent/ conceptual	Tracking, enhanced information	Little
12	Caring (tracking) technology for elderly - (master case)	In nursing homes for elderly	Necklace (or attached to clothing, wristband, etc)	GPS, long-range (RFID)	Conceptual	Tracking/locating people	Surveillance, privacy
13	Norwegian passports – digital biometric identification	In airports, border crossings	In passports	RFID, Short-range	Long-time, (implemented gradually from 2005)	Identification	Security, privacy

3.2 Extended template for case structuring

Based on the work described in the chapters above – involving several workshops/deliberations, desk research, search for relevant applications/pilots, and active visits and interviews – we developed an extended template in order to get richer, and more structured descriptions for the selected cases. These cases vary a lot, and it was expected that it would be difficult to find relevant information on all parameters for all cases. We also decided to include cases that we

would not continue to explore further, as well as cases that we would do fieldwork on later (this implies that there is a description from a case used in a master thesis, as well as a case used in the *post doc* work). Below we present the extended template:

Case information	
Case name	•
Year introduced	•
Sector type	•
Maturity	•
Actors	•
Technologies	
RFID type (or similar tech.)	•
Technology presentation	•
Functions	
Service function	•
Purpose (original purpose)	•
Potential functions (function creep)	•
User aspects	
Data harvesting/ transmission	•
User costs	•
User profiling	•
Proximity to user	•
Individual choice	•
Information/signs	•
Societal aspects	
Degree of controversy	•
Pervasiveness	•
Privacy issues	•
Consumer issues (+) and (-)	•
Societal issues (+) and (-)	•
Internet of things potential	•
Case description	•
Media links	•

4 Extended template applied to selected cases

The 13 cases identified and described by using the extended template were chosen for several purposes; some were already implemented systems with a long track-record, others were novel systems that had recently been implemented, while some were still on the conceptual/pilot level, but with future potential. The reason for picking cases at several levels of maturity was both due to practicalities (available cases) and to include the aspect of different "life phases" of systems.

The case descriptions below have been conducted by several researchers in the project, mainly in the period 2010 to 2012. It is important to note, as mentioned in the previous chapter, that the descriptions vary a lot due to differences in available data for each case. In addition, a range of other cases were discussed and left out for various reasons, such as lack of available information, discontinued pilots, failed implementations, and so on[21].

Case 1: AutoPASS – toll road collection system

Case information	
Case name	• AutoPASS – toll road collection system
Year introduced	• Technology implemented in 1998 (Oslo, Norway)
Sector type	• Transportation, road financing
Maturity	• Implemented, long-term, commercial (majority of toll-based highways)
Actors	• Q-Free (developer) • Vegdirektoratet (owner) • Fjellinjen and others (toll collector)
Technologies	
RFID type (or similar tech.)	• Active RFID (battery-enabled) – DSRC[22] • Long-range, constantly radiating signals, payment (encrypted), ID (non-encrypted) • Reader in toll booth • Assistive camera near toll booth • Decentralised database
Technology presentation	• "AutoPASS-brikke" (AutoPASS chip)
Functions	
Service function	• Toll collection (payment) • Car verification (legitimate access)
Purpose	• Automation (improved traffic flow at toll stations)

[21] Disclaimer: the information available in each case template reflects only interpretations by researchers based on available data from desk research. These data have not been verified by the actors/suppliers/service providers mentioned in the cases.
[22] Dedicated short range communication

(original purpose)	• Cost reduction (reducing man-staffed booths) • Loyalty (discounts) • Security/safety (reduced need for physical money handling)
Potential functions (function creep)	• Increased taxation control • Personalized insurance • Traffic management, traffic control (smart city) • Value added services, integrated services
User aspects	
Data harvesting/ transmission	• Yes; identification (car; driver indirectly deduced from vehicle ID), passage (location, time), payment (date, time) • Tag constantly emitting signals, reading only at toll booth
User costs	• Non (free use), only passage costs, tech replacement free for user
User profiling	• Yes; fairly extensive (full purpose + future purpose unknown) • Profile of users – connected to number of passages (third party management) • Users can access profile online (encrypted)
Proximity to user	• On belongings (on car window)
Individual choice	• Partly avoidable; alternative roads, manual payment some places (no traces, no profiling), 3) anonymous tag debated politically
Information/signs	• Information about data transmission displayed through sign at toll booth.
Societal aspects	
Degree of controversy	• Medium: Media debate (oscillating, tied to crime/police investigations), data authority (several aspects; anonymous passage, third party readings [unauthorized]). Controversies on the international arena.
Pervasiveness	• Medium; car not tied to individual users, but possible to circle in user by comparing with other data.
Privacy issues	• Single readings. But; potential for tracking movements on grander scale when systematizing/aggregating data readings. Potential for hacking (online profiles).
Consumer issues (+) and (-)	• (+) Convenience (easy traveling), automatic payment deduction, can be used at all Nordic toll booths, access to passage data (passage/cost management) • (-) Registration and monitoring of travel habits (time-location) over time, wide range of data harvested and transferred (consent?)
Societal issues (+) and (-)	• (+) Improve traffic flow, reduce traffic jams, reduce CO2 emissions, integrated national toll collection system. • (-) data management (what data, when, why and to whom?)
Internet of things potential	• AutoPASS, in combination with other systems, can potentially provide a complete ecosystem for traffic management (and other purposes). Combination of RFID, satellite systems, databases (CVIS[23]) possible. • Expand from toll collection to safety, warning, planning systems, insurance. Technologies work in combination.
Case description	• (extended case description in report deliverable 2 of 4)

[23] Cooperative Vehicle Infrastructure Systems. Ref: http://www.cvisproject.org/

Media links	• http://www.cvisproject.org/download/RACC%20Survey/CVIS_Norway_v1.0.pdf • http://www.rfid-rnet.com/Presentations_11_May_2010/O_Kristiansen_Q-Free_Workshop_IoT_Oslo_11_May_2010.pdf

Case 2: Skien Fritidspark – indoor waterpark

Case information	
Case name	• Skien Fritidspark – indoor waterpark
Year introduced	• Technology implemented in 2008 (Skien, Norway)
Sector type	• Leisure, amusement
Maturity	• Implemented, medium-term, commercial
Actors	• Menerga (developer) • Skien Fritidspark (owner)
Technologies	
RFID type (or similar tech.)	• RFID (short range) - integrated access/ticket, lockers, payment system • Semi-active chip? • Readers at entrance, on lockers, in café, at payment machine (near exit), at exit point
Technology presentation	• "Elektronisk armbånd" (Electronic wristband) (owner) • "RFID armbånd" (RFID braclet) (developer)
Functions	
Service function	• Ticket/access • Wardrobe locks • Payment at café (wallet; user pay at RFID-enabled kiosk before exiting) • Identification (only yearly subscribers)
Purpose (original purpose)	• Convenience – removal of physical ticket, locker keys and personal wallets from the premises. One bracelet integrates all functions. Water resistant (rubber sealed). • Loyalty (yearly subscription – bracelet brought home)
Potential functions (function creep)	• Further integration with new/future solutions • Little. Marketing/loyalty potential, registry of location, time, expenses? (registry kept for analyses already?).
User aspects	
Data harvesting/ transmission	• Minimum, only readings at specific points (access, lock, kiosk). Purchases paid upon exit. • RFID-chip in bracelet/wristband only activated by readers
User costs	• Non (free use, only entry payment)
User profiling	• Profile of users only relevant for yearly subscriptions. Individuals keep bracelet at home. Bracelet contains information and photo of the keeper.
Proximity to user	• On person (arm wrist) • Yearly subscriber – bring bracelet home • One time visitors – return bracelet upon exit
Individual choice	• None. RFID-enabled device required when entering the premises (access function) • Can be removed from arms inside premises • Children's wristbands have no payment function • Optional to use wardrobe locks and payment at kiosks
Information/signs	• No information at the premises (no signs of RFID tech).
Societal aspects	
Degree of controversy	• None. No media exposure. No public discontent uttered
Pervasiveness	• Low; only used at premises, not at home or outside.

	• yearly subscribers: medium when at premises. Same functionality as single use, but personal information contained in bracelet.
Privacy issues	• Only single readings when RFID-enabled wristband is activated by readers. But; potential for tracking movements on a small scale. System can in theory be hacked. Personal data may be extracted. Money cannot be stolen from the "wallet" as purchases are paid at exit (hence same function as a credit card). Low chance of fraud.
Consumer issues (+) and (-)	• (+) Convenience (integrated services), no need to carry keys, ticket or wallet on the premises. All valuables can be locked in. Water resistant bracelet, robust. No payment possibility for children. • (-) Registration of entry-exit times. Can be used for investigations?
Societal issues (+) and (-)	• (+) System can be expanded to a range of new integrated services. Synergies if integrated with other services in the local community. • (-) Unknown.
Internet of things Potential	• This system has potential for highly integrated services in defined areas of application – potential for a local/community internet of things?
Case description	• (extended case description in report deliverable 2 of 4)
Media links	• http://skienfritidspark.no/nor/Badeland/Bestill-aarskort • http://www.menerga.no/1/adgang.html

Case 3: Deichmanske bibliotek/Oslo universitetsbibliotek – public/university libraries

Case information	
Case name	• Deichmanske bibliotek/Oslo universitetsbibliotek – Oslo public/university libraries
Year introduced	• From 2010 onwards (first library project in Norway)
Sector type	• Public libraries
Maturity	• Pilot/partly implemented in public libraries
Actors	• University of Oslo Library • Deichman (Oslo public library) • RFID suppliers (Gemsys)
Technologies	
RFID type (or similar tech.)	• Passive RFID chips • Short range • Reader in self-service customer kiosk by the exit • Anti-theft system at exit (RFID in books responding to readers at entrance/exit) • Database
Technology presentation	• None signs/label in the libraries
Functions	
Service function	• Book or disc loan control • Theft prevention
Purpose (original purpose)	• Automation (improved customer service) • Cost reduction (reducing man-staffed reception) • Improved customer convenience • Inventory control/management
Potential functions (function creep)	• Mapping of loan patterns • Value added services, integrated services – e.g deeper analyses of users based on types/content of books/DVD etc. borrowed, to provide improved suggestions
User aspects	
Data harvesting/ transmission	• Yes, identification (from books; can indirectly deduce user) • Loan patterns • Tag read at loan automat and when exiting
User costs	• Non (free use)
User profiling	• Profile of users – connected to loans • Users can access “My profile” online (encrypted)
Proximity to user	• On loaned objects (books, CDs, DVDs)
Individual choice	• None
Information/signs	• Information sign informing about RFID-marked books
Societal aspects	
Degree of controversy	• Low: No media debate yet. High level of trust concerning data processing. Controversies in the US, connected to the ‘Patriot Act’ (potential ability to connect user readings with suspicious activity)
Pervasiveness	• Medium; tied to individual only as library customer, not to other aspects of the individuals everyday life.

Privacy issues	• Little, so far. Potential for mapping reading patterns and connecting these with other data. Frequency of use, book titles, location/time data registered could provide a sense of the person based on interests/reading habits (similar to Amazon).
Consumer issues (+) and (-)	• (+) Convenience (easy borrowing, easy access to book information), increased privacy as librarians does not have to see the content borrowed), increased automation may allow for extended opening hours/fully self-serviced libraries • (-) Registration/records of reading and listening habits over time, could prove to be privacy invasive.
Societal issues (+) and (-)	• (+) Improved/modernized public services, reduced customer lines, new tasks for librarians - such as improved customer service • (-) Too much automation/self-service. Librarians may lose jobs.
Internet of things potential	• RFID in libraries in combination with other systems (e.g. Bibsys) will give a more encompassing information system for library objects/things. • "Connected books" could potentially be integrated with other public "things" or services
Case description	• The case is of a 'double' character: It involves two large library institutions in Oslo; The library for the Human sciences at the University of Oslo, and Deichmanske, the public library for the city of Oslo. Deichmanske has already initiated RFID tagging of books and discs; the planning started in 2008 and is nearly completed in the main branch and some local branches. The digital group follows closely the development concerning IoT. The University of Oslo Library for the Human Sciences plans to begin tagging in 2012; the pace forward depends on funding. Since the two library institutions differ (e.g. in terms of user groups), and initiated the RFID planning process at different points of time, fruitful comparisons are possible, regarding purposes, implications and outcomes. • (extended case description in report deliverable 2 of 4)
Media links	• http://www.sciencedirect.com/science/article/pii/S0268401210000988 • http://www.deichmanske-bibliotek.oslo.kommune.no/ • http://www.ub.uio.no • http://www.bibsent.no/automatisering/rfid.aspx • http://www.biblev.no/rfid-no.html • http://www.biblev.no/RFID/nor-rfid.html • http://www.biblev.no/RFID/rfid_norsk_kommentar.html • http://digital.deichman.no/blog/2010/10/29/selvbetjening-pa-deichmanske-bibliotek/ • http://www.digi.no/109603/forste-rfid-prosjekt-i-norge-i-gang • http://www.bic.org.uk/e4librariesfiles/pdfs/090910%20fortune%20nag%20Changing%20times%20for%20RFID.pdf

Case 4: Flexus/Ruter – Oslo/Akershus public transportation

Case information	
Case name	• Flexus/Ruter – Oslo/Akershus public transportation
Year introduced	• From 2007 piloting, gradual implementation from 2010, by 2011 used in 94 % of all public transport
Sector type	• Public transport Oslo and Akershus
Maturity	• Implemented, commercial
Actors	• (Flexus) Ruter As, NSB
Technologies	
RFID type (or similar tech.)	• RFID, short range • Flexus is a contactless smartcard (Mifare DESFire). Based on the standard in (*Håndbok 206 Elektronisk billettering*). Other travalcards throughout Norway are based on the same standard, but delivered by Fara. • RFID readers inside public transportation vehicles and on platforms
Technology presentation	• «The Flexus card», new ticketing and payment system (Nytt billetterings- og betalingssystem, NBB) or electronic ticketing (Elektronisk Billettering i Ruter, EBIR from 2007). New name and look in 2010 (NSB)/ 2011 (Ruter); NSB/Ruter travelcard (NSB reisekort/Ruter Reisekort).
Functions	
Service function	• Payment • Ticket verification • Automation, self-service (improved customer service)
Purpose (original purpose)	• Better payment/control system • Improved customer service • Cost reduction for company
Potential functions (function creep)	• Mapping of travel patterns • Combined/integrated services, i.e with other public services, or similar services in other regions
User aspects	
Data harvesting/ transmission	• Yes; payment transfers and travel patterns. Money and travel pattern (8 last travels) on card, if unregistered card. If registered card, also tied to personal data) • Users can access "My profile" online (encrypted), register and keep track of several cards, also possible to subscribe to service/payments • Tag read only at automat at station or transport (and mobile reader control). Smartcard only communicate when activated by reader (no continuous transmission of signals)
User costs	• Non (free use), only use of transport service costs. (But the cost of travelling increased with the introduction of the card; covering cost of tech development?)
User profiling	• Not yet, but at a certain point check-in and check-out of public transport was intended, but deemed to be too privacy-invasive (location privacy)
Proximity to user	• Close to body (smartcard in wallet, pocket in clothes)
Individual choice	• None. Compulsory travel means
Information/signs	• No information of technology in use
Societal aspects	
Degree of controversy	• High to medium: Much media debate from 2005 – 2012 before and after implementation. Controversies on technical solutions, budget expansions, travel control and surveillance/privacy issues (i.e. the idea of registering

	both check-in and check-out of public transport by validating the card twice).
Pervasiveness	• Variable: unregistered cards are not linked to other aspects of the individual, but if user has registered the card on "My profile", then card is tied to individual information. Also; frequency of use, travel patterns, location/time data are registered and store several years, but not published online).
Privacy issues	• So far single readings. Potential for mapping travel patterns (location data). Travel information may be coupled to other kinds of information about the individual (profile data). Aggregated, anonymized data about user can be used for improving fleet efficiency.
Consumer issues (+) and (-)	• (+) Convenience (easy travel), automatic payment deduction, can be used in all of Oslo/Akershus area (perhaps in the future in all of Norway?), possible future access for consumer to personal travel data (and cost/travel management possibilities) • (-) Registration and monitoring of travel habits (time-location) over time, wide range of data transferred (consent?), paying and monitoring travelcard at the time of travel has been difficult, cards have limited functioning time, travel services have become less flexible and more expensive, and service personnel more difficult to reach.
Societal issues (+) and (-)	• (+) Improves public transport management/efficiency, reduces customer lines • (-) Privacy, data management (what data, when, why and to whom?)
Internet of things Potential	• In the future; integrated in smartphones to reduce the amounts of cards, integrated/combined with other RFID systems, to improve traffic flow in general ("smart city", "smart transportation"), travel information can be accessed by NFC-tags on stations and hotspots [cf. NFC City project].
Case description	• (extended case description in report deliverable 2 of 4)
Media links	• http://www.discoverrfid.org/your-questions/what-experts-have-to-say/daniel-p-mullen.html • http://no.wikipedia.org/wiki/Flexus • http://ruter.no/no/billetter/reisekortet/ • http://ruter.no/no/Om-Ruter/personvern/ • http://ruter.no/no/billetter/utsalg/ • https://www.nsb.no/kjop_periodebillett/ • http://www.ivarjohansen.no/dmdocuments/masteroppgave_julie_krogstad.pdf • http://www.ifea.no/wp-content/uploads/2010/12/Automatisering__artikkel_RFID_des2010.pdf • http://www.digi.no/219525/rfid-som-billett-paa-offentlig-transport • http://en.wikipedia.org/wiki/MIFARE#Transportation

Case 5: Oslo Vinterpark/SkiPass – alpine skiing resort

Case information	
Case name	• Oslo Vinterpark/SkiPass– alpine skiing resort
Year introduced	• Not found
Sector type	• Skiing resorts
Maturity	• Implemented, commercial
Actors	• Tryvann, Wyller, Hyttli, Tommkleiva and Varingskollen Alpine Centre
Technologies	
RFID type (or similar tech.)	• RFID contactless card • Short range • Reader at entrance to lift • Season cards; personal, long lasting, picture, ID, rechargeable • Drop-in card; personal, chip-card needed, disposable
Technology presentation	• Touch-free ticket system • Info om webpage about the «chip-card system»
Functions	
Service function	• Payment • Ticket verification (ID verification) • Automation (improved customer service, reduced queues • Hands-free comfort • Low risk of loss • Can be used in several ski parks
Purpose (original purpose)	• Payment/control • Automation (improved customer service) • Cost reduction
Potential functions (function creep)	• Payment control • For all: aggregated data for mapping of resort use • Personal; logging of height/meters of downhill skiing, based on which ski lifts are used, rating points for skiing, sharing in social media (through validation of RFID card + connected services [Facebook, etc]) • "Internet of Things"-promise: not only about collecting information in real time, but using information, aggregating it, enabling decision-making processes and providing customers with new information/services[24]
User aspects	
Data harvesting/ transmission	• Yes, for season card users; profile of users connected to payment and lift/ski-park use • Tag read only at automat by lift station (and mobile reader control?) • RFID ski-card only communicates when activated by reader (no continuous transmission of signals)
User costs	• The card itself costs NOK 45, card must be charged with money and can be recharged.
User profiling	• Not yet
Proximity to user	• Close to body (in wallets, pockets, attached to string)
Individual choice	• None, except type of card (season, drop-in)
Information/signs	• No information defining RFID in use • RFID briefly referred to on website
Societal aspects	
Degree of controversy	• Low. No controversies found.

[24] Cf: http://www.biztechmagazine.com/article/2013/05/rfid-tags-get-skiers-back-slopes-no-time

Pervasiveness	• Low: cards are charged with money but not with personal information, but each card has unique ID.
Privacy issues	• So far single readings. • But aggregated data - frequency of use, skiing frequencies patterns, location/time data - can potentially be registered and stored and used for new services/marketing purposes.
Consumer issues (+) and (-)	• (+) Convenience (easy use), automatic passage, low risk if card is lost, can be used in several ski parks in the Oslo area, possible future access for consumer to personal data (and cost/lift use management) • (-) Registration and monitoring of lift use (time-location) over time, wide range of data transferred (consent?)
Societal issues (+) and (-)	• (+) Improves management/efficiency at ski resorts + seamless use of several ski resort services, reduces customer lines • (-) Identification data management (what data, when, why and to whom?)
Internet of things potential	• In the future; integrated in the smartphones to reduce the amounts of plastic cards? • More seamless systems with integrated /combined services • Hence potential for fully integrated vertical services (delimited/closed internet of things)
Case description	• N.a.
Media links	• http://www.tryvann.no/oslo-skiresort-winter-park-holmenkollen/oslo-skiresort-tryvann/ski-pass-oslo-vinterpark • http://freak.no/forum/archive/index.php/t-123786.html • http://www.idg.no/computerworld/article198531.ece • http://www.epicmix.com/ • http://teamaxess.com/en/product-details.php?id=40&uid=120_smart_gate_turnstile_floormounted_ax500_v2 • http://www.biztechmagazine.com/article/2013/05/rfid-tags-get-skiers-back-slopes-no-time

Case 6: Oslo Maraton – time and runner management

Case information	
Case name	• Oslo Maraton – time and runner management
Year introduced	• From 2005?
Sector type	• Sport events
Maturity	• Implemented
Actors	• Sports club (SK Vidar) • Danish provider of technical gear (Ultimate?)
Technologies	
RFID type (or similar tech.)	• Passive RFID, medium-range? • Reads shoe-tag on runners when they pass certain RFID points along the track
Technology presentation	• Time-taking chip (*Tidtakerbrikke*) on shoe
Functions	
Service function	• Register runners • Measure intermediate time and end time • Aide in selling runners' pictures
Purpose (original purpose)	• Necessary to handle large sports arrangements • Improved services for participants
Potential functions (function creep)	• Linking to third-party commercial actors? (already introduced to some extent) • Mapping of individual running patterns, customized commercial contact. • Link to Facebook, mobile apps,
User aspects	
Data harvesting/ transmission	• Yes; sport club + several commercial actors • Sale of pictures of race, shoes, sports clothing, etc. – linked to personal email address • Profile of users – users can access info online? • Tag read only at given sites in the race.
User costs	• Linked to race fee.
User profiling	• Little available information
Proximity to user	• On shoes, only during sporting event
Individual choice	• No, necessary for participation
Information/signs	• Not info about the RFID-technology
Societal aspects	
Degree of controversy	• None
Pervasiveness	• Low: linked to individual user, but only during specific events. Tags on shoes only activated when close to readers.
Privacy issues	• Potential for linking personal/race info to other arrangements and for selling info to commercial actors. • No visible info about non-dissemination of private information.
Consumer issues (+) and (-)	• (+) Great user advantage in the sense of quick and reliable info on race-related issues (intermediate times, average, etc.) • (-) Little control over potential commercial exploitation.
Societal issues	• Little societal relevance, only if developed into new services

Internet of things potential	• On an arena in which bodies and physicality are central, which is of great significance for individuals, and of great commercial interest the potential for individualized based, potential for more permanent use of personalized chips (either on shoes, fit bands, or smartphones), to be used at several types of sport events. Hence people and their "sport things" may be connected to various open/closed connected (internet)-services.
Case description	• Mass sports arrangements have benefited greatly from the introduction of technological solutions to handle vast masses of information. The RFID-solutions give instant and reliable information both to those responsible for the events, and to the participants themselves. Information on intermediate times, on average time, on maximum and minimum time use on laps all give added value to those participating in such races. • One of the aspects that guarantees RFID's central role is that it is a cheap solution, it is easy to use for the participants and for each user it is hard to see any disadvantages, as long as users are aware of it being used, and given that they can give/withdraw consent to information being used for other purposes (and to third parties). • (extended case description in report deliverable 2 of 4)
Media links	• http://www.oslomaraton.no/ • http://www.rfidjournal.com/article/view/5068/2

Case 7: Dyreidentitet – tagging pets with ID-chips

Case information	
Case name	• Dyreidentitet – tagging pets with ID chips
Year introduced	• 1992 – central register of ID-tagged pets in Norway
Sector type	• Domestic animals / pets
Maturity	• Implemented, commercial
Actors	• Leading actor in Norway is the company Dyreidentitet AS (owner: Den norske Veterinærforening) (in cooperation with Norsk Kennel Klubb (NKK), Dyrebeskyttelsen Norge (DN), Norsvin, Geno, etc.
Technologies	
RFID type (or similar tech.)	• Passive microchip with unique ID. Cf. ISO Standard for the identification of animals (11784/785). • Microchip (transponder) measures 11 x 2,1 mm. and is preprogrammed with a 15 digit number, which follows the pet its entire life. A vet injects the chip under the skin, on the left side of the neck of the animal
Technology presentation	• Subdermal tagging of pets with ID
Functionalities	
Service function	• RFID tags for registration and identification of pets (and production animals) • Registering animals in a central database • Tracking and identification of animals
Purpose (original purpose)	• Digital identification of pets • Tracking of lost pets • Lifelong-ID, follows pet after change of ownership
Potential functions (function creep)	• Wider identification opportunities • Potential for combining with animal health data • Harmonizing with European pet databases
User aspects	
Data harvesting/ transmission	• To read the ID of a pet chip an RFID reader is needed. There is no restriction on purchase and use of readers. Prevalence of readers is increasing; and are now at custom stations, police offices, veterinaries etc. • Chip only read when a reader is near the pet.
User costs	• Yes; chipping, transfer of ownership, and readers
User profiling	• No, some user data in database, not in chip
Proximity to user	• Close, as users constantly interact with pet
Individual choice	• Yes, but it is highly recommended that pets are tagged
Information/signs	• No, not relevant
Societal aspects	
Degree of controversy	• Little
Pervasiveness	• Little
Privacy issues	• Few, as there is only an ID number on chip. Subdermal chips in pets, vs in people, are two completely different issues.

Consumer issues (+) and (-)	• (+) Easy to retrieve lost pets. Easier to transfer ownership • (-) None identifed
Societal issues (+) and (-)	• (+) Easier for people to return pets to owner. Provide assurance that pets are not stray animals. • (-) Few negative issues. Environmental concerns (general) regarding proliferation of chips in items and living creatures.
Internet of things Potential	• Pets could become more «connected» if more data about pets are put in chips, and if i.e. ordinary people can read data with e.g. smartphone apps.
Case description	• N.a.
Media links	• http://no.wikipedia.org/wiki/Radio_Frequency_Identification • http://www.dyreidentitet.no/

Case 8: Coop ShopExpress – scan and pay for groceries

Case information	
Case name	• Coop ShopExpress – scan and pay for groceries
Year introduced	• Conceptual from 2007, presented to customers in their express stores in 2011. By fall 2012 Coop introduced, to their member customers in the Coop extra stores, a scan and pay solution based on a combination of mobile, barcode and a mobile app (first available on Iphone, later on android).
Sector type	• Grocery stores
Maturity	• Young, only recently full testing, limited implementation
Actors	• Coop (and tech suppliers)
Technologies	
RFID type (or similar tech.)	• Not RFID-based (although considered initially), use QR-codes on products, smartphones for scanning. Apps downloaded to smartphones for scanning/payment
Technology presentation	• Scan and pay with your own mobile
Functions	
Service function	• Self-service • Easy shopping/bagging • Payment
Purpose (original purpose)	• Efficiency, less queuing • Reduced cost at counter (less staff, staff diverted to other tasks) • Consumer friendly, shop and pay at own pace
Potential functions (function creep)	• Marketing • Segmentation, personal pricing • Tracking of groceries and consumers
User aspects	
Data harvesting/ transmission	• Little new, shopping data already tracked in loyalty card • No chips or enhanced info on packages • Data only transferred when smartphone is scanning QR-code
User costs	• No, but users must register, give their credit card information and become members (as before)
User profiling	• Yes, but already through loyalty card (Coop)
Proximity to user	• Only in shops, no “after-sale” functionality
Individual choice	• Yes
Information/signs	• Yes
Societal aspects	
Degree of controversy	• Little. However, big controversies regarding supermarket tracking of goods in the US and Germany (with RFID, cf. Slettemeås 2009)
Pervasiveness	• Little
Privacy issues	• Little with this new tech (QR). But some privacy issues regarding existing knowledge about consumer habits through purchase data (through existing loyalty cards)
Consumer issues (+) and (-)	• (+) Convenience, less queuing, self-service (control), over time enhanced product info to consumers • (-) more self-service (less help from staff?)
Societal issues (+) and (-)	• (+) less queuing in general, over time more product info, easy tracking of consumer goods (from cradle to grave)

Internet of things Potential	• Little with this technology. More relevant if individual items are tagged with RFID-tags and unique IDs that can communicate with customers and «connect» to internet through digital representations
Case description	• (See full case description, del. 2 of 4)
Media links	• http://coop.no/Tips-og-rad/Apps/skannogbetal/ • http://www.mynewsdesk.com/no/pressroom/coop-norge/pressrelease/view/coop-lanserer-ny-og-effektiv-handlemaate-skann-og-betal-med-mobilen-794434 • http://www.aftenposten.no/norge/Na-blir-handelen-helt-selvbetjent-143941b.html • http://www.dinside.no/mobil/coop-app-lar-kunden-scanne-og-betale/61322505 • http://www.abcnyheter.no/031029/mikrobror-ser-deg • http://www.dagligvarehandelen.no/xp/pub/hoved/avisen/tidligere_utg/49620 • http://www.sintef.no/project/Smart%20vareflyt/Publikasjonsliste_desember_2009.pdf • http://www.idg.se/2.1085/1.227766/coop-testar-nya-betalsatt • http://www.dagligvarehandelen.no/xp/pub/hoved/avisen/tidligere_utg/557013 • http://www.datalogic.com/The+first+Coop+Lombardia+Hypermarket+with+Joya+and+Shopevolution!+The+Hypermarket+in+Milan+uses+Datalogic%E2%80%99s+Joya+and+Shopevolution+for+an+innovative+self-shopping+service_nws_idnws558_eng.aspx • http://www.slideshare.net/idaiskald/iphoneapp-forenkler-hverdagsmiddagen-presentation • http://www.lindbak.no/nyheter • http://coop.no/Tips-og-rad/Apps/skannogbetal/2012 18 sept • http://www.dinside.no/902467/coop-app-lar-kunden-scanne-og-betale • http://www.dailymail.co.uk/sciencetech/article-2217727/Phone-app-allows-shoppers-scan-pay-goods-unloading-trolley.html#axzz2Ka6c7bFl • http://coop.no/Tips-og-rad/Apps/skannogbetal/ • http://innodesign.no/CAD-Teknologi/Ny-handlemaate-Skann-og-betal-med-mobil

Case 9: Slottsfjell – music festival contactless access/payment

Case information	
Case name	• Slottsfjell – music festival contactless access/payment
Year introduced	• 2012 (RFID introduced)
Sector type	• Music festivals
Maturity	• Newly implemented
Actors	• Slottsfjell, technical solution by *ID&C*, a UK-based company (2012)
Technologies	
RFID type (or similar tech.)	• RFID chips on wristbands • Short-range • Readers at entrance and on premises
Technology presentation	• RFID wristbands / contactless payment
Functions	
Service function	• ID • Access • Payment • Information
Purpose (original purpose)	• Facilitate easy access/exit for festival goers • Limit queuing at shopping areas • Better control (ID for 18+ segment)
Potential functions (function creep)	• Connect to social media functionality • check-in to specific festival areas and update their status • Enhanced information • Connect to other services/arena, in town or other cities
User aspects	
Data harvesting/ transmission	• Data only transferred when user wristband is in the proximity of reader (short-range) • Limited to ID and payment info
User costs	• Not direct costs for RFID solution (increased total costs to consumer due to new technical system, or no increase due to efficiency gains?)
User profiling	• Little, only data necessary for ID verification/payment
Proximity to user	• Close, on wrist
Individual choice	• No, cannot be removed during festival. Can be cut off after event is over
Information/signs	• Little, some info on webpage about new payment system
Societal aspects	
Degree of controversy	• Little
Pervasiveness	• Little, only closed area system
Privacy issues	• Little, but data (e.g. payment info) could be hacked. • Personal data may also be registered through a website to personalize the wristbands
Consumer issues (+) and (-)	• (+) Enhanced access security, reducing queues, easier payment (credit transferred to the wristband chip), personal data can be registered on website - easier detection and action regarding loss and theft.

	• (-) Less control of purchases (easy, low threshold for buying), difficult for wheelchair users to pay at counters (chip tied to wrist), problems with refunding from chips after festival
Societal issues (+) and (-)	• (+) reduced queuing at entrance/purchasing stations, counterfeit tickets and unwanted reselling of passes is reduced • (-) Costly system, consumers pay more in total? Environmental concerns as tens of thousands festival goers throw away RFID-wristbands every year.
Internet of things potential	• Little, more closed/local internet of things, with potential for great variety of services affiliated with personal chip.
Case description	• The Slottsfjell festival (city of Tønsberg, Norway), is one of the biggest music festivals in the country. It started in 2003. During the first eight years of the festival, tickets were swapped for wristbands to be used only for access control, while a voucher system was used for purchasing beverages. Other merchandise had to be bought with cash or credit card. The first RFID system was introduced in 2012 (replaced with a new system in 2013). In 2012, the new contactless payment system was announced, promising more efficient purchases + refunds possibilities, in addition to faster entrance and purchases. • (extended case description in report deliverable 2 of 4)
Media links	• http://www.raseri.nu/Templates/Kultur/2008/juli/slottsfjell_retrospekt.html • http://www.slottsfjell.no/2012/06/07/nytt-betalingssystem-pa-slottsfjell/ • http://touch.tb.no/nyheter/na-kan-du-kjope-ol-til-slottsfjellfestivalen-1.7446631 • http://tb.no/kultur/slik-far-du-pengene-tilbake-1.7455855

Case 10: Trondheim clothing stores – item-level RFID (post doc case)

Case information	
Case name	• Trondheim clothing stores – item-level RFID
Year introduced	• 2008
Sector type	• Apparel/ clothing industry
Maturity	• Technological maturity, still industry hesitance
Actors	• Apparel companies Bogart (Norway), American Apparel (US), Gerry Weber (Germany)
Technologies	
RFID type (or similar tech.)	• Passive, short-range RFID (in clothes labels) • Readers at point of sale (POS), RFID gates, handheld readers
Technology presentation	• As tag added to textile, for enhanced information
Functions	
Service function	• Follow clothing items from supply to sales activities
Purpose (original purpose)	• Automation (improved counting efficiency) • Cost reduction • Improved Sales • Reduced shrinkage • Trace item from when the store receives items to point of sale
Potential functions (function creep)	• Enhancing sales experience • Multiply after-sales activities • Contribute to sustainable garment life-cycle
User aspects	
Data harvesting/ transmission	• So far harvested data is restricted to individual item and not connected to individual customer, not used actively outside sale facilities • Tag read at RFID gates, with handheld readers
User costs	• None
User profiling	• Several innovations are discussed, but privacy issues are still a major concern, although there are national and sector differences.
Proximity to user	• Potentially close to body (on clothing), if left active post-sale
Individual choice	• Potentially three different PETs (privacy enhancing technologies) under discussion, but only one preferred by customers today (killing RFID at POS). • Possibility for consumers to physically cut off RFID-based labels
Information/signs	• Different policies on global level (Gerry Weber uses info signs in stores where RFID is implemented)
Societal aspects	
Degree of controversy	• Medium to high depending on type and depths of research on controversy. International focus groups show similar negative response, privacy actors act on national basis, situational customers have a more relaxed attitude. People get more concerned when confronted with potential future development than when they are in a concrete shopping situation.
Pervasiveness	• So far only potential pervasiveness, depending on whether RFID tags will remain active after passing POS, entering everyday life activity

Privacy issues	• Six identified: Fear of loss of control, of being tracked, being responsible for purchased item, of technological paternalism, of losing control over collected personal information, and being spied upon.
Consumer issues (+) and (-)	• (+) Improved shopping experience • (-) Fear of being tracked, security/privacy risks
Societal issues (+) and (-)	• (See extended case description in deliverable 2 of 4)
Internet of things potential	• Due to proximity to user/customer and a high activity level based on personal preferences, the potential is unlimited in terms of industry innovation. Privacy policies are just as in demand as in other types of tag-related sectors (health, government, surveillance, security).
Case description	• (extended case description in report deliverable 2 of 4)
Media links	• http://www.trondheim-chamber.no/doc//Matiq.pdf • http://www.bogart.no/public.aspx?pageid=69009 • http://no.wikipedia.org/wiki/Radio_Frequency_Identification • http://www.nrk.no/nett-tv/indeks/166398/

Case 12: Caring technology for elderly – tracking devices (master case)

Case information	
Case name	• Caring technology for elderly – tracking devices
Year introduced	• Conceptual
Sector type	• Health and caring sector
Maturity	• Partly implemented
Actors	• Local politicians, unions (Tekna), Datatilsynet, Teknologirådet, caring workers, tech suppliers, etc.
Technologies	
RFID type (or similar tech.)	• Global Positioning Device (GPS), while other techs, such as RFID has also been debated • User terminal; matchbox sized GPS unit (microchip and GPS module) • Hardware communicating with user terminal • Smartphone with internet access can continuously receive position data • Extras; listening and alarm functions
Technology presentation	• GPS-technology (in general) – location/tracking system, to find users through satellite navigation system. • In this case; how can such tracking systems be introduced/converted into a caring technology
Functions	
Service function	• Tracking of dementia patients • Alarm function
Purpose (original)	• Track and locate people (with dementia)
Potential functions (function creep)	• Potential surveillance of movement/habits • Integrated with other “smart” things/sensors in smart environments
User aspects	
Data harvesting/ transmission	• Continuous tracking of people in caring facility. Tracking data is deleted after a certain time. • Caring workers get a profile where they can track the unit (GPS/person), through PC or phone/SMS • GPS coordinates are only sent to preapproved phone numbers • Data can be transmitted wherever there is coverage
User costs	• Unknown
User profiling	• Unknown, depends on service
Proximity to user	• On person. Part of demo includes redesigning GPS-terminal from being attached to things to being attached to physically active people.

	• Design needed which make unit easy to attach and carry around without being easy to through away or too uncomfortable to wear/carry (e.g. necklace) • Used "on" people rather than "by" people (dementia patients). Technology more for caring personnel
Individual choice	• Little if implemented. Difficult with informed choice/consent (e.g. dementia patients). Depend on condition of user.
Information/ signs	• Due to pilot situation (and public controversy), a lot of information about how tech is used in the pilot situation (mostly to family, caring personnel)
Societal aspects	
Degree of controversy	• High; much controversy in media debate, from 2008 onwards, about privacy and the right to be left alone (not surveilled), as well as debates regarding acceptable caring measures
Pervasiveness	• High, constant monitoring
Privacy issues	• Yes, as dementia patients are monitored continuously when device is active
Consumer issues (+) and (-)	• (+) Increased safety for dementia patient, family and caring personnel, reduced need for locking doors/windows, increased freedom and dignity • (-) Can lead to unjustifiable caring, more insecurity for patient/personnel due to more freedom to walk around (paradox), increased surveillance of individuals
Societal issues (+) and (-)	• (+) Answer to future challenges; tech can free labour to other pressing tasks as welfare sector is being challenged. • (-) more data gathered, distributed and stored about individuals; new tech as argument for government to use welfare technology instead of increasing budgets to health/ caring personnel
Internet of things potential	• GPS-tracking (or RFID) – and increasingly smart sensors and smart living environments. "Things" talk with other things and internet, as individuals in need of caring/welfare tech are less able to make choices themselves. Internet-connected things make decisions on behalf of users.
Case description	• (extended case description in report deliverable 2 of 4)
Media links	• http://www.vg.no/helse/artikkel.php?artid=10014834 • http://www.nrk.no/nyheter/distrikt/ostafjells/telemark/1.7860146 • http://h10109.www1.hp.com/cda/hpsmb_common/display/main/hpcpf_content.jsp?zn=hpsmb&cp=6989-7214-7232%5E95798_4129_15__ • http://www.vg.no/nyheter/innenriks/valg-2011/artikkel.php?artid=10081690 • http://www.seniornett.no/Seniornett/Opplaering/Seniornett-avisene/2011-Hoestavis/Velferdsteknologi

	• http://president.tekna.no/tag/velferdsteknologi/ • http://www.nho.no/offentligsektor/aktuelt/fra-utgiftspost-til-ny-vekstnaering-article23647-679.html • http://www.aftenposten.no/nyheter/iriks/Far-ikke-GPS-merke-demente-6783967.html • http://www.nordlys.no/debatt/kronikk/article2813250.ece • http://www.dagbladet.no/2012/02/16/nyheter/politikk/innenriks/helse/datatilsynet/20256698/

Case 13: Norwegian passports – digital biometric identification

Case information	
Case name	• Norwegian passports – digital biometric identification
Year introduced	• From 2005 onwards (electronic reading of biometric data)
Sector type	• Government
Maturity	• Intermediate
Actors	• Norwegian government, tech.suppliers
Technologies	
RFID type (or similar tech.)	• RFID embedded in passport
Technology presentation	• Presented as; e-pass, machine-readable passports, biometric passports
Functions	
Service function	• Machine readability, automation/more efficient ID-check • Passport owner can check information on chip using readers at police stations.
Purpose (original purpose)	• Verification, more secure ID of person, machine readability • Avoid counterfeit passports • Accommodate EU-regulation (2004) about digital storage of biometric data on travel documents
Potential functions (function creep)	• Can compare various biometric data (fingerprint, signature, face) • Can be used for cross-national ID services (criminals, refugees, etc)
User aspects	
Data management/ transmission	• RFID chip contains some personal data, passport number, picture, and more recently fingerprint data. • Passport can be read by authorized readers
User costs	• Costs to user when renewing passport
User profiling	• Little. It is claimed that with new e-passports, there is less need for data storage. The idea is to securely verify the information contained in the passport, and this can be done offline
Proximity to user	• On passport, carried by user (some countries used as regular ID, hence carried most of the time. Not common in Norway).
Individual choice	• No
Information/signs	• Information in media about new passports. • Information label on front side of passport (biometric signage)
Societal aspects	
Degree of controversy	• Some, see privacy issues
Pervasiveness	• Depends on travel habits. Frequent travelers carry passports often, and are checked/cross-checked in other countries using different systems/databases, applying different privacy schemes.
Privacy issues	• Data protection authorities voiced early concerns that security/encryption and privacy issues were not satisfactorily documented, demanded that passport owners need to be informed about their right to know, and if wrong, correct saved information (can be verified at police stations). • The department of justice argues that these passports do not threaten privacy interests. • Some public concern of long-range reading from unauthorized readers due to embedded RFID, hacking/spying concerns

Consumer issues (+) and (-)	• (+) More difficult to counterfeit passport (higher security for user), increased convenience, more secure identification • (-) concerns about unauthorized readings, hacking, ID-theft, etc.
Societal issues (+) and (-)	• (+) Reduced counterfeiting of passports, easier detection of criminals, higher security in ID-process (more digital biometric identifiers added over time; facial recognition, fingerprints, signature [multimodal biometrics] – provides higher security/more precise identification) • (-) More surveillance of citizens, more personal control at border-crossing (migrants)
Internet of things Potential	• Relatively little. However, over time, aggregated data of travel patterns/migration patterns, etc based on passport readings could be employed. Smart passport activity could connect to internet services (political decision).
Case description	• N.a.
Media links	• http://www.itavisen.no/nyheter/vi-tester-bio-pass-22196 • http://www.diskusjon.no/index.php?showtopic=594054 • http://www.digi.no/792075/lett-aa-klone-amerikanske-rfid-pass • http://www.cw.no/artikkel/telekom/mer-tyn-rfid-passet • http://www.tu.no/innsikt/2011/02/11/passet-kjenner-deg • http://www.regjeringen.no/upload/JD/Vedlegg/ID-kort-Sluttrapport.pdf • http://www.handysize.no/kategorier/tyvenes-skrekk-kategori---nyheter-innen-sikkerhet-pa-reise/kort--passbeskyttere---rfid-sikret.aspx • https://www.nidsenter.no/Global/Dokumenter/Biometri_nett.pdf

5 Summary and conclusion

The first research task of the *RFID in Society* project was to identify and map *what types of technology/systems/applications* (and related products/services) the project should focus on, as the "RFID/IoT territory" was relatively unchartered at the time of project initiation (2010).

Thus the main criteria for selecting cases, framed within the overall research aim of the project, should include the following aspects:

- *RFID or other enabling technologies*, with or without the potential of "going IoT".
- Technology/services *in the Norwegian market/context* or that are *being piloted in Norway*, by Norwegian or foreign innovators/suppliers.
- *People-centred applications* with direct/indirect impact on people as *consumers/citizens*.
- *Potential technological futures*, implying that people/society potentially will be exposed to pervasive (IoT) technological systems in the future

As part of the mapping process, the research team needed to identify *criteria* for both *selecting* cases and for *organising* them. This was done through a partly grounded approach, including;

- Literature study of existing cases from academic studies
- Desk research of cases using various search engines/search specifications
- Several workshops/deliberations discussing relevant aspects

In this way, the project group managed to identify a range of criteria for organising relevant cases, within the framework criteria specified above. Then a process of selecting relevant criteria followed, through an iterative process of adding/excluding criteria, and specifying these in a *tree-shaped structure*. This exercise started with *user roles* (related to relevant technologies/applications), then added *generic activities*, then *specific activities/services*, then *functions/benefits*.

Based on the structure and ideas generated from these iterations, the next step in search for relevant cases to study more extensively was to narrow down our focus to *specific cases in the Norwegian context*. Hence, the project group first gathered information about relevant cases at that time (primarily in the period around 2010-2012), showing diversity with respect to a variety of aspects.

Initially, 20-30 different cases were explored. Through a *funneling approach* we gradually eliminated potential cases one by one, as they were found to be incompatible with our design. Some were eliminated for practical reasons (e.g. too little information available). From this iterative investigation and exclusion process, we ended up with 13 cases to be explored further. All cases were first arranged in a *simplified template*, where only a few key criteria were used (in order to provide an accessible introduction to the cases). By following the simplified template, and adding insights from the previous iterative tree-structuring process, we developed an *extended template* for case description. Finally, information about the 13 cases were filled in

the table system of the extended template. The cases selected show a wide variety of approaches to RFID (or related) technology/services, relevant for consumers/citizens, in the Norwegian context.

Autopass (case 1), Deichmanske (case 3), and Flexus/Ruter (case 4) are all public services developed for the general public. Still they differ in that case 1 and 4 are tied to the public transport sector (activating the consumer role), while case 4 is a free public library service (activating the citizen role). They also differ in terms of maturity. Case 1 has been around for several years, and consumers have gained extensive experience with this service, while the technology provided in case 3 and 4 are new to its users (at the time of the study). They also differ in terms of the type of data (from users) that are being harvested, stored and transmitted, and how controversial they have become (seen in media discourses).

Skien Fritidspark (case 2), Oslo Vinterpark (case 5), Oslo Maraton (case 6), and Slottsfjell (case 9) are all commercial services that have introduced RFID for sport/leisure activities. Case 2 and case 9 are examples of how RFID-technology is used in a confined area involving many services, using wristbands/bracelets for access, purchases, etc. Case 5 and case 6 are sport activities, where RFID is used for a specific purpose. Furthermore, the cases differ in that case 2 is a constant all-year-round service, case 5 is a seasonal service, while case 6 and 9 are specific events lasting a short period of time. In most of these cases, RFID units are reusable, while in case 9 the wristbands are disposed of in the garbage.

Case 7 (Dyreidentitet) shows a different usage area, with subdermal chips implanted in domestic animals. Hence, people engage with RFID indirectly through their pets, but the technology is not a direct "consumer service". The RFID-unit is also hidden, and is not engaged with unless pets are lost or vets need information about them. Case 12 (the caring technology/tracking device), is in a way similar as the tracking unit (GPS, RFID) is "on people" and not an external service that is purchased. This also activates a different discourse in terms of privacy and rights.

Case 8 (Coop scan and pay), does not involve RFID (but QR), but is interesting as a case of enhanced info and self-service for consumers in the grocery sector. In the food market, RFID has also been negotiated as a "future" opportunity for many years, and pilots have been implemented in many countries. RFID has been evaluated for tracking/tracing food (food security), providing information to consumers about ingredients, for self-service and in-aisle services, for payment/loyalty services, marketing, and so on. Hence, RFID in the grocery sector is an interesting case in general. This is somewhat similar to case 10 (the apparel industry and clothes stores) as RFID is used in the supply chain (tracking items), and can provide relevant information to consumers about the product and how to handle it. It is also used for in-aisle services, with future opportunities for smart labels (things communicating with things – i.e. clothes interacting with washing machines), product recall/smart receipts, etc.

Finally, case 13 (passports) is an interesting case of how various biometric data about individuals are digitalised and made available in "off-line" service situations. This points to a general tendency of "digital shadows" of ourselves being generated, as the need for easily available, secure, and on-site/just-in-time verification of individual is increasing – through wireless/contactless transmission, with or without the active consent of citizens/consumers.

* * *

This report is the first deliverable in a series of four. It identifies and describes how the exploratory/descriptive "multiple case-study" design of people-centric RFID/IoT-services has been approached. This includes selecting criteria in order to identify and structure cases, designing a final case structuring template, as well selecting and mapping actual cases.

In the next report (deliverable 2 of 4) we describe how we made a further selection of 9 cases to be explored through more encompassing case studies.

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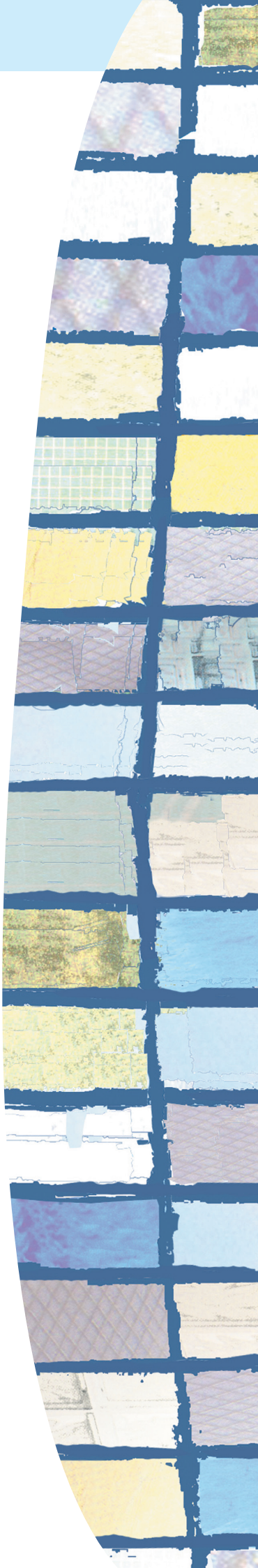
Consumption Research Norway SIFO at Oslo and Akershus University College of Applied Sciences (HiOA) has a special responsibility to contribute to the knowledge base for consumer policy in Norway and will develop new knowledge about consumption, consumer policy and consumer position and role in society.

Key research topics are:

- consumers in the market and consumer choice
- household resource allocations
- consumer economy - debt development and poverty
- technological development and consumers' every day life
- digital daily life and coping
- environmental effects of different types of consumption
- food and eating habits
- textiles - value chains - consequences for everyday life and environment
- consumption significance for social inclusion
- consumer policy



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