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**architectuRe for an Internet For Everybody**

# D2.1: Usage Scenarios and Requirements

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| Abstract | This document takes the first step in the RIFE architecture and system design work by outlining the Use Cases along three dimensions, namely user-centric, deployment-centric and business-centric ones. |
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# EXECUTIVE SUMMARY

This document takes the first step in the RIFE architecture and system design work by outlining the Use Cases along three dimensions, namely user-centric, deployment-centric and business-centric. We outline the main objectives for each, as well as the challenges that occur with each Use Case. We then derive the requirements, divided into several categories, which will in turn feed into the wider system architecture and design work, reported in later RIFE deliverables.

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# ABBREVIATIONS

| | |
|---|---|
| AP | Access Point |
| API | Application Programmer Interface |
| AR | Augmented Reality |
| CDN | Content Delivery Network |
| DTN | Delay Tolerant Networking |
| GTP | GPRS Tunnelling Protocol |
| ICN | Information-centric Networking |
| IRTF | Internet Research Task Force |
| ISP | Internet Service Provider |
| KPI | Key Performance Indicator |
| MNO | Mobile Network Operator |
| NGO | Non-governmental organisation |
| NO | Network Operator |
| OPEX | Operational Expenses |
| QoS | Quality of Service |
| SDN | Software-defined Networking |
| TCP | Transmission Control Protocol |
| TRL | Technology Readiness Level |
| UC | Use Case |
| VNC | Value Network Configuration |
| VNO | Virtual Network Operator |
| VoIP | Voice over IP |
| WISP | Wireless Internet Service Provider |

# 1 INTRODUCTION

This document takes the first step in the RIFE architecture and system design work by outlining the Use Cases along three dimensions, namely user-centric, deployment-centric and business-centric. We outline the main objectives for each as well as the challenges that occur with each Use Case. We then derive the requirements, divided into several categories, which will in turn feed into the wider system architecture and design work, reported in later RIFE deliverables.

The Use Case work has been driven by a set of brainstorming sessions, capturing the imagination of the participating researchers and their insight into how the RIFE vision can foster better usage of the Internet in a variety of settings. This brainstorming particularly emphasised the usages that lie outside the normal usage known today. It takes into account the insights from partners in their particular work as well as extrapolates work in well-known areas such as education, e-health and local services with respect to possible challenges faced when not assuming ubiquitous and well-built Internet coverage. The Use Case sessions were conducted during the initial kick-off in February 2015 and then again recapped in the following plenary meeting in June 2015. Figure 1 shows the output of the session as a mind map diagram.

This approach of utilising the individual partners' expertise to derive the collection of Use Cases and then to distil the resulting requirements for our system led to the presentation style which we chose for this deliverable, namely focusing on the output of this brainstorming mind map rather than an extensive literature-led examination of the Use Cases – this explains the lack of a reference section for this deliverable. This partner-led approach for each Use Case has the advantage of already identifying which partners have interest in the future implementation and deployment.

The output of this document, therefore, not only directly drives the specification of the overall system architecture and its interfaces but also defines the path forward in terms of the evaluation and trialling of the defined Use Cases in this document.

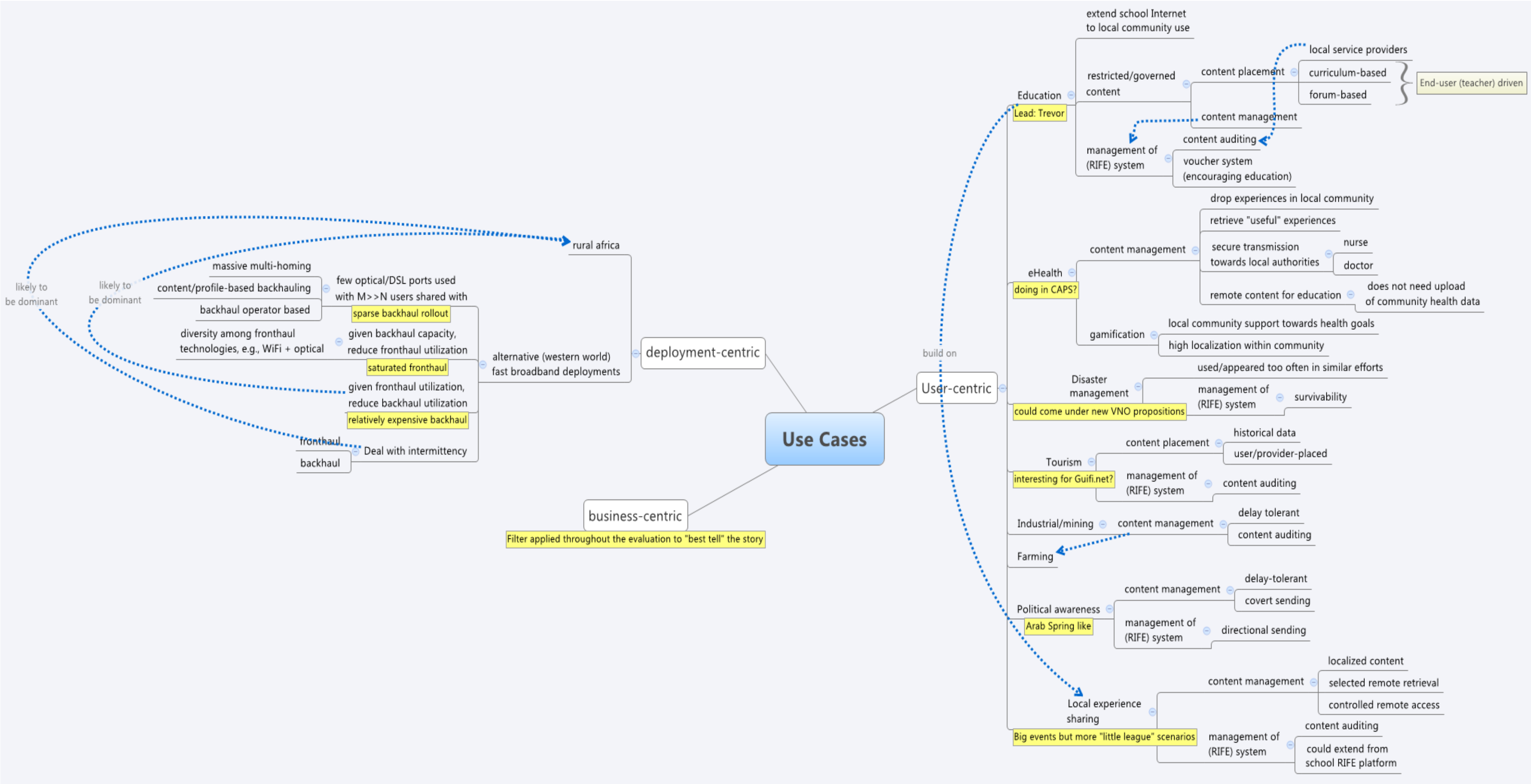


Figure 1: Brainstorming mind map

# 2 USE CASES

This document describes the Use Cases (UCs) RIFE has looked into based on previous discussions. The UCs are categorised into the following three domains due to the diversity of possible applications in RIFE:

- User-centric
- Development-centric and
- Business-centric

The user-centric domain described in Section 2.1 focuses on scenarios where an individual or a group of individuals could potentially benefit from a deployed RIFE system. Questions around who could benefit by what type of information and how this challenges RIFE are being discussed.

In comparison, the deployment-centric UCs in Section 2.2 focus on challenges that arise when considering a mix of orthogonal technologies used in the front-/backhaul which lead to capacity discrepancy. In particular, the quite diverse economic and political situations around the globe will stress the applicability of the concepts and solutions designed in RIFE.

The business centric UCs presented in Section 2.3 introduce the Value Network Analysis as a tool to assess value propositions derived from the RIFE architecture. Based on partners' business roles and technical expertise, Value Network Configurations VNCs will support the analysis of the viability of the business models.

Each UC is divided into objectives and challenges where the former sub-section explains the "*What*" while the latter one pinpoints the "*How*" including novel aspects or even technological issues regarding the integration with existing telecommunication networks.

## 2.1 User-centric Use Cases

This section presents user-centric UCs describing possible scenarios where RIFE can make an impact and users would experience a much better service if RIFE would be used.

### 2.1.1 Education (Lead: Avanti)

#### 2.1.1.1 Objectives

The education UC deals with scenarios where RIFE can play a significant role in improving (or establishing when not available at all) the access to educational, governmental or locally restricted content. With an exponentially growing user number of e-learning platforms such as Coursera, where content is made available by lectures through a digital dissemination medium, e.g., audio, video, slide decks or online questionnaires, educational institutions must be connected to the Internet to provide the content. Thus, these institutions have the potential to serve as a centric anchor point in the RIFE architecture by opening up their content resources to the outside – and more importantly – for local community use. Not only does this include access to content located somewhere in the World Wide Web, but also the ability to access content physically available in the school's Inter-/Intranet.

While providing content to users, a subscription to digital material always goes hand-in-hand with governing (restriction) of the published data. A restricted (governed) access to digital material always includes the tasks of content placement and content management. Especially when the content is generated by end-users within the institution, e.g., teachers, RIFE should be capable of allowing a location aware content handling.

Despite the support of governed content placement and management, the possibility to audit content by local service providers (or any other authorised third party) will play an important role for a more global acceptance of ICN paradigms, and RIFE in particular.

#### 2.1.1.2 Challenges

Most of the challenges in the education UCs concern the placement, management and governance of content, as information is created/updated regularly (classroom notes, assignments, forum entries, etc.) and has privacy restricted properties. While the actual data delivery itself is not of any concern in this user-centric UC, the major challenge is to actually encourage users to sign up for educational services using voucher-based schemes. Not only does this require the management and governing of sensitive user information, it also requires billing becoming an integrated part of the ICN solution RIFE is going to develop. Billing becomes also a key information element when content is licensed under a non-free agreement where access to content is restricted according to certain accounting models.

### 2.1.2 eHealth (Lead: IDC)

#### 2.1.2.1 Objectives

As for education, eHealth also receives more and more industry-ready solutions and is steadily transformed into a digitalised society. While the group of users accessing the same content is extremely sparse compared to other UCs (patient <> {doctors, nurses}), the management of the information including a secure and reliable data transmission is the key. The access to patient’s health file records requires an unfailing governing of per item access rights for authorised users only. Moreover, doctors and nurses must have a trustworthy profile so that people who seek health care do not become a victim of fraud.

For community and long-term / location-specific studies it is desirable to have access to anonymised cumulative disease and treatment records over a given timeframe in order to automatically retrieve uncommon occurrences of particular diseases or treatments for prevention purposes.

A combination of the aforementioned eHealth objectives could lead to a gamification projection as part of the digitalisation of today’s society. Local communities, public authorities and health care companies have a strong interest to raise the awareness for health topics and to increase the health conditions of individuals. It is therefore anticipated to increase the awareness of a healthy lifestyle and to involve individuals in programmes to improve the overall health condition of a community using gamification approaches.

#### 2.1.2.2 Challenges

The major challenges in this UC that need to be addressed from an ICN perspective are privacy, security and applicability. In relation to the cumulative determination of health-related information of individuals, it is crucial for its success that no party which is not directly involved with the active treatment of the patient is capable of correlating diseases to a particular patient. Furthermore, determined basic health data related to a patient, e.g., heart rates, blood pressure, sugar level or distances walked per day, is (almost) of even higher risk to be misused by public or private authorities for a more financially beneficial health care plan. Under no circumstances should this be possible with the RIFE platform.

Related to the privacy of individuals, the data communication and storage among patients, doctors, nurses, authorities and companies is required to be secure at all times. Not only does this include proper information governing access rights, it must also deal with a secure end-to-end communication and secure data storage.

A gamification UC has the potential to be adopted by a wider audience only if the usability and purpose of the application, the idea behind and the targeted audience have been well investigated and the derived product (game) is catchy and meaningful enough to be used. Support of a wide range of end device types and choosing appropriate communication channels to sell the product to the customers is crucial in order to be adopted by the community.

### 2.1.3 Disaster Management and Prevention (Lead: UCAM)

#### 2.1.3.1 Objectives

In the rare event of any type of disaster, there is usually a community effort taking place to support local authorities. Whenever communities face hurricane, flooding or snow disaster events the management of human and machine resources is a very complicated effort due to the non-existing infrastructure for managing and maintaining data sets. These data sets usually comprise weather conditions and forecasts, currently available versus needed resources in certain areas, and sensorial data to measure input raw data in order to derive the aforementioned information.

Usually, in most disaster events the actual communication infrastructure was partially or fully destroyed or is simply non-existing. That is why most of the time non-stationary solutions are used, e.g., TETRA, to ensure a basic communication. This circumstance however leads to the opportunity of RIFE to obtain, process and distribute information in a more location-aware fashion which in return reduces the overall communication resource usage. With the technological advantages ICN – and RIFE in particular – has to offer, communication solutions for disaster events could enable users to focus on *what* (instead of *how*) information is provided and/or required.

#### 2.1.3.2 Challenges

The disaster UC has been used several times in various R&D projects and should be considered as one that rather puts off the reader. Therefore, this UC should be handled with special care and included into the list of considered user-centric RIFE UCs only if it can be seen as extremely helpful to sell the project and solutions to be developed within.

Whenever a new set of technologies or infrastructure solution is proposed by an institution or consortium, first aid organisations immediately ask how reliable the proposed solution is and what they would gain from it. Also, arguments about reducing the operational cost are negligible, as reliability is far more important than technological benefits which positively affects the required budget. If anything, the solution developed in RIFE should have absolutely no implications to the way the existing communication infrastructure works in order to increase its applicability. Furthermore, if this requirement has been fulfilled it opens up the floor for RIFE to become part of a Virtual Network Operator (VNO) proposition, explicitly targeted at disaster scenarios.

As part of recent R&D work, there have been several solutions designed and developed towards ubiquitous emergency management systems which sit on top of an exclusively used communication infrastructure. Hence, this increases further the challenge in RIFE and this UC in particular to provide a reasonable and applicable solution from which existing deployments could benefit significantly.

Despite the expressed general concern about this UC, the diversity of information and how to map it to an ICN approach is the key for the disaster UC. Usability and functionality improvements must be clearly apparent to the user in the field in order to convince authorities to invest in this solution.

### 2.1.4 Tourism (Lead: Guifi)

#### 2.1.4.1 Objectives

The tourism UC provides a scenario which has the least restriction and requirements when it comes to information protection and user privacy related to the content accessed and/or created. In this particular UC it is explicitly desired that information, e.g., pictures, videos or social media interaction, is easily accessible without any restrictions to the users. And more importantly, people would follow the "sharing is caring" attitude by allowing the system to track their most entertaining or interesting touristic attraction, as no sensitive user information is required to achieve this cumulative information.

The RIFE ICN solution should allow users to generate and place data into the system where a "user" could be anyone from visitors, locals, professionals working in the tourism domain or even authorities responsible for maintaining the touristic information available to the visitors. In order to provide quality data, information auditing is required as part of the system. Similar to rating/feedback tools on Amazon, TripAdvisor or Yelp, the power of users and their opinions allow the ranking of information according to its validity and popularity.

However, for most platforms it is the case that any sort of manual feedback from users is disproportional to the number of unique visitors. Therefore, it would be expected from the ICN system to automatically collect anonymous information about the users visiting a particular site or piece of information. Additionally, collaborative and content-based recommendation algorithms could provide a rich autonomously working user experience if the user even signs up for sharing his/her anonymised data.

Applied tourism UCs where Augmented Reality (AR) applications are used to offer a more personalised and tactile multi-media experience are of significant interest. Combined with the aforementioned recommender system functionality and an applied ICN infrastructure, the user experience could be improved significantly for everyone's benefit.

#### 2.1.4.2 Challenges

The tourism UC comes with several challenges related to information auditing, connectivity assurance and to some extent user privacy. As for most tourist guide books, the content and its presentation is the key to attract attention. Therefore, quality touristic information available in the system is of high importance to the users in order to enjoy their time and to value the provided system. The challenge there is to efficiently utilise the resources available to audit content. In this regard, the privacy of users – who create, share or audit content deliberately or automated by the system – is of equal importance.

The more popular a touristic side is, the higher the chances are that tourists are not having a national mobile data contract and are on roaming. Therefore, in order to make them part of the tourism UC, the system must allow them to access the content at no extra charges. As this is certainly rather a technological border where a local virtual Wi-Fi Access Point (AP) deployment (e.g., Guifi.net) could play a significant role, ideas around a dedicated virtual network operator for the sole purpose of serving touristic sides with access to content related to the attraction could become part of the UC.

### 2.1.5 Political Awareness (Lead: UCAM)

#### 2.1.5.1 Objectives

The majority of humans closely follow news about local, national and/or international politics as part of their daily routine. However, politically motivated gatherings are often prone to subjective viewpoints and deliberate sharing of false information in order to boost either side of the discussion. Past events, e.g., Arabic spring or the Ukraine crisis, revealed the difficulty for news agencies to elaborate the vast amount of information generated on (social) media platforms in order to present an objective commentary to their readers. Especially people living in the area of interest have a strong interest in sending and receiving trustworthy information about an event. Not only does this include the ability to share content, but it also deals with possibilities to conceal information that could reveal the identity of the user – due to implemented political censorship rules.

In this UC the management of generated content focuses primarily on delay tolerant distribution strategies assuming that data delivery is much more important than a rapid transmission. Ignoring the global interest for politically explosive content for a moment, it is the local people who usually have a significantly stronger interest in receiving and sending information; that is why the system should have directional location-aware information dissemination mechanisms implemented to allow a more decentralised handling of information exchange.

#### 2.1.5.2 Challenges

The dissemination strategy for this UC is similar to the tourism one where content is primarily accessed in close proximity to the location of origin. But instead of being used entirely for amusement purposes, the political awareness UC deals with exchange of information which could have a strong impact on a countries' political order and/or its neighbour states.

From a technological viewpoint the RIFE system should provide answers on how to enable content management where delay-tolerant information exchange is acceptable. Even though the auditing of content generated by users is less important, due to the biased opinion about political events in general, a solution to conceal information about the publisher to the system is another important criterion.

Another challenge in relation to the content management is that the information creation (audio, video, text) is likely to be very bursty, coincident in time and similar; however, there lies an opportunity that this can be leveraged and turned into a verification solution indicating how representative a particularly explosive piece of content is (collaborative filtering).

### 2.1.6 Local Experience Sharing (Lead: Aalto)

#### 2.1.6.1 Objectives

The desire of people to share multimedia content from events they attend has never been more dominant. What makes this UC quite special is the requirement of a precise content management capability provided by the system to the user, as generated content is usually only aimed at a selected group of people, e.g., friends or family. Therefore, for this particular UC it is crucial that remote access to content is solely controlled by the user who generated it.

When it comes to publicly shared content (e.g., video/audio streams, blog entries or pictures) from large gatherings RIFE should allow a more selective remote retrieval of content generated which combines the task of content and system management as well as content auditing. However, it should be noted that there is a distinct difference in the type of information requested by users attending the gathering and by users accessing content remotely. Additional user behaviour metrics such as content retrieval frequency and end device type may vary between the two types of users. Publicly shared content which is accessed by users in close proximity of the ones that created it is probably more of a real-time (streaming) information exchange which causes the aforementioned different user behaviours.

#### 2.1.6.2 Challenges

One of the challenges which should be explicitly mentioned here is that this particular UC 1.6 could extend from the education UC 1.1 and tourism UC 1.4 due to the similarities both UCs share from a technical realisation point of view. Therefore, it should be a smooth transition switching from UC 1.1 to UC 1.6 without any particular new technological challenges. The only significant difference is that the purpose of the generated content falls more into the amusement area than in a more serious one such as education. Hence, the auditing and governing of content is of less importance in the current local experience sharing UC.

Content management challenges such as the differentiation of the targeted audience for generated content do differ slightly (local crowd versus remote users) while a selected remote retrieval and controlled remote access are very similar in both UCs, probably with the necessity of a finer grain remote access control in UC 1.6 compared to 1.1.

### 2.1.7 Summary

This section serves as a short summary of the aforementioned presented user-centric UCs focussing on providing an overview of reoccurring key objectives across all UCs.

Table 1: Summarising relevant and significant important objectives in user-centric Use Cases.

| | User Privacy | Comms Security | Governed Content | Content Auditing | Localised Content | Gamification | System Reliability |
|---|---|---|---|---|---|---|---|
| **Education** | ○ | | ○ | ● | ○ | | ○ |
| **eHealth** | ● | ● | ● | | ○ | ○ | ○ |
| **Disaster Management** | | | | ○ | ● | | ● |
| **Tourism** | | | | ○ | ● | ● | ○ |
| **Industrial** | | | | | | | ○ |
| **Political Awareness** | ● | | | ● | ● | | ○ |
| **Experience Sharing** | ○ | | ○ | | ○ | | ○ |

○ relevant to some extent
● of significant importance

## 2.2 Deployment-centric Use Cases

In the following, we now focus on the UCs that are dedicated to particular deployments, such as in rural areas. We expect these UCs to provide particular regional insights.

### 2.2.1 Rural Africa (Lead: UCAM)

#### 2.2.1.1 Objectives

Basic communication infrastructure in rural areas of Africa is poorly developed or is simply non-existing mainly due to financial barriers to deploy and maintain a telecommunication network. As this probably will not change in the near future, innovative solutions are sought to further reduce the overall operational cost. Additionally, it has been shown that access to a (global) telecommunication infrastructure has a very significant positive impact on a community's economic growth. It should be further noted that most African front-hauls are connected to the Internet via rather expensive backhaul solutions, e.g., dedicated satellite connections.

The potential of ICN solutions – and RIFE in particular – is to allow a timely scheduled update of content generated, accessed and revised by end users. So, instead of informing users when their front-haul has access to the backhaul in order to update information, RIFE aims at taking over this task by advanced edge caching solutions that are able to handle only periodic access to the back-haul.

Moreover, by allowing the network to accept a not always inter-connected front-haul infrastructure, though information is always available to end users, the capacity of relatively expensive back-haul connections (e.g., satellite or high power long distance link) can be significantly reduced. This in turn brings down the overall OPEX and connectivity provisioning and becomes economically justifiable for rural Africa standards.

#### 2.2.1.2 Challenges

Dealing with disruptive connectivity can become very challenging considering the diversity of application types available in the Internet. The identification of efficient information dissemination strategies to allow such scenarios is the key in this deployment-centric UC. These strategies must provide asynchronous pull and push functionalities for information elements since the front-haul has only temporary access to the back-haul. Additionally, opportunistic caching strategies for delay tolerant front-haul networks will be key in achieving this goal.

Another aspect for the applicability and feasibility of this deployment-centric UC is to outline the socio-economic possibilities for Virtual Network Operators (VNOs) to provide periodic-only back-haul access to local communities. Also, once RIFE can prove the technological feasibility of a delay tolerant front-haul, existing Network Operators (NOs) will have strong incentives to start negotiating paid-based back-haul access fees with existing or newly established VNOs which in return does create an additional revenue stream for NOs.

However, to ensure that existing Internet services (legacy applications in RIFE) work seamlessly over the RIFE platform, it is essential that the necessary ingress and egress protocol translation into RIFE namespaces works faultlessly in order to make content available to and from RIFE users.

### 2.2.2 Western World (Lead: IDC)

#### 2.2.2.1 Objectives

The western world UC deals with quite different deployment-centric objectives than the previous one due to an already existing high-capacity back-haul and front-haul infrastructure in respective countries. Western governments aim for a nation-wide fast broadband connection for everybody independently from the area the user is located in (i.e., urban, suburban or country side). However, the reality reveals a different story with quite frustrating performances related to coverage, connection speed and reliability, particularly at peak times. Therefore, the main objective for the RIFE platform is to focus on how to make the Internet experience more tactile for users facing a poor broadband service and to further optimise the OPEX for operators across their entire infrastructure. In many European countries fibre cables have been installed to inter-connect rather remote communities. Due to the rather low user density and astral distribution of potential users there is a disproportional number of users that are connected to the Internet via the same fibre cable resulting again in poor service. That same applies to 4G Base Station (BS) deployments which actually cover most rural sides of western countries; due to the much larger coverage area of a single 4G BS, its capacity is shared by a significant higher number of users compared to urban scenarios which causes the frustrating user experience. RIFE is expected to cope with this scenario by reducing the back-haul utilisation using edge caching solutions to overcome the capacity shortage in the back-haul. Following ICN principles, RIFE is expected to cache content opportunistically including delay tolerant network dissemination strategies to allow a more efficient usage of the resources available in the back-haul. Not only does this dissemination strategy involve the users and their targeted content, but it also opens the floor for VNOs to provide customised services to a particular user based on her/his interests.

Contrarily to a saturated back-haul scenario, the front-haul is likely to become also the bottleneck assuming a less advanced front-haul deployment, e.g., a single Wi-Fi access point serves multiple homes. RIFE should also be able to reduce the front-haul utilisation by applying CCN principles (content focused multi-casting).

For all objectives presented above it is expected from RIFE to apply a mix of content- and profile-based back-hauling algorithms to support a user- and content-centric opportunistic caching strategy as well as more resource efficient dissemination strategies in order to reduce the back- or front-haul utilisation which essentially would lead to a better user experience.

#### 2.2.2.2 Challenges

Compared to the rural Africa scenario, the western world comes with a harder-to-achieve price tag considering that going from no Internet access to "connecting the unconnected" is more impressive than improving the user experience for users that are actually connected to a broadband deployment but suffer from a not ideal deployment. Having said that, failing to gain access to online content stored miles away from the point of attachment, especially in rural western areas, is very often a frustrating experience.

Understanding the content a particular user is interested in is a key challenge for this UC, as the diversity of content is significantly high. The corresponding mapping to the dissemination and caching strategy requires smart and efficiently working recommender system implementations which can be accurately translated into ICN namespaces used in RIFE; this allows the system to determine how the content is disseminated through the network and where it is placed temporarily.

### 2.2.3 Data Mules for Less Well Connected Villages (Lead: Aalto)

#### 2.2.3.1 Objectives

This UC focuses primarily on the ability to temporarily inter-connect existing front-haul deployments in villages or areas with no permanent back-haul connection. The back-haul connection is realised through "data mules" such as public transport vehicles or lorries commuting between well-connected areas and the less well-connected ones. Those data mules are essentially elements knowing about their role in the network, i.e., collecting, updating and merging content from the caches of less well connected front-hauls with the caches of well-connected ones. Not only is this UC supposed to support communities with a totally disrupted back-haul infrastructure, it also allows the continuous usage of cached data in the front-haul while being disconnected from the Internet. The decision what to cache where and which items in a particular cache can be discarded due to a low popularity is one of the important objectives of this UC.

#### 2.2.3.2 Challenges

The challenges in the data mule UC can be classified as caching-related and networking-related challenges. The aforementioned item popularity score indicating what to cache in which physical network element must include a rich set of input parameters to make smarter decisions than a basic transient caching approach. Especially the classification of what is cacheable at all and the process of merging dynamic content is one of the challenges in this UC and require discriminative caching capabilities. On the other side, networking-related challenges comprise the need for methodologies on how to place content in caches. As some content can be pre-assessed and copied using existing APIs by content providers, e.g., YouTube or Netflix, it must be ensured that the network elements and cache APIs in particular support the interfaces towards the big players' CDNs.

### 2.2.4 Summary

The table below summarises the objectives presented in the rural Africa and western world UCs. Objectives which are less important for a particular UC to improve the overall system are marked with a white circle (○), and objectives of significant importance are marked with a black dot (●). If neither of both symbols are displayed the objective can be considered as not relevant for a particular UC.

Table 2: Summarising relevant and important objectives in deployment-centric Use Cases.

| | **Back-haul Capacity Reduction** | **Front-haul Capacity Reduction** | **Delay Tolerant Networking** | **Implicit Content placement[2]** | **Explicit Content placement[3]** | **Discriminative Content Caching[4]** |
|---|---|---|---|---|---|---|
| **Rural Africa** | ● | ○ | ● | ○ | ● | ● |
| **Western World** | ○ | ● | ○ | ● | ○ | ● |
| **Data Mules** | ● | | ● | ● | | ● |

○ relevant to some extent

● of significant importance

## 2.3 Business-centric Use Cases

Four business-centric UCs are described in this chapter. Three out of the four UCs took as the starting point the IRTF GAIA[5] definition of Alternative Networks. The Mobile Network Operator (MNO) UC was included to allow comparison with competing business structures. Each of the UCs describe how the main business actor is able to sustain its service operation while addressing RIFE business objectives. Discussion about benefits and costs is provided in combination with different revenue models and pricing structures.

The main business objectives of the RIFE project are:

[2] Referring to private or non-existing content placement API for discriminative content caches (e.g., CDNs)

[3] Referring to exposed content placement API for discriminative content caches (e.g., in CDNs)

[4] An example for discriminative caches are CDNs or web proxies with discriminative caching policies (e.g., name/timer-based evacuation policies)

[5] According to the GAIA definition in draft-irtf-gaia-alternative-network-deployments-00.txt

- Enable **business inclusion** by allowing governments, charities etc. to become virtual network operators and create secondary-markets of affordable Internet services for businesses.
- Enable **social inclusion** towards a universal Internet access by providing affordable Internet access for consumers.
- Develop **concrete business models** that are evaluated with respect to possibility of market adoption in different policy regimes, the viability under different incentive regimes (not only focusing on economic viability but also including social viability in, for instance, community-driven deployments) and sustainability in terms of investment models (e.g., driven by cross-subsidies with economic growth programmes).
- Develop **concrete revenue models** that benefit from an extended network of partners with multisided market synergies. (Content Providers, Device manufacturers, Local government, etc.)

### 2.3.1 Wireless Internet Service Provider WISP (Lead: Aalto)

#### 2.3.1.1 Objectives

WISPs are commercially-operated wireless Internet networks that provide Internet and/or Voice Over Internet (VoIP) services. They are most common in areas not covered by incumbent telecom operators where local companies respond to a perceived market gap. WISPs provide services through a communication infrastructure with low deployment and operation cost. Access technologies implemented by WISPs are wireless and operate on the range of unlicensed frequencies.

As a result of the introduction of RIFE technologies, improvement on both front-haul and back-haul bottlenecks makes extra capacity available for the WISP. Moreover, utilisation of the Internet bottleneck-link (e.g. served by a satellite provider) could be maximised if real time information is provided about transit price (congestion-based pricing structure).

The introduction of RIFE enabling technical components is not considered a significant driver of cost because they maintain compatibility with IP technology and are easily deployed in virtual machine form. Therefore the WISP is able to increase its customer base without introducing significant drivers of cost. In case the WISP network suffers from congestion, the most likely pricing structure for consumer customers is the block in the context of a monthly Internet subscription. Otherwise flat fee could be also considered.

We assume that an already existing organisation could act as Virtual Network Operator (VNO). Its aim is making content available for the local community and developing a business inclusion programme for local companies in order to support their access to network services. An example of a VNO that fits in this UC could be an NGO that carries out a health-related campaign. The NGO aims at local health centres to have access to specific training content as well as particular health network-supported services (e.g. instant access to tele-consultation service through videoconference or off-line laboratory tests sent to reference hospital).

The business inclusion programme requires from the VNO to acquire large amounts of data blocks in advance from the WISP through a Bulk network subscription contract at a discounted price in order to assure affordability for local businesses (due to increased bargaining power). In addition, data blocks must be provided to local businesses under specific schemes depending on the nature of their activities.

As a conclusion, the VNO creates a secondary market of sponsored and prioritised data. It's in VNO's interest to create proper pricing structures that match local business revenue models and become sustainable in the long run. For example, access to content available in the WISP's local cache could be sponsored to promote its consumption by citizens. The same way, prioritisation of real time traffic could allow local businesses to provide added-value services and avoid what otherwise could be congested networks (e.g. packetised data block for instant access to tele-consultation services through the bottleneck-link).

#### 2.3.1.2 Challenges

This UC requires from the VNO (and in the long run from the WISP) the employment of local resources to survey the market, define the new service characteristics as well as the introduction of new technical components that implement traffic classification, prioritisation and metering which become significant drivers cost.

From a contractual point of view, the VNO requires from the establishment of a content-related contract with the WISP to assure availability of the same under certain quality of service within a geographical location. As a consequence, the WISP also requires from the agreement with the owner of the content exploitation rights in order to include them in its local cache.

### 2.3.2 Community network (Lead: Guifi)

#### 2.3.2.1 Objectives

Community Networks are built and organised organically in a decentralised and open manner. Community members have formal control over the management of the network by mutual agreement on terms of use. Ownership as well as knowledge about building and maintaining the network is decentralised and open and therefore deployment and operation costs are distributed along the community.

Community networks can serve as a backhaul for providing a whole range of services and applications, from completely free to even commercial services. Hardware and software used can be very diverse and therefore different cost structures might apply to its segments.

We assume several Internet Service Providers (ISPs) operate in the Community network under fair competition conditions. Provided that Community members own the infrastructure, their switching cost between ISPs is rather small (assuming no lock-in is enforced by contract) and therefore competition is presumably high. In case there is only one ISP the UC is similar to the WISP but deployment and operation costs are transferred to the end-users.

Each Community member establishes an Internet subscription with a particular ISP in order to access the Internet. Thus ISPs equipped with RIFE technologies might be able to provide content under better QoS as well as improve utilisation of their own network resources. Such fact could differentiate ISPs from competitors and unleash resources enabling, for instance, Freemium pricing structure. This way community members would be granted with free access to a limited Internet service.

In addition, ISPs with strong relationship with the local community could easily address local requirements and anticipate changes in demand. Furthermore, locally integrated ISP could develop mechanisms to enhance visibility of service benefits to the community thus increasing local acceptance and service adoption.

#### 2.3.2.2 Challenges

The fact that no centralised organisation is responsible for the operation of the infrastructure may affect its performance and timely resolution of failures. The same difficulties could be faced when introducing RIFE technologies and the increase in network capacity could be limited to some segments. Moreover, it increases complexity on the implementation of policies that need to scale across the network as traffic prioritisation. The small size of ISPs could not sustain the operation cost of a metering and billing system (required for block pricing) and the most likely pricing structure is a flat fee.

This fact may reduce the number of applicable pricing structures and revenue models per single ISP. As a consequence, flexibility regarding service customisation would be limited as well as VNO's capacity to address local businesses requirements.

### 2.3.3 Shared infrastructure (Lead: IDC)

#### 2.3.3.1 Objectives

The shared infrastructure UC describes the scenario where a WISP and Mobile Network Operator (MNO) cooperate to extend 3G services to an area where the MNO has no incentives to invest. Cooperation is based on MNO's interest in increasing its customer base without investing in new infrastructure and incurring in new operational costs. WISP customers benefit from MNO's vertical integration of complementary services as mobile payment solutions. Horizontal integration also allows reachability of global mobile network resulting in a win-win situation.

Since the inception of femtocells, there are complete technical solutions for low-cost 3G coverage using the Internet as a backhaul in which it is particularly important to guarantee minimum QoS conditions[6]. Technical solution is feasible only for low populated areas where the number of simultaneous users and the servicing area are small enough to use low-cost femtocells. Due to this technical constrain, we assume the WISP is not commercially viable and, as consequence, it acts as a VNO embracing business inclusion programme as non-profit objective.

As a result of the introduction of RIFE technologies, improvement on both main technical WISP bottlenecks (front haul and backhaul) allow provision of service to more customers and/or the improvement of its quality. We assume that Software Defined Networking (SDN) controller and implementation of multi-stack Ethernet 802.1ad allow interoperability of both WISP and MNO systems[7].

In this UC, two 3G subscriptions could co-exist taking into account market availability of dual SIM devices. Therefore the WISP could issue their own SIM cards and establish their own 3G subscriptions or, alternatively, work as a network extension of the MNO. In the

[6] ICT-601102 STP TUCAN3G Wireless technologies for isolated rural communities in developing countries based on cellular 3G femtocell deployments

[7] SDN optimized caching in LTE mobile networks, Jose Costa-Requena, Maël Kimmerlin, JukkaManner, Raimo Kantola

first case, the WISP could create its own customer base as its primary source of revenue and charge other operators for roaming services of transiting customers. Such scenario would only be sustainable under competition conditions in case the WISP controls an area with high demand or its customer base is comparable to MNO's. In the second case, the WISP's sustainability dependents exclusively on the revenue the MNO is willing to share per each of the handed over clients, complemented with revenues from local services enabled by the cache.

As assumed previously, the WISP provides business inclusion programme as part of its non-profit objectives. Therefore the WISP aims at creating a secondary market of sponsored and prioritised data to enable new business models for local organisations. In this UC, 3G access technology already implements basic prioritisation of traffic and could be supported by WISP infrastructure to address local businesses requirements in the context of the business inclusion programme.

#### 2.3.3.2 Challenges

Although the RIFE enabling technical components maintain backward compatibility with IP technology and could be easily deployed in virtual machine form, this UC requires from additional technical components to allow integration of both MNO and WISP systems and therefore deployment costs could counter balance part of the savings introduced by femtocell technology.

Sustainability of the WISP depends completely on the agreed terms on shared revenue with MNO. In the likely case the WISP operates with MNO's SIM, cooperation needs to exist in the context of shared non-profit objectives (e.g. serve remote areas or emergency situations), otherwise the WISP has no bargaining power to reach revenue model sustainability. Exception to this general case could be association of multiple small WISPs in order to gain volume.

### 2.3.4 Mobile Network Operator MNO (Lead: Aalto)

#### 2.3.4.1 Objectives

In this UC, the MNO provides 3G services to all customers and routes all Internet traffic through a Bottleneck-link provider (e.g. satellite provider). In order to introduce RIFE technologies in a MNO network, SDN controller is deployed to replace the 3G GTP tunnel by a floating mobility control unit[8]. This way 3G services have access to cache systems located close to the Base station.

Generally, MNO's average cost per customer depends on both capacity utilisation and size of the particular link in use. Increase in the capacity utilisation reduces unit cost but could potentially reduce service levels. As a result of the introduction of RIFE technologies, improvement on both main technical MNO bottlenecks (front-haul and back-haul) allow provision of service to more customers.

In this UC, a Content Provider with incentives to promote content consumption is interested in placing content to MNO's cache system due to large customer base and statistically high content hit rate. Assuming both MNO and Content Provider's revenue model benefits from

[8] SDN optimized caching in LTE mobile networks, Jose Costa-Requena, Maël Kimmerlin, JukkaManner, Raimo Kantola

economies of scale on the demand side, it is mutually advantageous to increase customer base and maximise positive network externalities. Depending on expected combined revenue from new customers, sponsorship of traffic to targeted content could be assumed.

Regarding network promotion and contract management, highly centralised management approach of the MNO provides a simplified and uniform service subscription typically bundled with user equipment. As a downside, knowledge of the local community as well as service customisation is inexistent.

#### 2.3.4.2 Challenges

Deployment costs associated with 3G technology are the most significant challenge of this UC. In fact, development of RIFE technologies comes to address the lack of investment of for-profit operators. However, interesting approaches could be extracted from this UC, for instance service provisioning costs of 3G technology are dramatically small as well as the initial capital required from customers to access the network. It could be decreased even more by bundling the user equipment with the 3G subscription. Moreover, infrastructure operation costs are reduced with scale.

### 2.3.5 Summary

Flexibility from the service and pricing structure point of view is required to accommodate requirements from both citizens and local businesses and, this way, foster social and business inclusion. The introduction of RIFE technologies enable such flexibility to a certain extent without increasing deployment and operational costs because they maintain compatibility with IP technology and are easily deployed as virtual machines.

As shown in Table 3, each of the described UCs presents some benefits that take advantage of the mentioned flexibility. However, new drivers of cost appear depending on particular requirements addressed, value network of partners and selected access technology. Revenue models were discussed in this section in order to match benefits and costs and guarantee sustainability.

Table 3. Summarising relevant and important benefits and costs in business-centric Use Cases.

| | | WISP | Community network | Shared infrastructure | MNO |
|---|---|---|---|---|---|
| **Benefits** | Increase in overall network capacity | ● | ○ | ● | ● |
| | Knowledge of local community | ○ | ● | ○ | |
| | Service customisation / pricing flexibility | ● | ○ | | |
| | Mobile network Interoperability | ○ | ○ | ● | ● |
| | Data sponsorship | Depending on VNO funds | Based on high competition | Depending on VNO funds | Based on content hit rate |
| **Costs** | Customer required initial capital | ○ | ● | | |
| | Local promotion and contract management | ● | ○ | | |
| | Traffic prioritisation, metering and billing | ● | ● | | |
| | Deployment costs | Small | Transferred to community members | Reduced due to Femtocells, but MNO integration required | Large |

○ relevant to some extent

● of significant importance

# 3 REQUIREMENTS

The following section outlines the requirements, derived from the various Use Cases presented in Section 2. We divide the requirements into various categories for a better presentation. Each requirement is clearly numbered according to requirement category.

## 3.1 System Requirements

### 3.1.1 Functional

| | | |
|---|---|---|
| **1.1.** | **Rife-Req-(F)** | The RIFE project shall deliver a technology platform based on a unified architecture that shall enable internet access to locations where it is not economically viable to do so with existing network architecture. |
| **1.2.** | **Rife-Req-(F)** | The RIFE platform shall support any current (IP-based) Internet service as well as future applications in the ICN/DTN space. |
| **1.3.** | **Rife-Req-(F)** | RIFE platform shall implement caching mechanisms that support selective context-aware content placement. |
| **1.4.** | **Rife-Req-(F)** | The RIFE platform shall improve the efficiency of existing network resources compared to TCP/IP for the delivery of digital information, such as multimedia content and interactive services. |
| **1.5.** | **Rife-Req-(F)** | The RIFE platform shall tolerate disruption and delays in backhaul connectivity more efficiently than TCP/IP. |
| **1.6.** | **Rife-Req-(F)** | The RIFE platform shall support the development and deployment of online applications and services including access to web resources, secure e-services, knowledge sharing and messaging. |
| **1.7.** | **Rife-Req-(F)** | The RIFE platform shall enable secure access to health data databases. |
| **1.8.** | **Rife-Req-(F)** | The RIFE platform shall enable access to on-line material that could increase the awareness of healthy lifestyle trends. |
| **1.9.** | **Rife-Req-(F)** | The RIFE platform shall allow developers to develop e-health application and services using gamification approaches. |
| **1.10.** | **Rife-Req-(F)** | The RIFE platform shall provide the capability through the e-health applications to the medical personnel to interact with patients, derive information relating their |

| | | |
|---|---|---|
| | | medical condition, obtain and update medical records, and provide feedback in the form of diagnosis and suggested possible treatments. |
| **1.11.** | **Rife-Req-(F)** | The RIFE platform shall provide access to tourist information content, such as pictures, videos, social media and tourist attractions information. |
| **1.12.** | **Rife-Req-(F)** | The RIFE platform shall provide the capability to maintain, edit, audit and add tourist information that would be available to visitors. |
| **1.13.** | **Rife-Req-(F)** | The RIFE platform shall provide the capability using content based algorithms to collect and present anonymised information about tourist sites and attractions. |
| **1.14.** | **Rife-Req-(F)** | The RIFE platform shall provide information, such as the ranking based on the collected data according to the validity and popularity of a tourist site. |
| **1.15.** | **Rife-Req-(F)** | The RIFE platform shall support augmented reality applications to enhance tourist experience through localised caching as well as the potential for placing computational resources for pre-aggregation of input data. |
| **1.16.** | **Rife-Req-(F)** | The RIFE platform shall enable local stakeholders to access educational, governmental or locally restricted content. |
| **1.17.** | **Rife-Req-(F)** | The RIFE platform shall enable the use of e-learning platforms such as Coursera including the relevant multimedia content. |
| **1.18.** | **Rife-Req-(F)** | The RIFE platform shall enable local educational institutions such as schools, to open up their educational resources to local stakeholders. |
| **1.19.** | **Rife-Req-(F)** | The RIFE platform shall enable local business and stakeholders to subscribe and have access to online published data. |
| **1.20.** | **Rife-Req-(F)** | The RIFE platform shall support a 'front haul dissemination strategy' to allow services to reach users beyond the direct reach of the central access node. |
| **1.21.** | **Rife-Req-(F)** | The RIFE platform shall employ dissemination strategies that ensure secure data delivery. |

| | | |
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| **1.22.** | **Rife-Req-(F)** | The RIFE platform shall allow the remote access to public shared content, such as video/audio streaming and the remote retrieval and auditing of the content. |
| **1.23.** | **Rife-Req-(F)** | The RIFE platform shall allow local users to restrict remote access to content that they have generated during local experience sharing events. |

### 3.1.2 Interface

| | | |
|---|---|---|
| **2.1.** | **Rife-Req-(I)** | The RIFE platform shall be able to interface to different underlying network infrastructures, such as DSL, fibre-optics, mobile, or satellite technologies. |
| **2.2.** | **Rife-Req-(I)** | The RIFE platform shall support both physical network interface (NIC) offering direct link layer access and logical network interface to implement overlay functions. |

### 3.1.3 Operational

| | | |
|---|---|---|
| **3.1.** | **Rife-Req-(O)** | Dissemination strategies shall be interoperable. |
| **3.2.** | **Rife-Req-(O)** | The RIFE platform shall support 'ICN dissemination strategy' focusing on fixed line community deployments. |
| **3.3.** | **Rife-Req-(O)** | The RIFE platform shall support 'DTN dissemination strategy' that focuses on wireless and intermittent links. |
| **3.4.** | **Rife-Req-(O)** | The RIFE platform shall support 'IP dissemination strategy' to support IP connectivity to local existing networks and the operation of existing IP-based services. |
| **3.5.** | **Rife-Req-(O)** | The RIFE platform shall enable controlled access to digital material related to the content placement and management. |
| **3.6.** | **Rife-Req-(O)** | The RIFE platform shall provide the capability of content location awareness. |
| **3.7.** | **Rife-Req-(O)** | The RIFE platform shall expose content awareness through well-defined interfaces. |
| **3.8.** | **Rife-Req-(O)** | The RIFE platform shall enable the use of quality assurance for graphical content in e-health applications. |

| | | |
|---|---|---|
| **3.9.** | **Rife-Req-(O)** | The RIFE platform shall be capable of being deployed over temporal no-stationary communication solutions during disaster events. |
| **3.10.** | **Rife-Req-(O)** | The RIFE platform shall support location aware delivery solutions to distribute information during disaster events. |
| **3.11.** | **Rife-Req-(O)** | The RIFE platform shall allow a selective remote locally generated content management functions, such as content editing and auditing. |
| **3.12.** | **Rife-Req-(O)** | The RIFE platform shall provide a way to separate the users that subscribe for the service from the ones who get discounted access at lower quality through a backhaul dissemination strategy to manage the available backhaul network system resources. |
| **3.13.** | **Rife-Req-(O)** | The RIFE platform shall enable the distinction between local and remote users during local experience sharing events. |

### 3.1.4 Security

| | | |
|---|---|---|
| **4.1.** | **Rife-Req-(S)** | The RIFE platform shall implement security mechanisms and strategies that can support trustworthy information exchange between the end users and Internet based services. |
| **4.2.** | **Rife-Req-(S)** | The RIFE platform shall provide security mechanisms to protect published data from unauthorised access. |

### 3.1.5 Reliability

| | | |
|---|---|---|
| **5.1.** | **Rife-Req-(R)** | The RIFE platform shall be designed to eliminate single points of failure. |
| **5.2.** | **Rife-Req-(R)** | The RIFE platform shall have an assured MTBF (Mean Time Between Failures). |
| **5.3.** | **Rife-Req-(R)** | The RIFE platform shall have an assured probability of failure value for a defined time interval. |
| **5.4.** | **Rife-Req-(R)** | The RIFE platform shall have an assured maximum number of failures within a defined time interval. |

### 3.1.6 Performance

| | | |
|---|---|---|
| **6.1.** | **Rife-Req-(P)** | The RIFE platform shall provide online services to end users with a performance at least equivalent to existing online service provision technologies. |

### 3.1.7 Verification

| | | |
|---|---|---|
| **7.1.** | **Rife-Req-(V)** | The RIFE platform shall be analysed by performing tussle analysis of the major aspects of the proposed architecture to evaluate the overall viability in terms of business and socio-economic impact. |
| **7.2.** | **Rife-Req-(V)** | The RIFE platform shall be verified in a test bed by simulation and emulation using the open sand satellite emulator and the NS-3 network emulator. |
| **7.3.** | **Rife-Req-(V)** | The RIFE platform shall be verified in an operational trial with the following characteristics: using real network, having at least 40 end users, involving an operational satellite, using minimum of two user scenarios e.g. education and health. |
| **7.4.** | **Rife-Req-(V)** | The RIFE platform shall be verified with a variety of access methods including mobile. |
| **7.5.** | **Rife-Req-(V)** | The RIFE platform shall be verified using a variety of well-known internet application layer protocols. |
| **7.6.** | **Rife-Req-(V)** | The RIFE platform shall be verified against a set of KPIs including performance, cost, and usability**.** |
| **7.7.** | **Rife-Req-(V)** | The RIFE project shall develop a prototype platform capable of demonstrating the RIFE architecture at TRL-6. |
| **7.8.** | **Rife-Req-(V)** | The RIFE platform shall be verified in comparison with standard IP-Based technologies in terms of bandwidth utilisation, efficiency, latency, and energy efficiency. |

### 3.1.8 Maintainability

| | | |
|---|---|---|
| **8.1.** | **Rife-Req-(M)** | The RIFE platform shall enable maintainability actions such as corrective (correcting faults), perfective (enhancements in terms of effort and time), adaptive (adapting changes according to the environment) and preventive (actions to be taken to reduce future maintenance costs) or any other actions specified. |

### 3.1.9 Standards Compliance

| | | |
|---|---|---|
| **9.1.** | **Rife-Req-(S.C)** | The RIFE platform shall be developed to comply with the international standards and codes, laws and regulations including health and safety for every sub-system that will be used in the platform. |

## 3.2 Business Requirements

### 3.2.1 Regulatory

| | | |
|---|---|---|
| **10.1.** | **Rife-Req-(Re)** | Regulators shall promote the extension of the telecommunication industry value chain incentivising the introduction of more than two traditional parties (consumer and ISP). |
| **10.2.** | **Rife-Req-(Re)** | Regulators shall allow the policy regimes to VNOs to be able to provide network services based on social and economic criteria. |
| **10.3.** | **Rife-Req-(Re)** | Regulators shall enable policy regimes to promote cooperation between operators and local authorities aiming at the replacement of costly public services with digital services. |
| **10.4.** | **Rife-Req-(Re)** | Regulators shall enable the establishment of spectrum licensing processes for fair competition among wireless technologies. |
| **10.5.** | **Rife-Req-(Re)** | Regulators shall foster the competition among incumbents, by enforcing unbundling to enable new entrants to develop infrastructure and operate as mobile virtual operators. |
| **10.6.** | **Rife-Req-(Re)** | Regulators shall enforce competition in the market introducing the mobile number portability solution and bundle the mobile services with handsets. |
| **10.7.** | **Rife-Req-(Re)** | Regulators shall control and define through a legal framework the conditions and regulation where the NOs and VNOs will operate and function. |
| **10.8.** | **Rife-Req-(Re)** | Regulators shall enable the digital connection of disenfranchised communities. |
| **10.9.** | **Rife-Req-(Re)** | Regulators shall enable policy frameworks for the promotion of local business expansion in health or education programs. |

### 3.2.2 Network Operator

| | | |
|---|---|---|
| **11.1.** | **Rife-Req-(N.O)** | NOs shall define new pricing structures that allow the sponsorship of data transmission based on positive network externalities derived from an extended network of partners. |
| **11.2.** | **Rife-Req-(N.O)** | NOs shall define new pricing structures that match local business revenue models and thus become sustainable at the long run such as packetising high quality service data block according to local business revenue model. |
| **11.3.** | **Rife-Req-(N.O)** | NOss shall define new pricing structures that enable access services with different quality of services depending on customer's needs**.** |
| **11.4.** | **Rife-Req-(N.O)** | NO shall adopt horizontal business integration of services allowing service interoperability with other network operators and benefit from positive network externalities. |
| **11.5.** | **Rife-Req-(N.O)** | NOs shall adopt vertical business integration of services allowing bundling with user terminal, payment systems and many more. |
| **11.6.** | **Rife-Req-(N.O)** | NOs shall enable its business plan based on overall reduction of deployment, operations and network maintenance costs. |
| **11.7.** | **Rife-Req-(N.O)** | NOs shall rely on its own equipment, continue all the services, and re-sell the unused capacity to VNOs. |
| **11.8.** | **Rife-Req-(N.O)** | NOs shall have the necessary elements to deliver services such as radio spectrum allocation (mobile), backhaul infrastructure, customer care, roll out, and maintenance. |

### 3.2.3 Bottleneck Link Operator

| | | |
|---|---|---|
| **12.1.** | **Rife-Req-(B-N-L-O)** | LOs shall define new revenue models that take advantage of currently underutilised infrastructure and resources. |
| **12.2.** | **Rife-Req-(B-N-L-O)** | LOs shall reduce the overall costs of deployment and operation of the network without reducing the quality of service and reliability. |

### 3.2.4 Virtual Network Operator

| | | |
|---|---|---|
| **13.1.** | **Rife-Req-(VNO)** | VNOs shall develop concrete business models to be evaluated with respect to social viability. |
| **13.2.** | **Rife-Req-(VNO)** | VNOs shall develop concrete business models to be evaluated through investment models, driven by cross-subsidies with economic growth programs. |
| **13.3.** | **Rife-Req-(VNO)** | VNOs shall define new pricing structures that allow sponsorship of data transmission to a network of partners by placing strategic content such as health campaigns and official announcements. |
| **13.4.** | **Rife-Req-(VNO)** | VNOs shall introduce new services addressing technology challenges such as intermitted connectivity in challenging environments. |
| **13.5.** | **Rife-Req-(VNO)** | VNOs shall enable new revenue models that take advantage of the currently underutilised infrastructure and resources. |
| **13.6.** | **Rife-Req-(VNO)** | VNOs shall define new pricing structures that enable access to services with different quality of services depending on customer's particular needs. |
| **13.7.** | **Rife-Req-(VNO)** | VNOs shall define new pricing structures that match local business revenue models and thus become sustainable at the long run. |

### 3.2.5 Content Provider

| | | |
|---|---|---|
| **14.1.** | **Rife-Req-(C.P)** | CPs shall promote revenue models to allow the sponsorship of customer's data transmission by expanding the customers range and benefit from demand side economies of scale. |
| **14.2.** | **Rife-Req-(C.P)** | CPs shall reduce the overall costs of deployment and operation. |

### 3.2.6 Customer and Local Community

| | | |
|---|---|---|
| **15.1.** | **Rife-Req-(C and L.C)** | C and LCs shall provide proper inception of the business objectives in the community aiming at minimising service rejection. |
| **15.2.** | **Rife-Req-(C and L.C)** | C and LCs shall provide identification of community related value-creating aspects that maximises service acceptance and adoption. |

| | | |
|---|---|---|
| **15.3.** | **Rife-Req-(C and L.C)** | C and LCs shall enable the development of applications and services that provide crucial services, such as healthcare and education. |
| **15.4.** | **Rife-Req-(C and L.C)** | C and LCs shall develop mechanisms to enhance visibility of service's benefits to the community thus increasing local acceptance, service adoption and infrastructure preservation. |
| **15.5.** | **Rife-Req-(C and L.C)** | C and LCs shall develop mechanisms for the community to make service providers accountable for service failures. |

# 4 CONCLUSIONS

In this document, RIFE started the system architecture and design work by outlining the main Use Cases being considered for a RIFE system. These Use Cases were derived through a brainstorming exercise, which specifically focussed on the expertise of individual partners in addressing challenges in Internet service provisioning. Due to this approach in defining our Use Cases, lead partners have been identified across these Use Cases that reflect not only their interest in terms of implementation but also in terms of deployment and commercialisation.

Of particular interest are those that we are likely to select for the trial deployment in the Guifi.net network. While all Use Cases can be considered as being relevant, we specifically highlighted the Use Case of local tourism due to the importance to the Catalonian region as well as that of local experience sharing, which is highly connected to the tourism one. Furthermore, the data mule Use Case is of particular interest as a deployment Use Case due to the existence of often well-connected villages and the transfer of data between them. At the business level, the community network Use Case has been clearly identified as being relevant due to the commercial setup of Guifi.net.

Although these Use Cases present a heightened importance to the RIFE project, the spectrum of Use Cases beyond those show the relevance of RIFE to everyday life of citizens living in connected communities and striving to participate in the digital society. With this in mind, RIFE will actively seek to promote these Use Cases beyond the specifically chosen ones for deployment.