BIONETS

WP 3.3 – BUSINESS MODELS

LSE

D3.3.4

BIONETS Service Description with Analysis

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Author(s):	**Silvia Elaluf-Calderwood, Paolo Dini, LSE**
Editor	**Silvia Elaluf-Calderwood, LSE**
Verification:	**Iacopo Carreras (CREATE-NET)** **Fabio Carati (TI)**
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Summary

This document aims to present an analytical view of potential business models that can be sustained within the BIONETS environment depending upon the development of suitable services and applications. It is an important contribution from the BIONETS research team to enhance this understanding, since any further development of the technology will be conditioned by the ability to provide sustainable services not only from the technological point of view but also from an economic and business approach.

The complementary sources of this document are the research completed in D3.1.1 (Service architecture: Requirements Specification and Concept Definition), and D3.1.3 (Refinement of BIONETS Service Architecture), D3.3.1 (Initial business models for BIONETS implementation), D3.3.2 (Economics for BIONETS business models), D3.3.3 (BIONETS concept development and evaluation, this document is still in progress at the date of this writing), with a strong economic and business component to the analysis of those services and use cases. Secondly, it also comprises the integration of the BIONETS Economic Business Model simulator developed in D3.3.2 with data provided in XML format by BUTE, using the BIONETS Simulation Platform.

This document consists of seven sections: the first three of them presenting the economic and business analysis, followed by a presentation of the results of applying data from a BIONETS application to the BEBS simulation model, and finally two more sections reflecting on the results and potential future research work.

Document History

Version History

Version	*Status*	*Date*	*Author(s)*
0.1	*First Draft*	*03.06.2009*	*Silvia Elaluf-Calderwood, LSE*
0.2	*Second Draft*	*31.07.2009*	*Silvia Elaluf-Calderwood, LSE*
0.3	*Third Draft*	*21.09.2009*	*Silvia Elaluf-Calderwood, LSE*
0.4	*Final Draft*	*11.10.2009*	*Paolo Dini additional comments and review*
1.0	*Final*	*05.11.2009*	*Comments and revisions based on feedback by internal reviewers added by Silvia Elaluf-Calderwood, LSE*
1.1	*Post-final review*	*31.07.2010*	*Paolo Dini, LSE*

Summary of Changes

Version	***Section(s)***	***Synopsis of Changes***
0.1	*N.A*	*None – first draft: Scheme, goals, aims for research layout*
0.2	*All minus 5*	*Draft advance content –Under review completion and edition. Pending in section 5 BUTE data*
0.3	*Items revised*	*Complementary references, pending work in section 5*
0.4	*Final Draft*	*Includes all revisions for submission minus feedback*
1.0	*Final*	*Includes all internal reviewers comments*
1.1	*Post-review*	*Inserted comments after final review ESR feedback*

Note

Reviews after final document delivery (Version 1.0) of the project may or may not result in modifications to the document. If post-review modifications are necessary, then the first version of the resultant document will be 1.1.

Contents

1. EXECUTIVE SUMMARY

This document is a deliverable report into the research work undertaken by the LSE within the context of the scope and objectives of BIONETS D3.3.4 and due at Month 44. It has been reviewed internally by BIONETS partners (Create-Net and Telecom Italia), and their comments have been added to this final version.

The analysis performed in this report is based on the current BIONETS service description model. The primary sources for this analysis are cross-references to research work completed for the deliverables D3.3.1 (Initial business models for BIONETS implementation), ID3.3.2 (Economics for BIONETS business models), D.3.3.3 (BIONETS concept development and evaluation), D3.1.1 Service architecture: requirement specification and concept definition, and D3.1.3 (Refinement of BIONETS Service Architecture).

A discussion of how alternative business models can be used in BIONETS-enabled networks is presented in the form of a taxonomy of the economic areas in which such services can be developed. This final work package deliverable reflects on how the research output of this project can – within the right business framework – provide sustainable economic and business models. This has been enabled through the alignment of goals and expectations to produce a high-quality vision of the potential aroused by BIONETS future services.

The matching of services and users that BIONETS networks and applications might serve in the future is discussed in the context of the Digital City use case. As part of the BIONETS use cases and service applications business discussion, the lack of an evolutionary framework is debated, along with the project's aim to identify where opportunistic and evolutionary metaphors can be used in place of such a framework.

A strongly economic and business-focussed component has been added to the analysis of the services and use cases contained in this research. This focus is a complementary vision to the technological and computing aspects to the project. In particular, the document aims to reflect on future BIONETS services and applications based on current trends and changes in the telecom and mobile business sector. This document also comprises the integration of the BIONETS Economic Business Model Simulator (BEBS) developed in D3.3.2 with data provided in XML format by BUTE, extracted from one of the use cases discussed and explored within the project's core research.

This document aims to be helpful in providing insight in the areas described to future developers, business modellers, telecom operators or manufactures and content providers. It goes beyond the traditional approach of a utility model (paying per consumption) [HUI06] to reflect on the potential of alternative models in which the transaction costs are based on sharing-on-demand, in response to users' requirements for the provision of a "long tail" of potential personalised services.

2. Objectives

The aim of this deliverable is to reflect upon an economic and business analytical framework for the diverse pieces of research work presented over the timeline of the project. It aims to understand how the bio-inspired metaphors can be applied to use cases and service description analysis within BIONETS.

In economic and business terms the discussion between the project partners has been focussed on how to convert the BIONETS services and applications to self-sustaining or open business models [CHE06]. However, converting the transaction-based revenue model[1] from telecom operators to a more distributed and less itemised model of billing is challenging [COR01]. One of the more interesting aspects of this project is its potential to support innovative networking and economic strategies allowing the creation of as many information inputs as possible with a zero marginal cost to the network [AND08; BEN06; COR01]. The zero marginal cost is critical to the understanding of how those services and applications will be sustainable [COR01].

This zero or minimal marginal cost is an important milestone in the exploration of the added value of transactions in BIONETS networks. This was done by exploring the economic processes linked to the establishment of traditional business models [ECO94; ELA09; HAS06] and transposed to the so-called alternative models based on the principles of economics of sharing and community currencies [CAM03; SCH02, WSJ09].

Once it was established – in a theoretical economic framework, including some well-developed practical examples – that there is potential added value for users of the BIONETS-inspired networks and services, the work package was able to illustrate such transactions and quantification of added exchange values by developing a simulation evolution model called BEBS (BIONETS Economic and Business Model Simulator).

In Section 5, this model is applied to data sourced from the main BIONETS emulator. We forecast that in the future, as more BIONETS applications or services become available, this model will increase in importance and complexity. If there are running applications based on the BIONETS paradigm, providers and consumers or users will develop an interest in using such networks. Furthermore, the ability to estimate and quantify such exchange values with a numerical calculation adds to the potential attraction of the BIONETS approach at networking.

The services described at the start of the project were developed as use cases for the Digital City use case scenario. The consortium decision was to focus its development and resources on a set of three use cases:

- Transportation guide
- Unsolvable quiz
- Restaurant search

Although only one of the use cases in this document will be discussed in Section 5 as part of the BEBS execution, the overall focus of the document has been on the internal and external economic and business aspects of the Digital City use case scenario developed through the contributions of all partners.

[1] Since the start of telecommunication companies in the XIX century(e.g. Cable and Wireless), telecom operators have based their revenue models on defining their operational structure on per-use transactional models for billing. These models have allowed over time to create a price structure and billing model that is not flexible enough when applied to environments in which content generation for example requires multiple agents (e.g. other operators, content creators, etc) in the composition of services .

This final deliverable for WP3.3 has not been an easy one to elaborate. There are many drivers in WP3.3 from the technical, biological and business fields. The complexity attained is illustrated in Figure 1, which shows the diverse components of this deliverable. The figure also shows the components and interfaces in the context of other workpackages and external products such as U-Hopper, which are loosely related to BIONETS. The BEBS analysis does not provide a detailed calculation or conversion to a monetary currency (hence the No Euros comment in the diagram) – but an illustration of how the calculations mentioned above can be quantified [D3.3.2].

Within this document use cases and scenarios are viewed from the angle of the possible economic and business models that might emerge, grow, evolve, or be discontinued according to bio-inspired models. The bio-inspired approach aims to 'self-solve' and 'self-sustain', in real time, problems in which the nature of the BIONETS architecture with its opportunistic exchange, non-connected operation, and scalability can support the distribution of data clouds following social networking interactions. Furthermore, the analysis can then be complemented by presenting a taxonomy of potential areas in which alternative business models can expand and be developed.

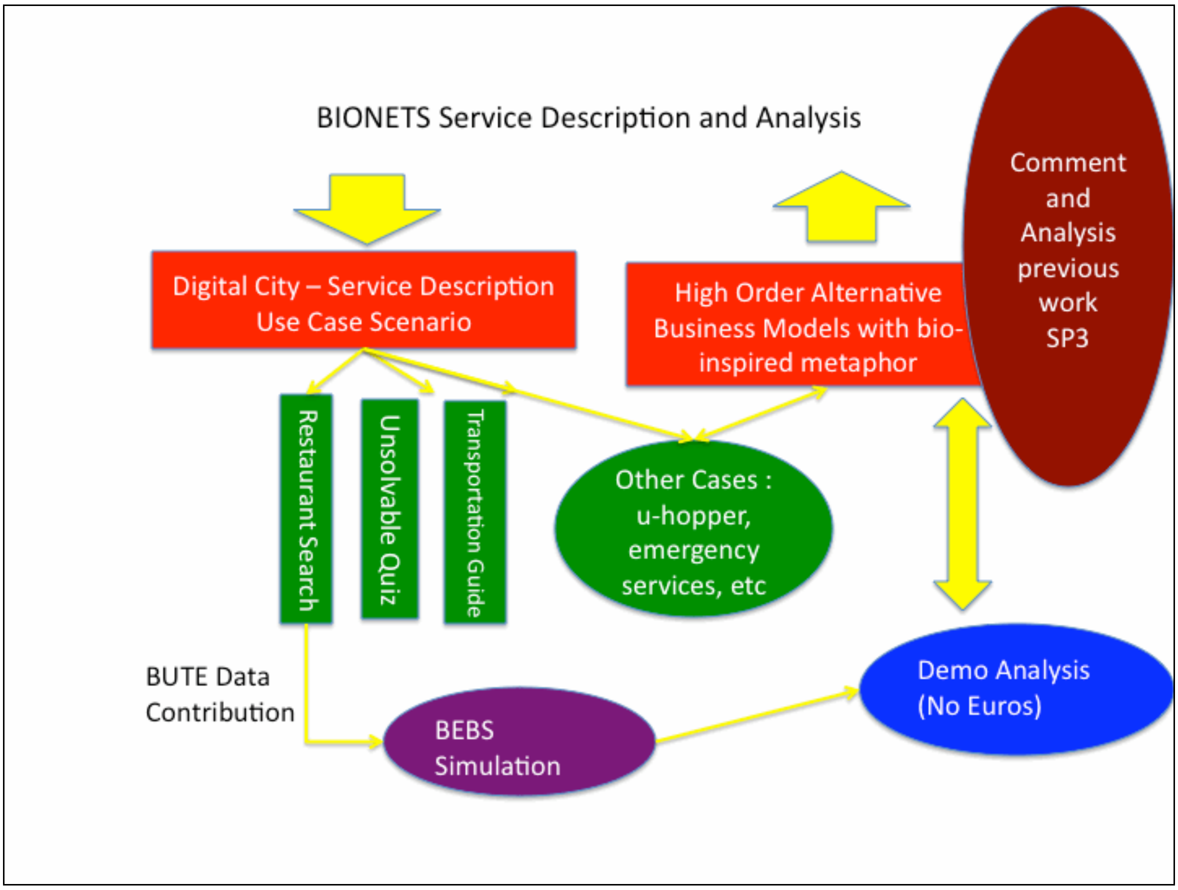

Figure 1: Research components of this deliverable

3. A Socio-Economic Analytical Lens for BIONETS Service Description

This section presents two progressive approaches to understanding the challenges, based on a socio-economic approach, to the implications of the development of non-centralized networks such as BIONETS. From one angle there are the services and use cases transformed into business models, and from the other the actual description of those services and the analytical lens – e.g. shall qualitative or quantitative guidelines be applied? – which is open to discussion. At the early stages of the project the use case scenarios and service descriptions drew on the experience and knowledge of the BIONETS business partners, and the expertise of the technical partners. Each member of the consortium contributed to D3.3.1 and a set of 17 use cases was collected with a wide range of possible applications.

The business models discussed were based on current or existing services focused on the World Wide Web and included the domains of brokerage, advertising (revenue model), infomediary (selling and buying data), merchant, manufacturer (direct), affiliate, community, subscription and utility. However, the main project issue arising at the EC reviews 1 and 2 has been the need create an evolutionary framework in which a reduced number of use cases could then be used to find or explore business and economic models that are unique to this project [D3.3.1].

By the end of the second year, the progress in the project allowed the number of use cases to be reduced to four. These use cases were developed by a Task Force in an internal deliverable led by NOKIA. The result was the definition of the Digital City umbrella use case scenario in which any potential economic and business models for BIONETS application could be developed. In the sub-section below the Digital City umbrella use case will be explained in further detail.

3.1 From Services and User Cases to Business Models

One of the main challenges faced by the research partners during the first half of the BIONETS project was the description of the BIONETS system, which, despite its fairly simple basic architecture, is a complex task. Thus, a strong emphasis was placed on the technical and mathematical aspects of it. The result was the BIONETS e-book (http://www.bionets.eu), which is a live document aimed to provide a taxonomy of the bio-inspired metaphors of the project. These include the computational, mathematical, and some of the economics research domains. The aim of such a document was to be the foundation for establishing the overall service architecture at a high level, use cases, and business model issues.

By the time the task force completed their internal report for the use cases to be used there was a significant improvement in the common understanding of the goals of the project. In the first instance, the use case description starts with an introduction to the main features of the BIONETS system. Besides the technological details, a description of some representative environments, where the BIONETS system can operate, were provided. From the description of some relatively concrete implementations of BIONETS Service/U-node platforms, a set of use cases was discussed within the project.

One of the most important use case scenarios – which was fully supported by both Nokia and TI – is the Digital City Scenario, in which a set of devices and users interact in different spaces, after which use cases can be put forward. It must be noted that this usage scenario has been developed by the industrial partners of the project and not only the academic partners, and had input from real economic and business proposals. And although the Digital City use case scenarios are very ambitious in form and context, most of the features described for services and applications within this context are already used for interfacing multiple technologies in the so-called convergence of services [HER08], hence those are also feasible by using BIONETS-enabled networks.

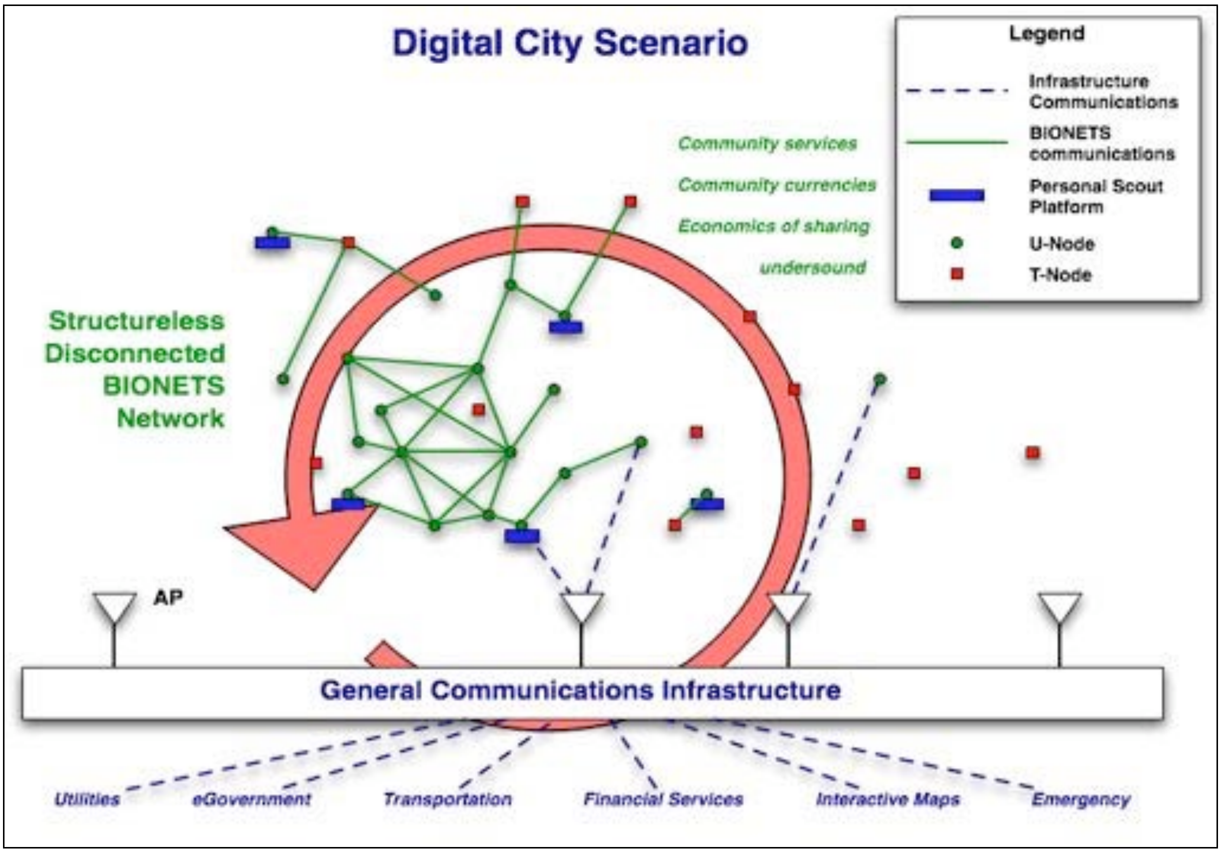

Figure 2: Digital City Scenarios

The Digital City use case scenario provides a complementary and consistently laid out set of use cases for BIONETS services and applications. As seen in Figure 2, backbone services and applications (e.g. utilities, e-government, transportation, financial services, interactive maps, emergency services (control and report), etc.) are linked by the backbone to many smaller and localised BIONETS networks, which all have their own internal communications and services. The choice of linking them to the main backbone is a combination of value and opportunity for the services to expand or to remain self-sufficient [D1.1.2; D3.1.1].

So far, the use-case document describes one environment (Digital City) and one service platform (Personal BIONETS platform) in greater detail, in terms of technical and operational feasibility. The Digital City environment envisages a future city within which a vast number of sensors (T-nodes) are embedded, from which U-nodes can read useful information and basic services. The personal BIONETS platform has been defined as a subset of U-nodes running within personal devices. The reason for this subdivision is to be able to capture the impact of social networks of user communities, as there is a high correlation between personal devices and their users [D3.3.1; D3.3.2].

For example, based on the Service Scenarios collected so far, there is the possibility to define additional services such as a BIONETS Car Platform, which is functionally similar to the Personal Platform, but may be more powerful as it is attached to a car. On the other hand this car-based platform is less personal than the platform based on handheld devices, and thus services running in cars cannot rely on user communities to the same extent. There is an inherent flexibility to the Digital Scenario that makes it a strong choice when applied to BIONETS.

It was important for the project and for WP3 that business models be better described in the document [D3.3.1]. During 2008 these models needed to be better defined, mostly within use case descriptions, as business issues developed a view that such clarification would help to pinpoint which ones are primarily relevant for specific services and their usage. To some extent the platform descriptions are also required to deal with business issues (e.g. making provisioning for billing, rating systems, etc).

The current scenario descriptions within BIONETS were a good source of requirements for networking and service architecture definition work. However, they were initially collected in an early phase of the project when partners did not yet have a full view of what the BIONETS-specific features would be at the end.

From a business modelling point of view there are still several open issues that are part of the evaluation and development in the latter part of the project. It is necessary to define an approach for evaluating the cost and value for the user of adopting the BIONETS habitat. Nevertheless we also need to find a way to evaluate the possible revenues to various actors generated within the system, either as real money, or as some type of community currency combined with an exchange rate, or through economics of sharing principles [BEN06].

3.1.1 The technology choice – making the case for BIONETS

From the start of the project the technical discussion on service description has not included an evaluation of the reasons why users would use BIONETS networks and services instead of already established active services (e.g. convergence of mobile services). Hence, in this section some of the socio-technological issues that are relevant to establish such a preference are briefly presented.

One main characteristic of the services and applications BIONETS-enabled networks are able to provide is a high degree of localisation – in physical terms – of the area in which those communications occur. The second main characteristic is the ability to retain data collected or supplied over intervals of time. Currently there are a number of technologies that can provide, efficiently and at relatively low cost, the services and applications that are described for the use cases so far discussed [LIN09, ROW09].

From a socio-economic point of view, this ambivalence in the selection of BIONETS as the technology to be used for certain services and/or applications is illustrated in Figure 3. This is a double-entry diagram showing how location-based services, measured in terms of the time the data must be retained in the devices, overlaps with a number of possible BIONETS use cases discussed within the project. It is clear that in locations where many services can be provided over different media there can be an overlap or oversupply of these.

In Figure 3, the diagonal axis represents a number of current technologies from Internet (WWW access), Grid computing, GSM (conventional mobile technology), Wi-Fi, and finally BIONETS-enabled, included as potential choices. By linking current active technologies to services, it is possible to understand the range of business models that can emerge from this set up; some might be composition of current models while others might fall out of use [CAM03]. The aim of this diagram, rather than to understand business models, is to understand the application scenarios in which BIONETS could contribute to unique niche markets enabling the later corresponding business models.

The horizontal axis toggles the expected time for data retention based on current standards, and with the perspective that data retention in a centralized backbone network is not a requirement for the provision of temporal and ephemeral services. The vertical axis tries to represent the geographical location and access for the different technologies.

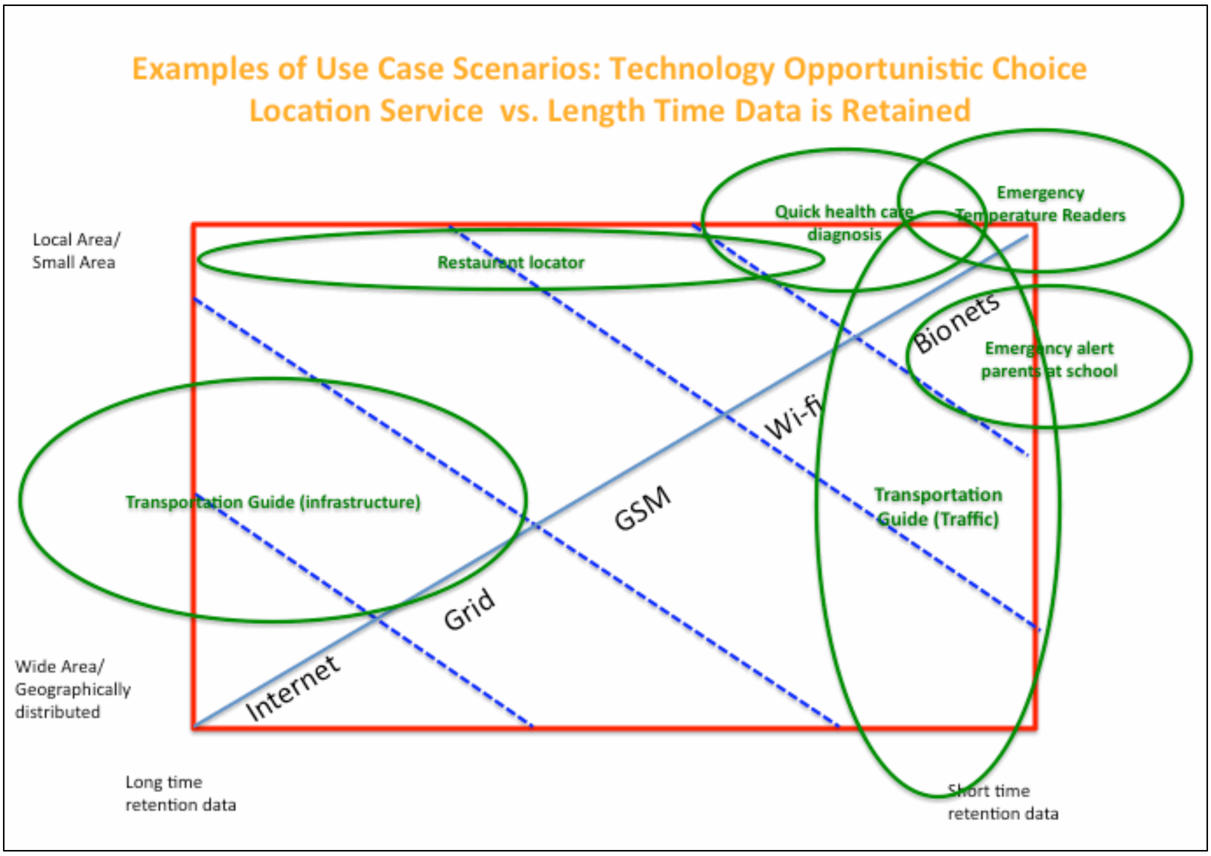

Figure 3: Technology Opportunistic Choice - BIONETS technologies and the confines of its utilization

As an example, take the use case of a digital and mobile transportation guide: the aim is to satisfy road users wishing to be aware or notified of the traffic conditions ahead. Mobile devices installed in their vehicles could read or be fed information from similar devices installed in vehicles coming from the direction in which the first vehicle is going. This exchange could be local and temporal. The information could only be related to the next 500m, 1Km or a similar smaller distance ahead.

However, there are already mobile devices that provide similar services using other technologies, such as GPS and mobile Internet services, Wi-Fi or GSM [HAR08; ROW09]. The data is distributed over longer road distances and integrates information from satellites and weather stations, and can cover a wide geographical area. A disadvantage of this type of service might be the perception of the driver that each time a batch of data is requested there is an active track of location of activity in the vehicle. In some cases the information is not up to date or there is a "time gap" in providing real-time service information. The data can also be perceived as being not so "user-friendly" and personalized as is the case in a BIONETS-enabled network, where a community of people might be able to react to events or situations in a more quick and effective way.

In the case of a BIONETS restaurant locator service, the aim is to provide to users information about locations and menus, and perhaps some kind of rating on the restaurant services. There are already a number of applications in use [GAR09; MIS07] that provide such services. Most of them use a combination of GPS and GSM mobile networks or Wi-Fi, but there is no reason for not having a similar application running on a BIONETS-enabled network. The advantage for the user is that the query data will not be recorded in a backbone network and can be kept for only a short period of time. It is possible to think of a group or individual using a restaurant and wanting to leave feedback in the form of comments, jokes, or perhaps content media (e.g. images, sounds, etc) to be just based in the local area where the restaurant they have just visited is located.

The discussion on the technology-opportunistic choice could take a long time and has different aspects to take into account. In hindsight, the use cases for which BIONETS is most suitable are those in which the data collected or exchanged follows the design goals for BIONETS services and applications originally established. One way to look at this service opportunity is to consider only services providing an opportunistic and perhaps emergency role. An example of this use case is an emergency alert service for parents at school, which could raise an alarm around the school area to all parents in the area if a child went missing, and depending upon the reply of all the parents in the area, the search or alarm could be extended through other technologies to other emergency services such as police, news media, etc.

Another example, but presented with a more opportunistic approach to its possible applications is a mesh or network of wireless sensor networks, which could be enabled to run BIONETS software [KHA09]. For instance, temperature sensors may be used to provide quick readings of temperatures during a forest fire and allow emergency services to allocate their resources over a local area in an efficient way, and compute the safest path through the burning forest, aiming to extinguish the fire quickly. Habitat monitoring, such as seabird nesting sites, is another area of application, in which nodes stream useful live data about the habitat onto the web for use by a community of biological scientists and other interested people [MAI02].

The technological choices for the use of BIONETS services and applications are based on the specific requirements of the use case. Some services can be provided better using BIONETS if the communication is asymmetrical[2] [D3.1.1; D1.1.3] and focused within a certain interval of time during which the services are required to be live and active. The project has not yet developed any applications that combine the opportunistic use cases with the other two drivers of the project: bio-inspired and evolutionary approaches. However it can be expected that the propagation and dissemination of information might mirror epidemic metaphors discussed in the project.

3.1.2 BIONETS Service Description and the Socio-technological lenses

The other approach to the socio-technological lens of analysis is to look at the BIONETS service description or possible "real" services from the point of view of distributed and centralised services paired to more conventional service frameworks such as the web[3]. The idea formed is that for each BIONETS-enabled service description that might appear in the future, a number of questions are raised before the service is considered to be more effective if using the BIONETS platform.

[2] Asymmetrical communication is a well known term in the field of mobile studies. It refers to the expectations common to the sender and receiver of a mobile communication, to negotiate, based on contextual situations, whether to reply immediately or at another convenient time to a communication request [LIN09].

[3] From the point of view of a Digital Business Ecosystem or User Ecosystem the Internet is a service framework for many services: searches, digital markets, software development, etc.

Figure 4 explains the correlation between the socio-technical units of analysis of the service descriptions. Each service category has a brief description and technical challenge summary or most-difficult-to-overcome challenge. For example, if we take the case of services that require larger databases such as Wikipedia or Google search, many of those are services that might have distributed storage; however, their management is centralised (or follows centralised control management procedures) and they face multiple technical challenges such as service vulnerability and redundancy. Nevertheless their effectiveness is beyond doubt as they are able to provide services and applications with a reliable level of satisfaction to their many users.

By identifying the BIONETS service description in this double-entry table it is possible to establish differences and similarities that strengthen the BIONETS case for services and applications to be developed in the future.

As discussed in previous sections of this document, the service case for providing maps and localised information to mobile users by BIONETS networks is more ambiguous. The type of service provided shares characteristics in its functionality that can be worked either as a centralised service on a distributed network, or provided by a BIONETS communication network where the information requested is localised or contextualized in a small area. The challenges those services present are expressed by estimating the time lag before new data becomes live, or in the case of multiple searches, to keep records or semi-records, handle security and deal with abuse between network users.

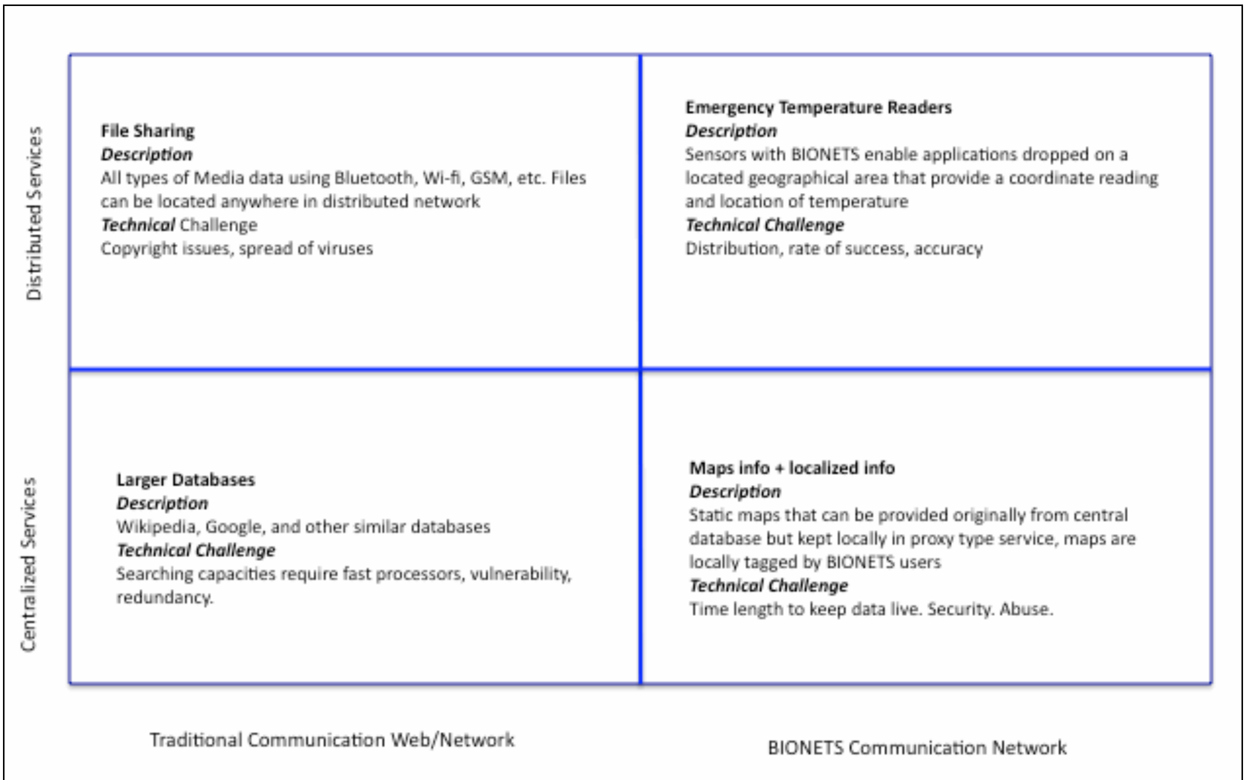

Figure 4: BIONETS Service Description

At first glance the file sharing service seems to be an ideal case for BIONETS communication networks. When examined in more detail, however, technical issues are encountered. For example protocols such as Bluetooth 2.1 did not provide speeds adequate to exchange the information efficiently, and Bluetooth 3.0, released in April 2009, is not yet widely supported; hence some users can communicate but others not, depending on the software and hardware configuration of their mobile devices. There are indeed multiple issues raised by file copying and a distributed (as opposed to centralised) pattern of distribution [LIN09; SOR05].

The success of these exchanges needs to take into account the level of trust between the traders at the service and network layers [GOL06]. If the trust is high between exchanges the distribution of services or content can attain an epidemic distribution in a very short period of time. In the opposite case, absence of trust will limit the expansion of content and might also reduce the chances of success of an application or service if perceived by users as too risky or not trustworthy [ROW09].

BIONETS applications so far seem to achieve success when applied to emergency services, where trust is a given factor and where the issues of concern are the form of physical distribution, accuracy and rate of success, since not all enabled devices will transmit data effectively. From the economic and business point of view the technological components included in the BIONETS infrastructure for a specific use, the selling point of this case, ought to be able to define clearly the added value the use of this technology provides.

This added value might be negligible from the point of view of a telecom operator – or the numbers of transactions have to be considerable to generate significant revenue – but might be relevant for mobile users. Two situations might arise: if in a use case scenario actors can be assigned relative transfer values according to a static framework, implying that such values do not change over time, some of the added value will stay within the confines of the established network and some might be exchanged externally.

For example, in an ideal bio-inspired evolutionary framework, if it were possible to determine variations of the transfer value according to the evolution in services and infrastructure, the added value can be transferred to an external network connected to a backbone. The added value might change over time depending on the uses and profiles users shift or swap when accessing the services provided within a BIONETS network.

To provide theoretical strength to this proposition, it is necessary to link the relationship between the self-referential economic models and relative values for value transfers. It is difficult to determine the socio-technological actors or how the value transfer components are defined, but as applications are developed and the technical links are determined (e.g. parameters such as lifetime, keepalivetimes, etc) within the BIONETS service framework it will be possible to estimate those relative values more accurately.

3.2 Mobile Business Models and BIONETS use-cases

The discussion of use cases and service descriptions highlights the importance of finding an answer to the question: why would a mobile user choose to use BIONETS services and/or applications? Many answers can be given to this question. One possible answer is that the users demand less centralised and control-monitored networks and services [D4.2; ROW09]. This is a potential trigger for services and applications encouraging later adopters of mobiles to use this technology.[4]

[4] This current theme on this area of privacy is the dilemma of Facebook the social networking site and Google the Internet search engine. For example: [Mark] Zuckerberg [creator of Facebook] doesn't pull any punches, describing Google as "a top-down way" of organizing the Web that results in an impersonal experience that stifles online activity. "You have a bunch of machines and algorithms going out and crawling the Web and bringing information back," he says. "That only gets stuff that is publicly available to everyone. And it doesn't give people the control that they need to be really comfortable." Instead, he says, Internet users will share more data when they are allowed to decide which information they make public and which they keep private. "No one wants to

Other possible answers can be drawn from this project's main research theme, and are based on the bio-inspired metaphor, the evolutionary framework, and the opportunistic choice and development of technological challenges. There are many potential applications not yet developed that will provide either services on their own or that will serve as components of other services in those areas.

While the future seems very promising for BIONETS applications, in the present we have tried to represent the dilemma of any use case proposed, to comply satisfactorily with all the project research area drivers. Figure 5 illustrates the identification of the named "niche applications suitable for BIONETS networks", which are now making good use of the services and applications potential. As time passes by, there is a technical and business opportunity for these services to develop their attraction from niche markets to mainstream commercial use.

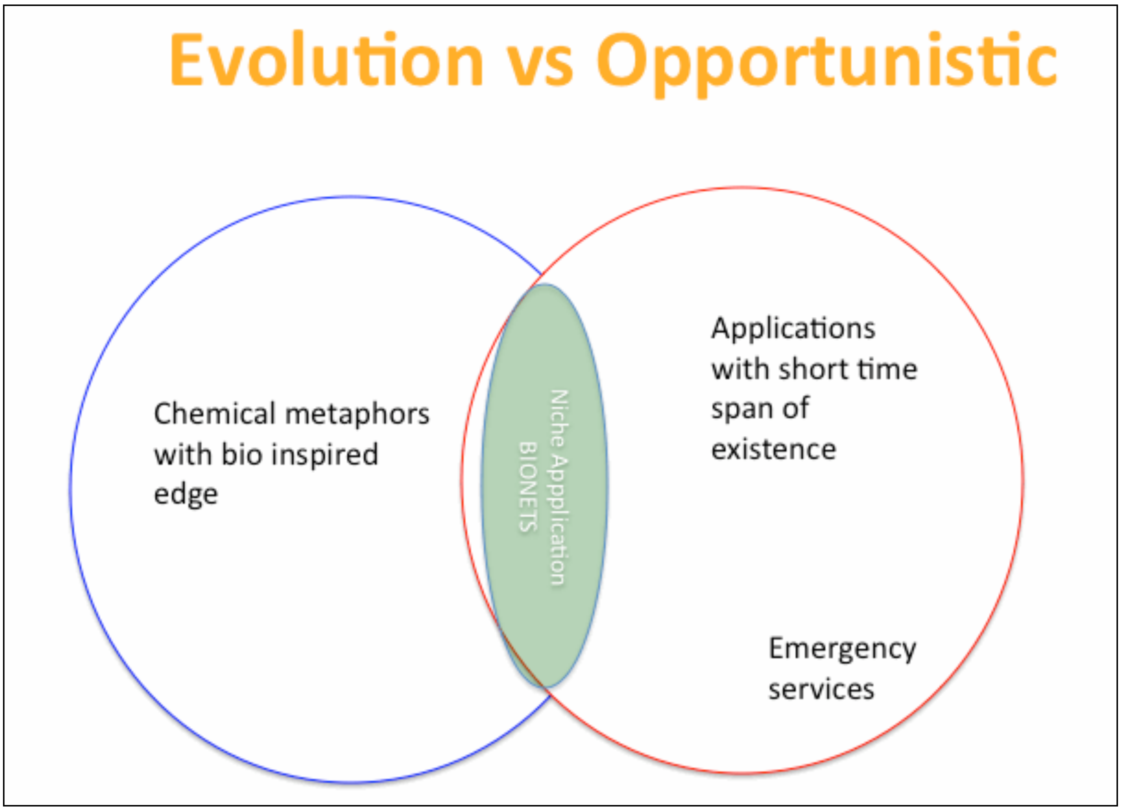

Figure 5: Determining best-suited applications to the BIONETS environment

However, there is one main constraint or requirement on finding the type of application suitable to an evolutionary framework: the evolution metaphor. Evolution in biological and economic terms requires real-time[5] intervals to allow the modification of gene code or environmental variables [D1.1.2]. These times have also to be big enough to be perceived by humans. At this moment in time, all the use cases explored within the project, in compliance

live in a surveillance society," Zuckerberg adds, "which, if you take that to its extreme, could be where Google is going." [VOG09]. Users are aware of these social discourses and it is reflected in their uses and choices of technology.

[5] Real-time intervals in biological terms depend on the life cycles of live creatures. However in chemical reactions such intervals could be on the order or nano seconds. This document takes the view that to provide services on a real time interval it will required a certain level of human awareness or perception to the services to be provided in a BIONETS network.

with the BIONETS service description, seem to have a strong component of either biological inspiration (e.g. chemical metaphors with an inspired computational edge such as Fraglets[6]) or opportunistic application with a short time-span of existence (e.g. emergency services).

Figure 5 illustrates the point made. On one side the chemical metaphors do require a longer time exposure to algorithms, so changes can be triggered for evolution. These processes have been experimentally forced [D4.2] with interesting results in the computational and chemical fields. The other side of this process for determining best-suited applications is the opportunistic service; most of the use cases under Digital City fall into this category and it is still to be determined whether there is a service or application that could be indentified as a unique application for BIONETS services and networks.

This situation should not be regarded as a negative output of this project. In fact it is a great finding for the project to be able to take a step further in the development of applications that can eventually provide such services. It gives future research a more specific field to work with and to be explored for commercial capabilities.

3.3 Section Summary

This section has presented a discussion of the difficulties associated with the generation of service scenario descriptions that are bio-inspired and that take into account the evolutionary, opportunistic and epidemic metaphors at the core of the BIONETS project. By exploring the many alternatives, a potential area for niche services has been found. It is still an open question how to translate those practical services and applications into sustainable business models. This area is discussed further in the next section of this document. However, we are optimistic that, over time, more detailed use cases and/or service descriptions can be developed with characteristics satisfying both an evolutionary and an opportunistic development frame.

[6] At this point in time Fraglets are well developed but no applications are yet developed to be used within the BIONEST environment.

4. BIONETS BUSINESS MODELS ANALYSIS

This section aims to make a link between the use cases selected for analysis and economic and business models. Most of the use cases, and in particular the Digital City, have components or elements in their modelling with a strong element of usage driven by social networking needs. The mobile literature has in many cases explained how social networking can and does provide a strong bio-inspired behaviour, e.g. from news propagation by SMS, a type of epidemic behaviour, or others in which the expansion or changes (evolution) of news change as the news are propagated in a network [HAR08]. It can be said that the use cases within BIONETS are not 100% bio-inspired, but the solutions applied to them are.

This has been a good opportunity for the development of new business models exploring the new social networking media [FRO09; MAK09; TAP06]. The perspective presented in this section is to evaluate the project progress, as a way of discovering a number of collective issues emerging from the need for real-time responses to the services, which can be proposed in the BIONETS architecture, leading to a more holistic approach to the propagation of ideas for alternative business models. As seen in ID3.3.2, a theoretical discussion of the possibility of applying concepts such as Economics of Sharing and Community Currencies co-exists with more conventional models of revenue and advertising.

4.1 The BIONETS economic and business environment

The BIONETS economic and business environment is composed of the external or backbone networks that provide established services though diverse formats and media, either fixed or mobile networks (e.g. payment of utilities, e-government, transportation of data, digital markets, etc), and the localised and self-contained networks, in which services and applications run. These decentralized networks could host new innovative services supported by local resources and not by an external network due to lack of profitability [ECO94; ELA09]. Some of these networks provide services, which are community-orientated,[7] or apply community currency principles to the exchange of information (e.g. tokens, ratings, etc). Other services are based on the principles of economics of sharing (e.g. convergence of services on remote locations) or are able to provide localised exchanges of data.

In Figure 6 this model for service exchanges is presented. The localised networks have a main characteristic: it is a requirement that they at some point become self-sufficient. Self-sufficiency is understood as the existence of a demand for the services and applications provided within this network, enabling enough exchanges to sustain the provision of those over time with minimum disruption. The relationships established due to the exchanges can be synchronous (e.g. each exchange has in return another immediate exchange) or asynchronous (e.g. one exchange can have a return over a period of time). There can be one-to-one relationships, or one-to-many links (e.g. broadcast).

The area in red with the green dots is an area, both physical and virtual, in which community services, community currencies, and the principles of economics of sharing can be applied. Most of the transactions that occur within this network do not need to be coupled to an external environment or actor. Mobile devices, as seen by the development of mobile trading of currency in some countries in Africa, allow transactions to remain local [SHI08; WHI09].

[7] Community in understood in this content as an associated form of members or devices sharing a common interest to provide content or services [BEN04].

In recent years, the economic trend – sustained by mobile operators in the developed world – has been to give away mobile phones, service plans, applications, etc., resulting in the creation of a network of devices able to support demand for many products or services that did not exist before, such as apps (Iphone), mobile media, etc. [PIT09]. This strategy combined with the emergence of "FreeEconomics" [AND08], where business models are based not on cross-subsidies — the shifting of costs from one product to another — but on the fact that the cost of production and therefore of the products themselves is falling fast, has resulted in the shift of the control of transaction costs from networks to content.

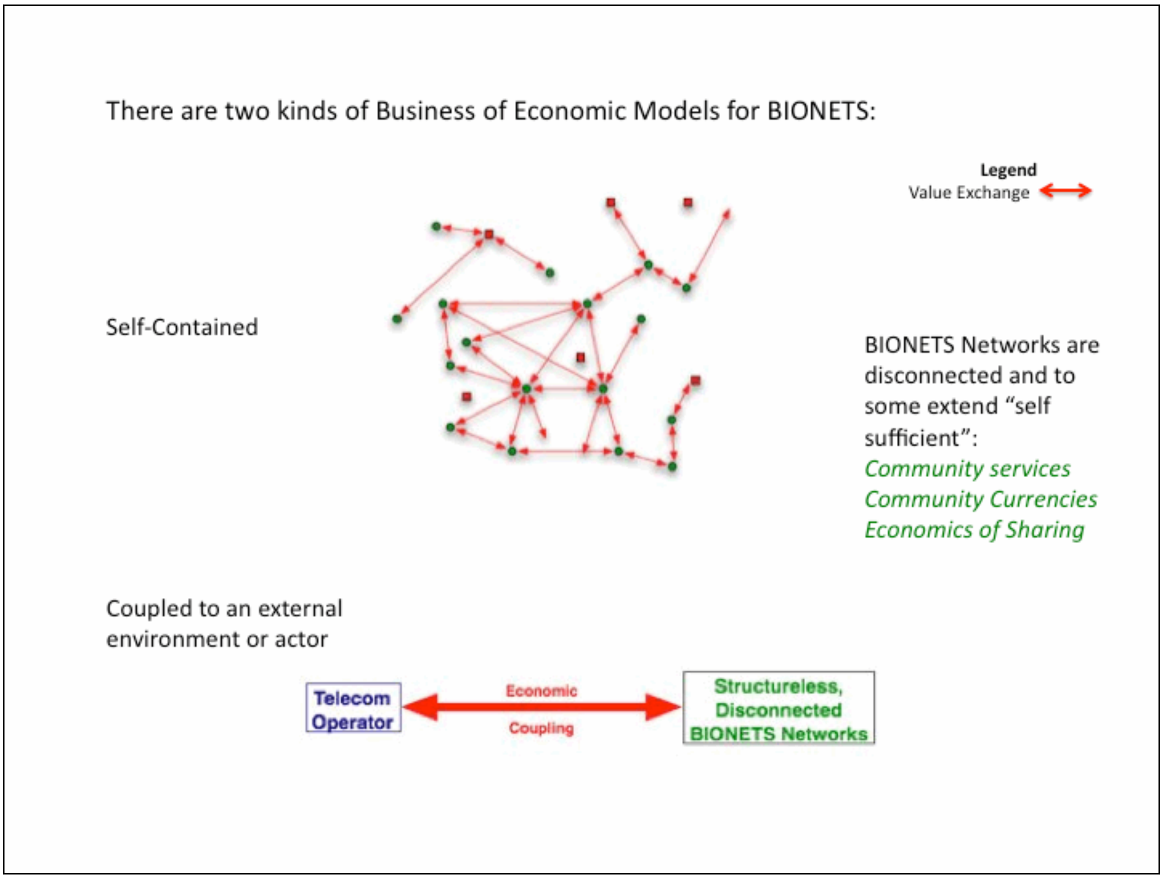

Figure 6: BIONETS Economic model

Once a marketing gimmick, "free" has emerged as a full-fledged economy, with a full global effect. Offering free music proved successful for many pop and rock groups using their Internet web presence to distribute content in special networks such as MySpace, which grasped the audience building benefits of zero cost. For example, the fastest-growing parts of the gaming industry are ad-supported casual games online and free-to-try massively multiplayer online games. Google provides almost all services free to consumers, from Gmail to Picasa to GOOG-411, as well as the Android mobile operating system.

This trend, driven first by the web and now by mobile, will get stronger over time. However, BIONETS services and applications have the potential for a perfect fit with such economic and business model by providing the digital ecosystem that can sustain such environments. The economic tension between the trend towards free information driven by FreeEconomics and the financial drive for profit will not go away over time but is, in fact, likely to become more critical as time passes [JEN06].

The cost of the equipment in the racks at the data centres or the network in place (e.g. hardware) will remain high, but these costs are fixed and can serve tens of thousands of BIONETS users. The investment can be part of a traditional business model, or a model in which the added value, supported by low marginal costs, has a stronger role.

In the following sections a brief description of both the traditional, backbone-based telecom model and alternative, localised business model for BIONETS networks are discussed, linking their relevance to the question of the added value in this type of networks.

4.2 Future business models and traditional mobile operators

The networks proposed for BIONETS applications and software have the potential to interact with backbone networks, which are operational and support traditional economic and business models utilised by fixed and mobile operators. In D3.3.2 the economic actors and agents were defined and described in detail. In Figure 7 these models are described for business transactions in a conventional network [MVC08].

There are a number of actors to be taken into account: from the telecom point of view the network and spectrum trading is regulated either by a EU, national or regional governance institution, which defines the rules of competition and sharing. An example of this can be found in the UK: the OFCOM regulator determines roaming charges within networks. However, more recently, the EU has been forced to provide guidelines on roaming, which has led to the standardisation of roaming fees within the EU [OFC09].

Telecom operators can provide multiple roles in these business models. They can provide the terminal supplier (mobile device[8]) to the users or personal agents. Telecom operators take the role of mobile operator[9] and can also take the role of ISP for standard or business customers; in some contexts they will provide their own supply of new media content or have special arrangement to supply such content.[10] There is also a component for services and content providers that for most operators offers a market for developing applications linked to models of phones or operating systems.[11] Identity management control is split between mobile operators and users.[12]

For users the access to all these services and applications is only made possible by means of specialised mobile gateways. In real terms this means that telecoms have considerable visibility of and control over all transactions that occur in the network at anytime and in any place [ZUB02]. This is illustrated in Figure 7 in which the arrows linking the different elements described above are also monetary links of flows of cash.

The main assumption of any business model that could be deployed in this type of network is that if a user wants to make transactions of any kind with another user, their devices will have to be connected by the backbone network.

[8] Most mobile operators within the EU sell or offer in conjunction with their brand mobile devices such as Nokia, LG, their own cheaper versions of those mobiles made in Asia that have limited functionality but attract the cheap end of the user market [LIN09]

[9] Mobile operator is understood in this model as the main holder on the accountability for billing services and applications (e.g. ringtones, Apple apps for the iphone, etc)

[10] This is the case of BBC iplayer on mobile phones. Other cases are sports broadcasts for UK premiership football, cricket, rugby, and in the near future the day to day results for the Olympic Games 2012 in London [BBC09]

[11] iPhone applications market, and the Google Android applications market.

[12] Mobile operators are regulated on how access to users can be obtained, however users are more concerned with the security features of applications they use on their everyday life and to which they have accepted membership or participation [OFC09].

In the following section the discussion goes a step further to explain how, within this model and taking into account the economics in Section 4.1, there is room for services applications with added value.

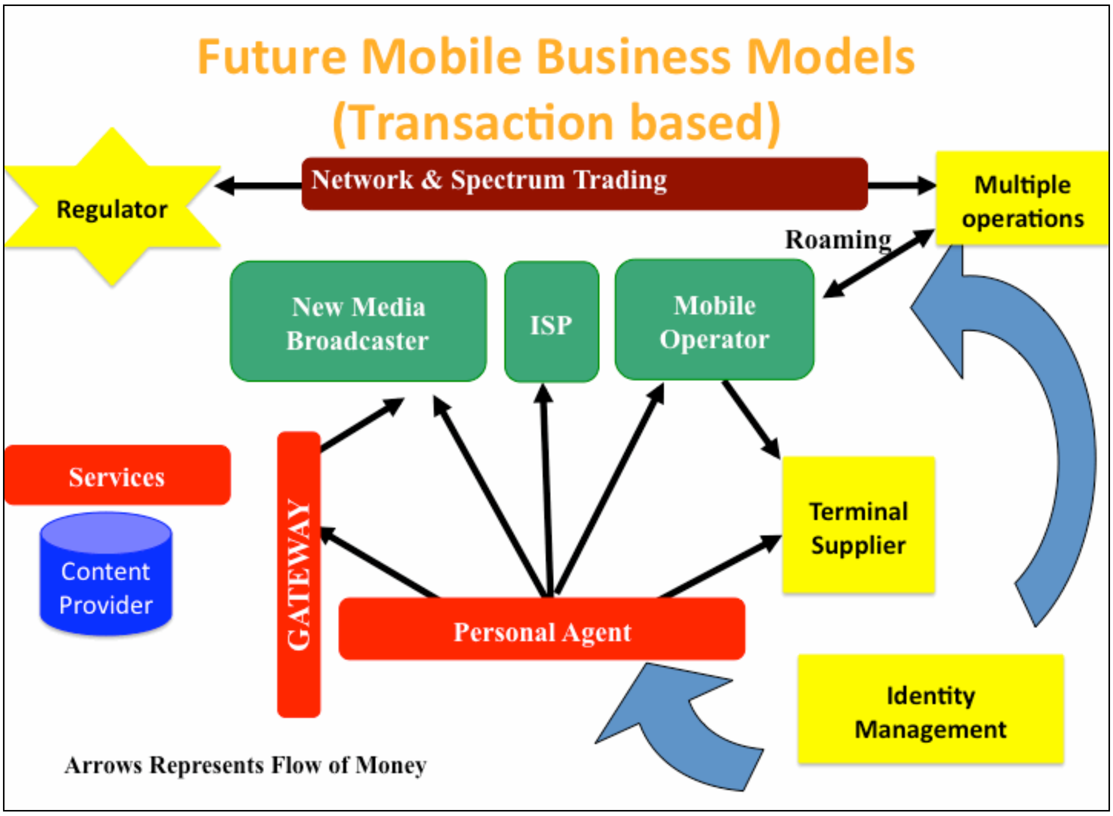

Figure 7: A traditional business model for mobile operations

4.3 The Proposed BIONETS alternative business model: Added value central to sustainability

After reviewing several of the documents associated with this deliverable, the BIONETS business partners (Nokia and Telecom Italia) made the comment that BIONETS networks do significantly reduce the need for the centralised interaction discussed in Section 4.2. If this is the case, the control over billing for the use of services and applications will be only partially managed by the telecom operators. Also the cost of setting up and maintaining self-evolving networks is minimal and does not require a significant start-up investment, making the marginal cost of establishing one near to zero.

In Figure 8, as a subset of the case explained in Figure 7, a model is proposed of these kinds of added value. It is possible to identify the need for a regulatory framework in which these transactions or communication exchanges can occur. One possibility is self-regulatory rules for their management. Identity management might be also self-regulated or heavily determined by the user. It is still open to discussion how the billing will be affected and what kind of regulatory framework will be needed. It is outside the scope of this document to provide a higher level of detail.

Within a BIONETS network, users are able to provide services and content without accessing a gateway provided by a mobile telecom operator. This is a major change in the model. Whilst they may belong to a BIONETS-enabled network, personal agents can or may wish to exchange tokens and data, that might have relevance only for one other agent in this network. In the diagram those values exchanged are split in two: transactions that can be converted by interacting with the traditional network as real money and added value, and the transactions that occur in the BIONETS network but might not be convertible to external money.

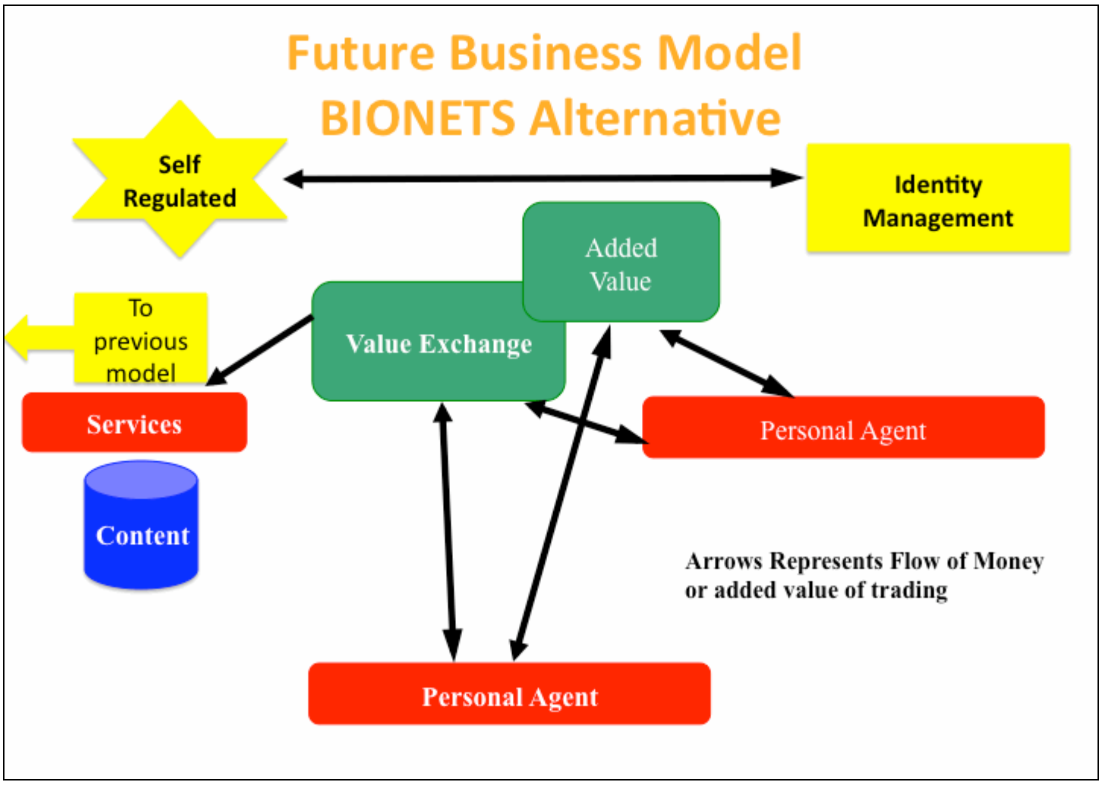

Figure 8: A proposed BIONETS Business Model – Added Value

This proposal for BIONETS business models assumes that in the context of a BIONETS network there will be applications and services designed in such a way that even if the value exchange (in real money) is small, the need for a specific set of users is such that the added value is high but difficult to quantify as real money. This does not prevent those networks from coming into existence, evolving and being sustained. The creation of innovative content has a strong component in which this type of environment might be the most suitable for creating new media ecosystems [AND09].

There is no economic reason to dismiss this type of business model. Micro-transactions with mobile devices are proving a successful idea in developing countries in Africa and beyond [ECO09]. What is innovative in this analysis is that the BIONETS model for the development of these networks effectively uses resources already in place for this type of transaction.

Another abstraction is the control users have over their identity profiles and services. It is too early to establish the most efficient and convenient way this will be done, but more and more users do want up-to-date information about locational services without having to micro-describe their activities or actions in those locations or over time. The ability of someone or something to monitor our movements is not an attractive idea, but the idea of briefly exchanging some information and maybe earning some points that can later be used somewhere else, without having to provide a sequential set of information, is very attractive to many mobile users [ROW09].

As remarked in the Evaluation Summary Report of the final project review, another relevant idea that could be useful to BIONETS-based business models is to import the concept of secondary and tertiary value chains. An example of how this concept has been applied is by the Google advertising model for the secondary value chain as shown in Figure 8a. In this figure, "G" stands for Google, "U" is a User, and "3" is a Third Party, normally a company advertising on Google's search results page.

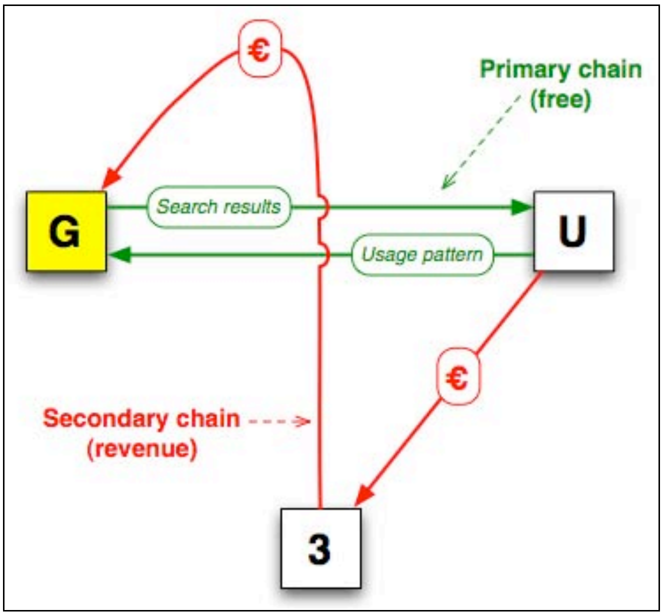

Figure 8a: Google's advertising model illustrating the secondary value chain concept

Iterating the concept further, we can show how free content can become entangled with an additional level of value chain, in Figure 8b, and leading to the tertiary value chain.

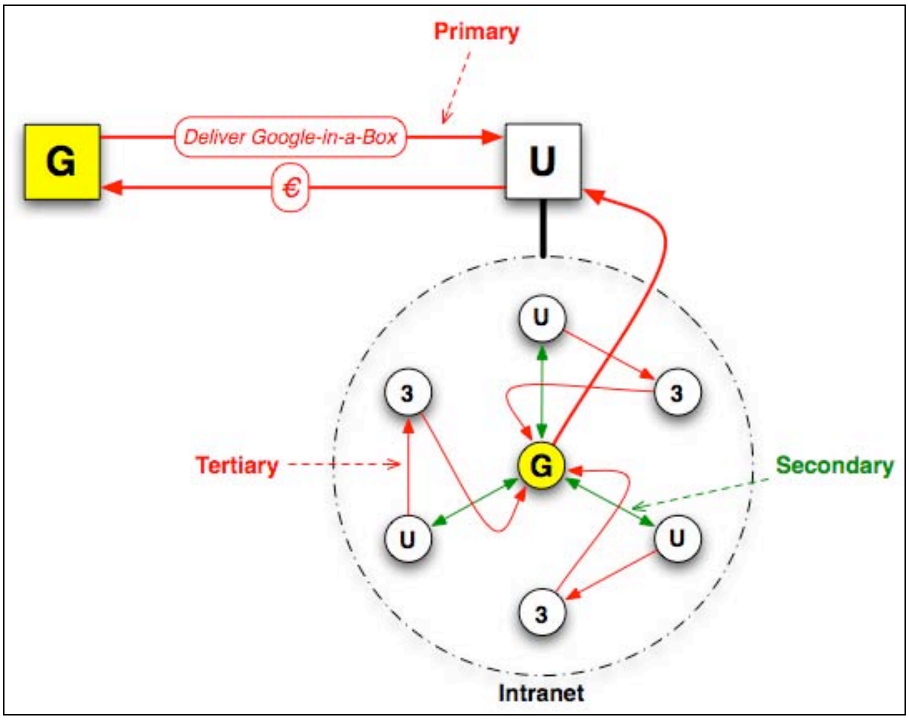

Figure 8b: Google-in-a-Box illustrating the tertiary value chain concept. The circles represent user machines (i.e. client or server) within an intranet. The third parties could be internal or external to the intranet, although in this figure they are internal.

The tertiary case is more complex. This is when Google sells the functionality of Google services packaged in a single server, to be used as part of an intranet. So in this case there are two levels of users: (1) a company or an institution with an intranet, who offers a suite of Google services to (2) its internal users. It is not clear whether the advertising can be performed by the internal users, as shown here, or by third parties external to the intranet (possibly more logical). In either case a revenue stream is generated that can be routed to U. After keeping a part for its own profit, U pays G a fixed price for the use of Google-in-a-Box.

Because a significant number of BIONETS use cases are based on the exchange of free content, it would be interesting to explore how these secondary and tertiary value chain concepts could be applied to the kinds of content and services that have been identified in this and related deliverables. This may be work to be pursued in follow-on projects in this area.

In Section 6 of this deliverable we propose a taxonomy of potential areas in which these models can be successfully applied. In the following section, the BIONETS Economic and Business Model Simulation will illustrate how these kinds of added value could be calculated within a network that is able to provide services or applications to its users.

5. APPLIED USES: BEBS EXECUTION MERGING BIONETS MODELLING DATA

The economic model described in D3.3.2 and analysed in detail in the section above can be structured in a simulation model. This is a significant and interesting step further in understanding the added value of this type of networks. Neither of these networks has an exchange rate to convert between the services or transmissions within the distributed BIONETS network and that of the conventional telecom network. The decision to build a computing model using a modelling tool to illustrate alternative business models is a way of evaluating how these exchange rates could be calculated.

At the core of the work on usage scenarios presented by several BIONETS partners there are two main networks of interaction (See figure 6) in which business models might develop. The economic principles of the model are based on the use cases developed by the BIONETS consortium, which can be grouped at an abstract modelling level as the ability of each node or actor to transmit (send or receive) up to five types of data (this can be changed in the model), assigning to each of these transmissions a token value for the desirability of this transaction. The data transmitted can be for example either environmental variables such as the ones presented in the Digital City scenario, with services that for example allow real-time access to Digital Maps or music exchanges, or a combination of all of these.

A generic model in this case tries to express the added value of the exchanges that occur in the node-based networks that are trading values or exchangeable, for either other tokens or real monetary value, for the actors or users of the network. This section will include the work to be completed using the data (use case searching a restaurant) from BUTE merged to BEBS XML data. The results and comments sections aim to verify or refute the potential existence of a business benefit for this type of model.

Further details in the model were fully described in D3.3.2 section 8. In this document the focus is on providing continuity in the development of the application and its integration in a complementary manner to the body of research work completed within BIONETS.

5.1 Data format and source

The data was generated by an emulator at BUTE and supplied in XML format in a single file. It consisted of a single trace containing nested transmission sets. Figure 9 is an extract from the original data file in which all the elements described are shown. This is an entity containing any number of transmissions from a single node to multiple other nodes. Its attributes are overall start and end times, and the ID of the originating node. The attributes of a single transmission are status (success or failure), sim time (the end time of the single transmission), and the ID of the recipient node. The times are presumed to be in seconds, but this is arbitrary since no units are supplied.

```
<trace>
  <transmissionSet startTime="0.056712975725" endTime="0.056713083966" id="96">
    <transmission status="SUCCEDED" simTime="0.0567130175" id="195"/>
    <transmission status="SUCCEDED" simTime="0.056713083966" id="132"/>
  </transmissionSet>
  <transmissionSet startTime="0.056903536018" endTime="0.056903536018" id="195">
    <transmission status="SUCCEDED" simTime="0.056903536018" id="194"/>
  </transmissionSet>
  <transmissionSet startTime="0.056903602484" endTime="0.056903602484" id="132">
    <transmission status="SUCCEDED" simTime="0.056903602484" id="131"/>
  </transmissionSet>
  ...
</trace>
```

Figure 9: XML Trace Sample

The file contained around 500,000 transmissions and there are from 1-10 transmissions per set. When the application is run, this file is first parsed using XPath to obtain all the transmissions, and the results indexed in order of start time using a Java TreeMap, which is automatically sorted by natural order, and loaded into memory. Since there is often more than one transmission with the same start time, typically in a transmission set, these are placed in Java List collection, consisting of any number of transmissions.

The program steps at time intervals of 0.0001 time units, collecting any transmissions whose start time is in the period since the previous interval. These transmissions are then added to the set of live transmissions and indexed by their end time. At each step, the live transmissions due to end are removed from the live transmission set. Note that all steps will have a transmission.

5.2 Changes and adjustments to BEBS

Program structure
The four classes of the original program – Model, Table, Agent and Transmission – remain. Model and Agent are required since they implement interfaces specified by the Repast framework, whilst Table models the table of accumulated values, and Transmission represents the transmission link between agents. The most radical changes have been made to the Model.buildModel() method, which now loads the model data from an external file rather than specifying the algorithm, and to an inner class, BebsStep, within the Model.buildSchedule() method. BebsStep has a method, execute(), which is run at every time interval (step) and updates the current state of the model. Transmission now has additional methods to get rounded start and end times to enable transmissions to be displayed in the model view window, as described below. Agent and Table are unchanged.

Display
The display windows – output, accumulated value graph, model view window, table of accumulated values and control panel – are unchanged. There have however been some changes to their content, as described below.

Location
The program runs in the Java Repast simulation framework developed by the University of Chicago in 2006. By default, Repast provides a model view window, which contains a spatial map of the agents and transmissions. In the original program, each agent had a location, whereas in the new model, there is no location data supplied. Purely for the purposes of visual representation, a location for each agent has been generated in a way that ensures a fairly even distribution through the window. In practice, the agents appear to fall into two groups, since the location is generated from the agent ID, which is not random. There is one group of mainly transmitting agents and another of mainly receiving agents.

Model
The original BEBS was a simulation and used an internal model. One purpose of re-writing the application has been to make it possible to use external data, which can either be live data or data generated by another simulation program. The main change to the program has been to allow parallel transmissions to be handled, as required by the data supplied.

Cumulative total value graph
The model held in memory is an exact representation of the data provided. However, the display is updated only at time intervals of 10^{-4}. Since the first (lowest) end time is around 0 and the last (highest) end time is around 1.0, this gives a total of 10^{4} intervals. A reasonably

fast modern machine can therefore run the simulation in around 2-3 minutes. To create an exact display would require the model to step at intervals of 10^{-12}, leading to 10^{12} intervals. The simulation would then be impractical (taking around 10 years). Conversely, a longer interval between updates leads to a large number of transmissions appearing to be simultaneous, when in fact they are not.

Model display window
The result of approximating the transmissions start and end times is that whilst agents are displayed continuously, transmissions flash for a few microseconds into the model display window. This time is calibrated to take account not only of the total simulation time mentioned above, but also of the visual effect of the transmissions. The time for which they appear is considered long enough for them to be visible, yet short enough to give a feel for the true transmission time, which is very short relative to the total time of the simulation. If the transmission patterns need to be studied, the step/pause feature of Repast can be used.

Values
Each transmission has a value, which is calculated using:

$$Value = endTime - startTime$$

The values accumulate over time and the total value since the start of the simulation is held in memory. Only a small proportion of time intervals contain a transmission. The accumulated value therefore increases in a step pattern, which can be seen on the graph. As the simulation progresses, the steps become less apparent and the graph appears smoother.

5.3 Results

The aim of the simulation is to establish whether there is any correlation between the pattern of use of the BIONETS application and that proposed in the BEBS model. In particular, the value generated through the use of the application is compared to that anticipated in the model.

The pattern of accumulated value appears to have three phases. In the first stage, it is an apparently random step increase. In the next stage, the value appears to increase exponentially. In the final stage it approximates a linear increase.

From a visual inspection, it does not appear that there is any correlation between the rate of increase in value and the rate of creation of new nodes. Since a new node is only generated when it transmits for the first time, this suggests agents' patterns of transmission remain similar over time.

There are, therefore, two important results of the simulation. Firstly, it is quite apparent that added value is created through the use of the BIONETS application, which verifies the BEBS model. Secondly, although less obvious, habits in the use of the application are formed soon after it is adopted.

5.4 Brief comments on results

The initial stepped, then exponential increase in value appears similar to the curve of adoption followed by many new technologies. The later approximation to linearity suggests that a saturation point is reached. In contrast to many new social applications, however, it appears that agents will use BIONETS regardless of the total number of agents. There does not appear to be a critical mass required, and the introduction of new agents does little to alter established patterns of communication. This might suggest that people adopt the technology in small social groups that are already well formed, and the communication networks created by the transmissions are closed rather than open.

Figure 10 comprises an overview for a simulation ran on the value of the internal network over time. The longer the nodes are live the more stable the transactions are, hence the increase in the network value for all the nodes.

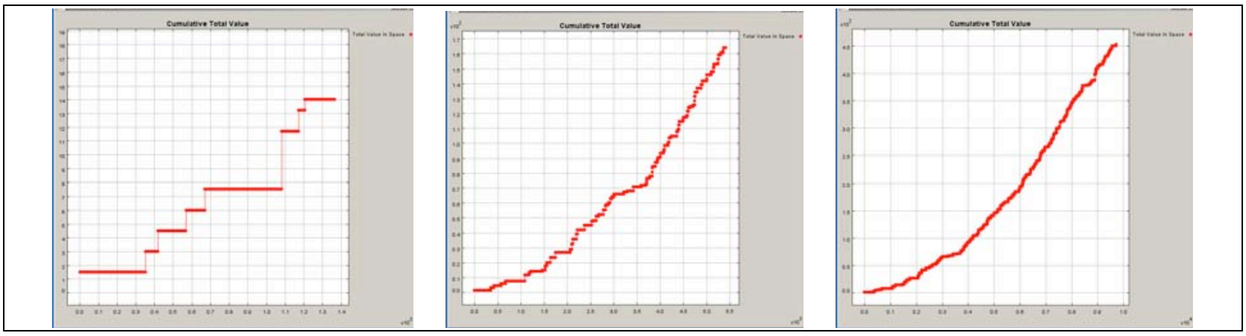

Figure 10: Changes in the Simulation over time
a: 1400 steps; b: 5500 steps; c: 10000 steps

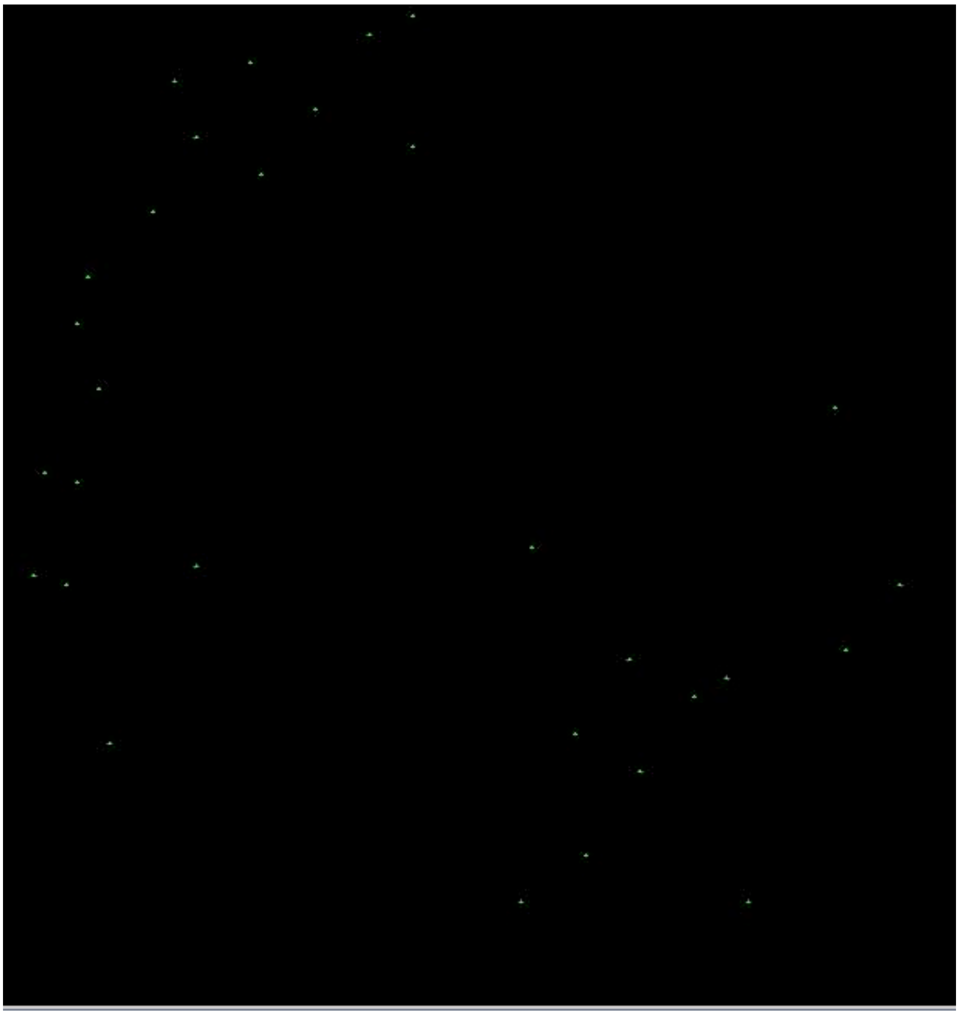

Figure 11: Spatial representation of the Simulation (links not shown)

Figure 11 is just an example of how the links are graphically ploted during the duration of a simulation execution. The physical location of the nodes, while keeping in the boundaries of the areas in which a service is enabled does not modify the calculations of value inside the network.

It would be interesting to analyse the initial increase in transmissions in greater depth. The reason for the increase is not clear, since the model does not account for frequency of transmission or for the number of agents involved. There are a number of possible models that could be investigated. Larger transmission sets, i.e. more transmissions from a similar number of agents, would suggest that a few people become dependent on the technology, but not necessarily a mass market. Increasing value per transmission, where the number of transmissions remains constant, would suggest that the application is being used for "serious" business transactions. A greater overall number of transmitters would suggest a high degree of market penetration. Other scenarios might also be proposed. There is therefore considerable scope for extending the Repast program to analyse the transmission data at a greater level of granularity.

6. ANALYTICAL REMARKS

There are not many research computer models specially created to simulate social networks economic behaviour, such as ability to exchange information over distributed networks and to allocate to those transactions token values. And since a business model that is not centralized sustains the simulation, this piece of work contributes to enhancing the understanding of these types of networks, and their research paradigms.

Overall what is more important is the fact that there is a value metric for this kind of trading that can, with calibration estimates, make a strong case for the implementation of applications and systems in which the sustainability of alternative business models can be assessed, and their viability and economic profitability verified, since the investment for establishing such networks is practically null from the point of view of traditional telecoms.

D3.3.4 has tried to reflect on the economic and business discussions explored from a theoretical point of view in previous deliverables. In D3.3.2 a first attempt was made to understand the role technology has in mediating the value transfer or services and applications at a general level, either by understanding the technological model, the socio-technological actors, or the value transfer associated with the BIONETS research framework. As well as this, D3.3.2 attempted to establish how value transfers were related to the BIONETS system, depending upon service specification, and the actors' actions were seen as economic elements.

In this deliverable an understanding of a business model from a mobile service point of view and elements of social networking have been added to the analysis, focusing on the use case scenarios selected and the BIONETS service specification. As the economic case for business models grows in BIONETS, the elements of analysis of the business models reflect the opportunities for novel business models from the user and provider perspectives that have arisen.

A wider analysis in the context of current and forecast events in the area of technology allows us to propose a taxonomy for BIONETS services.

6.1 A Proposed Taxonomy for future BIONETS services and applications

The purpose of this proposed taxonomy is to classify the economic areas in which BIONETS services and applications are strong enough to provide sustainable business models by using an alternative business approach to the generation of revenue. It is envisaged that there are six major areas for expansion and development. These can be contextualised within the many applications or services that could exist within the Digital City use case umbrella.

A first category is the *standard free access*. BIONETS applications (software and services) can be used, downloaded or distributed for free. It could be the case that some content in a basic form will be provided for free too. This “free” service is provided or accessible to all users of the basic or shell versions.

A second category is *advertising*. Users can access content, services, software and more in exchange for visualising or interacting with some form of advertisement. The advertising sponsors then cover operational costs of the network. Ideally this category will be “free” to everyone.

A third category is *cross-subsidies*. This category has been included in BEBS software and includes any product (software, service and content) that entices the user to pay for something else. An exchange rate can be externally (e.g. by the telecom operator) or internally (e.g. through the collection of ebay points) quantified. It is only perceived as “free”, however, as it depends upon the success of products or services that most users will eventually be willing to pay for, one way or another.

A fourth category is *zero marginal cost*. This category has been included in the BEBS software and includes products (software, service, and content) that can be distributed without an appreciable cost to anyone. This is possible due to the intense level of access to such products. This service ought to be free to all users.

A fifth category is *labour exchange.* This category is drawn from Internet history. The transition to mobile is well in execution and it is sensible to forecast a transition of web sites and their services to the mobile arena. The “free” service is accessible to all users, since the act of using these sites and services actually creates something of value.

A sixth category is the *gift economy*. This category is inspired by the free-for-all models of the Open Source movement. Envisaged as an open source software or user-generated content, the “free” service is accessible to all users.

As explained in Section 4 on the changing economic models, the business success of these six categories will depend on the innovation users provide to the services and products enabled within a BIONETS network. The Digital City use case scenario is rich in potential for innovation and evolution.

6.2 Final remarks

Although this document started by presenting the evolution in the service description and analysis by taking a socio-technical approach, the work completed has also allowed us to discuss the identification of the areas in which BIONETS can provide a sustainable business model and be competitive when offered in parallel to other services. By illustrating the case of BEBS and showing how in a network that fulfils the characteristics of such service descriptions added value for transactions exists and can be quantified, this document has presented a case for services that are not only based on the pay-per-transaction model but on other, novel, models, which can also be exploited.

Users’ consumption of services is driven by choice [AND07] and low cost. This has been for a long time the business and economic view in providing services. Telecom companies developed a great infrastructure to provide pay-per-transaction services. As technology offers not just one but multiple technologies in parallel to the user, able to provide in many contexts or environments similar and in some cases competitive services, users seem to be driven to become creators of content [AND09].

By transferring the control of the added value from telecom services to content providers, mobile technology has created conditions for the exploration of new business models in which sharing, furthermore “sharing nicely” [BEN06], and exploration of the willingness to exchange resources, content or anything users want is not a direct link to a transaction billing process. Telecoms – if they wish to survive in the brave new world of content – need to adapt their services and products to a more flexible business model [BBC09].

In terms of the output of this project, the challenge encountered in BIONETS in its current state is the lack of developed commercial applications. Since a primary type of research was the focus on the exploration of pre-competitive industrial technologies, there is still an open opportunity for the business partners to follow up the research and deploy some “real” applications.

In terms of the output of this workpackage, the research completed is innovative in its approach to this type of new technology and its overlap with socio-economic models for the development of alternative business models. Also BEBS continues to be available at Source Forge as an Open Source project. There are now other computer models trying to understand this type of value transfer [FRO07; MAK09; WSJ09], and this attempt is contributing to the understanding of this field.

Since the start of the BIONETS project other technologies have matured and are currently being proposed as alternatives for the expansion and development of new business models in the mobile environment. Cloud computing and SmartGrids are some of them. These are driven by the current need for telecoms to increase their revenue by participating in the creation of content.

To conclude this document within the scope of the project, the fundamental link to biology in the conceptual idea of BIONETS – the evolutionary framework for the services and applications – has not been completely developed. As explained in Section 3, bio-inspired business models are still a work in progress and the subject of further research.

7. REFERENCES

[AND07] Anderson, C. (2007). The Longer Long Tail: How Endless Choice is Creating Unlimited Demand, Random House Business Books.

[AND08] Anderson C. (2008) Free! Why $0.00 Is the Future of Business. Wired Magazine 16,

[AND09] Anderson, C. (2009). Free: The Future of A Radical Price, Hyperion Books.

[BBC09] BBC (2009). Mobile UK 2012 Future Scenarios. Internal Report. London UK.

[BEN04] Benkler, Y. (2004). "Sharing Nicely: On Shareable Goods and the Emergence of Sharing as Modality of Economic Production." Retrieved October, 2006, from.yalelawjournal.org/pdf/114-2/Benkler_FINAL_YLJ114-2.pdf.

[BEN06] Benkler, Y. (2006). The Wealth of Networks: How Social Production Transforms Markets and Freedom. New Haven and London, Yale University Press.

[CAM03] Camponovo, G. and Y. Pigneur (2003). Business Model Analysis applied to Mobile Business. 5th International Conference on Enterprise Information Systems, Angers-France.

[CHE06] Chesbrough, H. (2006). Open Business Model. Boston, Massachusetts, Harvard Business School Press.

[COR01] Cordella, A. (2001). Does Information Technology Always Lead to Lower Transaction Costs. Global Co-Operation in the New Millennium-The 9th European Conference on Information Systems. Bled, Slovenia: 11.

[D1.1.2] Bionets Deliverable D1.1.2, Architecture, Scenarios, and Requirements refinements

[D1.3.1] Bionets Deliverable D1.3.1, The initial mathematical models of new BIONETS network elements and algorithms

[D3.1.1] Bionets Deliverable D3.1.1 Service architecture: requirement specification and concept definition

[D3.1.3] Bionets Deliverable D3.1.3 Refinement of BIONETS Service Architecture

[D3.3.1] Bionets Deliverable D3.3.1 Initial business models for BIONETS implementation

[D3.3.2] Bionets Deliverable D3.3.2 Economics for BIONETS business models

[D3.3.3] Bionets Deliverable D.3.3.3 BIONETS concept development and evaluation

[D4.2] Bionets Deliverable D4.2, Towards Security in BIONETS

[ECO94] Economides, N. (1994). The economics of networks. EARIE European Association for Research in Industrial Economics Conference, Crete, Greece.

[ECO09] The Economist, (2009). Special report on telecoms in emerging markets. London, UK, The Economist.

[ELA09] Elaluf-Calderwood, S. (2009). Historial-Interpretive Considerations about Money as a Unit of Value and Scale-Dependent Phenomenon. Paradigms for Biologically-Inspired

Autonomic Networks and Services - The BIONETS Project e-book. E. Altman, P. Dini, D. Miorandi and D. Schreckling, BIONETS Consortium: 220.

[FRO07] Frogloop (2007). "Is it Worth it? An ROI Calculator for Social Network Campaigns." Retrieved February, 2009, from http://www.frogloop.com/care2blog/2007/7/17/is-it-worth-it-an-roi-calculator-for-social-network-campaign.html.

[GAR09] Garden, O. (2009). Business Models - Open Garden http://opengardensblog.futuretext.com/GSMA%20network%20access%20API.jpg.

[GOL06] Goldbeck, J. and J. Hendler (2006). "Inferring Trust Relationships in Web-Based Social Networks." ACM Transaction on Internet Technology 6(4).

[HAR08] Harwood, R. (2008,). "Nesta Connect: Connecting Dots and Valuing Networks." Retrieved Jan 17, 2009, from http://blogs.nesta.org.uk/connect/2008/12/connecting-dots-and-valuing-networks.html.

[HAS06] Hassas, S., G. Di Marzo-Serugendo, et al. (2006). "On Self-Organizing Mechanisms from Social, Business and Economic Domains." Informatica 30: 63-71.

[HER08] Herzhoff, J. D. (2008). The Urge to Converge -The ICT Convergence Discourse in the Context of the Mobile Internet in the UK – A Second-Order Observation -. Information Systems Group, Department of Management. London, London School of Economics and Political Science: 68.

[HOD99] Hodgson, G. M. (1999). Evolution and Institutions. Cheltenham, UK, Edward Elgar Publishing.

[HUI06] Huitema, G., J. Andres-Colas, et al. (2006). D4-G.3 Compensation enabled Business Models, FP6 - Ambient Networks Phase 2 Project.

[JEN06] Jenkins, H. (2006). Convergence culture: where old and new media collide. New York, New York University Press.

[KHA09] Khanna, A. (2009). The future of Mobile Application Storefronts - "The world in your pocket". London, UK, Wireless Expertise: 39.

[LIN09] Ling, R. and J. Donner (2009). Mobile Communication. Cambridge, UK, Polity Press.

[MAI02] Mainwaeing, A et all (2002). Wireless Sensor Networks for Habitat Monitoring, WSNA02 (International Workshop on Wireless Sensor Networks and Applications), Atlanta, Georgia, USA

[MAK09] Maki (2009). "The Value of Friends in Social Media Websites." Retrieved Jan 2009, 2009, from http://www.doshdosh.com/the-value-of-friends-in-social-media-websites/.

[MVC08] Mobile VCE, Core-5 Flexible Networks Project Proposal, MVCE, 2008

[MIS07] Mishra, G. (2007). http://www.gauravonomics.com/blog/brand-centric-business-model-mobile-advergaming/. Gauravonomics Blog - Gaurav Mishra's Weblog on Social Media & Social Change.

[OFC09] OFCOM (2009). Enforcement Report. London, UK, OFCOM.

[PIT09] Pittampalli, E., M. Nespatti, et al. (2009) Business Transformation: Advanced Business Models for Converged Communications 2,

[ROW09] Rowan, D. (2009). Tracking your desires: The New Hidden Persuaders. Wired: 96-109.

[SCH02] Schumpeter, J. A. (2002). "The economy as a whole - seventh chapter of the theory of economic development." Industry and Innovation 9(1 & 2).

[SHI08] Shirky, C. (2008). Here Comes Everybody: The Power of Organizing Without Organizations. London, Allen Lanes for Penguin Books.

[SOR05] Sørensen, C., Y. Yoo, et al., Eds. (2005). Designing Ubiquitous Information Environments: Socio-technical Issues and Challenges. New York, Springer.

[TAP06] Tapscott, D. and A. D. Williams (2006). Wikinomics : how mass collaboration changes everything. New York, Portfolio.

[VO09] Vogelstein, F. (2009). "Great Wall of Facebook: The Social Network's Plan to Dominate the Internet — and Keep Google Out." Retrieved 22 June 2009, 2009, from http://www.wired.com/techbiz/it/magazine/17-07/ff_facebookwall?currentPage=2.

[WHI09] White-African (2009). Mobile services in Africa. Internet blog. Las visited July 2009, http://www.mashada.com/blogs/White_African/.

[WSJ09] Wall Street Journal (2009). "The Coming Currency Revolution." from http://online.wsj.com/video/the-coming-currency-revolution/25225F5A-B979-4609-A55D-1BAE9A1BA158.html.

[ZUB02] Zuboff, S. and J. Maxmin (2002). The support economy : why corporations are failing individuals and the next episode of capitalism. New York, Viking.