BIONETS

WP 3.3 – BUSINESS MODELS

NOKIA

D3.3.1

Initial business models for BIONETS implementation

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Summary

The objective of this document is to define potential actors within the BIONETS business ecosystem and to identify the most suitable business models among the existing ones. Potential enablers for further business models are also identified.

The existing-web based business models were taken as the starting point and their suitability for BIONETS architecture was analyzed.

From this work we can conclude that subscription-based business model could be a basic way to monetize BIONETS services. It can be enhanced by some type of broker who could provide access to large number of T-nodes owned by different actors.

It has been identified that *service habitat* is something that could be sold as a product as it would enable the BIONETS services to communicate with external world, facilitate the service evolution and guarantee that services will not act maliciously.

As the services are evolutionary by nature the most suitable business model for them is the community model. As community model does not enable monetizing the services directly, the value extraction could be enabled by previously mentioned service habitat as a product.

The BIONETS project should enable business transactions between different ecosystem components. One of the basic issues to be enabled is the subscription business model for T-node data, e.g. the capability to limit the access to the data based on some type of subscription identifier.

Document History

Version History

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Summary of Changes

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0.1	*Not Applicable*	*None - first draft*
0.3	*All*	*Comments from CN and LSE taken into account*
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[1.1] *note*		

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

Contents

1. Executive summary

The objective of this document is to define potential actors within the BIONETS business ecosystem and identify the most suitable business models among the existing ones. Potential enablers for further business models are also identified.

The business actors around BIONETS architecture components, T-nodes, U-nodes, APs and Services have been identified based on usage scenarios in the deliverable D1.1.1. [BIODelivD111] and service architecture in D.3.1.1 [BIODelivD311]

BIONETS services are expected to evolve autonomously but they can not evolve in any environment. This means that that the BIONETS system needs a "**service habitat**" in which services can live and evolve. This habitat needs to be distributed over U-nodes somehow. The service habitat is not very unlike existing "run-time environment" or "sandbox" concepts but should include, in addition to functionalities found in previous environments, the aspects related to the lifetime of evolving services.

The services will also need some kind of "seed" services to be distributed before they can start to evolve.

As BIONETS services are evolving autonomously we should not use words like "service deployment". The proposal is to use the bio-inspired word "**Service seeding**".

The existing web-based business models were taken as the starting point and their suitability for the BIONETS architecture was analyzed.

From this work we can conclude that a subscription-based business model could be the main way to monetize BIONETS services. The basic model can be enhanced by some type of broker who could provide access to a large number of T-nodes owned by different actors.

In specific locations and for specific applications it will be possible to use vertical business models where service-specific T-nodes and service logic are provided by the same actor.

It has been identified that the service habitat is something that could be sold as a product as it would enable the BIONETS services to communicate with the external world, facilitate the service evolution and guarantee that services will not act maliciously.

As the services are evolutionary by nature the most suitable business model for them is the community model. As the community model does not enable monetizing the services directly, the value extraction could be enabled by above mentioned service habitat as a product (or even as a service?).

As this document is only the initial approach to business models this study needs to be revised later in the project. Meanwhile the rest of the project should work towards enabling maximum flexibility for business models within the BIONETS ecosystem.

This would be enabled by somehow enabling business transactions between different ecosystem components. One of the basic issues to be enabled is the

subscription business model for T-node data, e.g. the capability to limit the access to the data based on some type of subscription identifier.

Additional work concerning business models within WP3.3 is foreseen on community based business models and non-traditional ways of measuring the transactions within the BIONETS ecosystem.

2. Objective of this Document

The objectives of this document are to define potential actors within the BIONETS business ecosystem and to identify most suitable business models among relevant existing ones.

This document aims at clarifying the issues related to Business Models within BIONETS business ecosystem.

This document also gives guidelines to the rest of the project on what type of functionality would be needed from the BIONETS system so as to enable maximum flexibility from the business model point of view.

3. Introduction

A business model can be defined as "*A conceptual tool that contains a set of elements and their relationships and allows expressing the business logic of a specific firm. It is a description of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams."* [AO+02]

This definition looks business model from a single company point of view. In this document however we look at the whole BIONETS architecture based business ecosystem and try to find (potentially) economically viable models for it.

Business ecosystem is defined by J F Moore as "*An economic community supported by a foundation of interacting organizations and individuals--the organisms of the business world. This economic community produces goods and services of value to customers, who are themselves members of the ecosystem. The member organizations also include suppliers, lead producers, competitors, and other stakeholders. Over time, they co-evolve their capabilities and roles, and tend to align themselves with the directions set by one or more central companies. Those companies holding leadership roles may change over time, but the function of ecosystem leader is valued by the community because it enables members to move toward shared visions to align their investments and to find mutually supportive roles."* [JM96]

In a business ecosystem it is not enough that one actor can run a profitable business but it is necessary that all key ecosystem participants can have a viable i.e. profitable, business model. Profit can however in some cases be in some other form than financial profit, so generally speaking every actor should be able to extract its additional value from participation in the ecosystem.

As BIONETS services are services that interact with end-users via mobile terminals (U-nodes) we can assume initially that we can utilize business models currently used for web-based services.

From the BIONETS architecture itself we can deduce some core actors that are necessary for the BIONETS ecosystem. It is then possible to map existing business models over these actors and see how they could fit. We shall also identify if there is a need for additional actors to facilitate the business transactions within the business ecosystem.

3.1 Background

Traditional sensor network applications have not needed a proper business model yet as the practical applications of sensor networks have been mostly for military use. This means that all parts of the system have been owned by the same entity and there are no commercial transactions between parts of the system. The system has usually been built for a single purpose and the total cost of the system has been allocated for this purpose. This means that the business model consists of two main actors: The owner/user of the system and provider of the system.

It is typical that new business concepts are introduced applying a vertical business model i. e. one actor is responsible for large part of the value chain. A typical example of a vertical business model is the Apple iTunes service where single provider provides the device and software for service consumption and the centralized service backend. This of course is not fully vertical model as the connectivity between the service backend and end-user devices is not provided by Apple. The key aspect here is the closed DRM technology that the system relies on.

The maturity of the business system can be measured by the level of horizontality of the value chain i.e. how many participants there are in the value chain providing a product or service. Maturity in practice means that the business system has found its most efficient form.

The business model theories say that the horizontal business model is always more efficient than the vertical business model because it enables more competition at all levels of the value chain. Vertical models are often needed in early phases of the business because all interfaces between value chain participants are not clearly defined and business transactions are thus difficult. [RB+03]

As BIONETS business ecosystems are expected to be introduced commercially only after 2020 we are not in a hurry in defining these issues. However, the better the business ecosystem works e.g. the transactions between actors are efficient, the easier it is to introduce the concept to the market.

When designing the BIONETS system, issues enabling horizontal business models should be taken into account, because it is very difficult to change already working vertical model based business systems. This has been seen recently in the telecommunications business.

4. BIONETS core actors

The BIONETS architecture is chacterized by two main types of nodes – T-nodes and U-nodes. In addition the architecture includes AP nodes which are the means to connect U-nodes to the world outside the BIONETS environment.

From a business model point of view all these nodes can be owned by different entities or some of them can be owned by a single actor. For example in the wellness scenario [BIODelivD111] , [BIODelivD311] the user has some personal sensors (T-nodes) which follow her/him and are typically owned by the user as well as the U-node. However in the parking lot scenario [BIODelivD111] , [BIODelivD311] it is not very probable those parking-lot sensors would be owned by the end users. This means that there needs to be various ways to connect these actors to enable the business ecosystem.

The ownership itself can be hardware, software or application based, although within the scenarios proposed so far this issue was not visible.

The AP nodes will also be utilized in the business ecosystem. They can be owned by yet another actor because user can have access to them due to some agreement on communication services they are using.

The main actor in a BIONETS system is the end-user. She/He can have various roles like pure end-user, service developer/composer, terminal owner, terminal user, T-node owner and AP-owner. The role of end-user and terminal owner are separate here although in many cases the end user owns the terminal she/he is using. However there are often cases, like employer owned mobile phones, when the owner of the terminal is different from the user.

The other important actor within BIONETS ecosystem is the owner/deployer of T-nodes.

Traditional sensor networking applications have used a very simple vertical business model where all parts of the ecosystem are owned by the same organization. In practice this means that the value extracted from the system needs to be very high (like national security) to justify the investment in the whole system.

In addition to “hardware” related actors there will be business actors related to the BIONETS services. They will also be discussed below.

4.1 Actors related to U-Nodes

U-nodes in BIONETS are mobile nodes that people carry with them like mobile phones, PDAs or mobile multimedia computers.

Most of the current mobile phones are owned by the individuals themselves although there are people that use mobiles owned by their employer. From this we can deduct that usage of that kind of device as a BIONETS U-node should definitely bring additional value to the end-user and preferably also to the owner of the device too, in case the device is not owned by the user.

If the BIONETS U-node functionality is embedded into an “existing” device it needs to have a relatively open programming environment to enable BIONETS services to evolve within it and among U-nodes in general.

It is also possible that a U-node is a device that is specifically purchased for the purpose of BIONETS architecture. An example of this type of device could be a cycle computer having pulse meter functionality.

An initial list of actors related to U-nodes is:

1. Device user
2. Device owner
3. Device programmer (BIONETS community?)
4. Device manufacturer
5. Device distributor
6. Mobile operator (e.g. allows for SIM based billing/payment for services)

4.2 Actors related to T-nodes

T-nodes are the sensing nodes within the BIONETS architecture. From the proposed usage scenarios it is notable that it is not totally clear for project partners what the T-node features finally will be within the BIONETS system. If we assume that all usage scenarios are valid for the BIONETS architecture we can only say that T-nodes have some capability to give relevant information about their environment to U-nodes (e.g. sensor information or some preloaded information). This means that T-nodes are fairly heterogeneous devices.

One concept that is very crucial for T-nodes is the location. A T-node always gives information that is related to its location. Unfortunately this location can come in two distinct types. The majority of T-nodes are assumed to be immobile, e.g. their information is relevant for a fixed location like parking space, building etc. On the other hand some T-nodes are following the object they are sensing for. A pulse sensor is attached to a person, a lot of sensors can be within a car or other vehicle or they can be part of a package for a product.

This makes the actors related to T-nodes also heterogeneous, because the sensed data is very heterogeneous and usage scenarios vary a lot depending on application. In any case it is obvious that the “location owner” is a very relevant actor be it the person her-/himself, a building owner or a distributor of a product within a package.

“Device user” is a bit more vague a concept here because many scenarios assume that T-nodes are used only via U-nodes and access to T-nodes is not too much restricted for U-nodes. In many scenarios it is even desirable that information is disseminated from T-nodes to everybody interested. In case sensed information is more or less confidential, there is a need to develop suitable security mechanisms to enable data access only to authorised U-nodes.

The main actors relevant for T-nodes are:

1. Location owner
2. Device owner
3. Device manufacturer

4. Device distributor
5. Device programmer
6. Device user

4.3 Actors related to AP-nodes

AP nodes are currently in "not considered" category within the project. Their importance from new functionality point of view within the project is low as there is existing wide-area connectivity functionality within expected U-nodes. It can be easily re-used without additional development work within the BIONETS project. It means that from the technology development point of view APs are not that important but they are important when we consider the business ecosystem, especially as a part of the service distribution mechanism. The ownership of the AP device is less important than the possibility to utilize the AP for communicating with the world outside the BIONETS environment. Thus the main actor related to APs is the service provider providing the wide-area connectivity behind the AP.

Key actors related to AP's thus are:

1. Service provider
2. Device owner

4.4 BIONETS Service related actors

In the BIONETS ecosystem there are actors which are not related to the participating devices as such but are related to the service/services the BIONETS system provides for its users.

BIONETS services are expected to evolve autonomously but they can not evolve in any environment. This means that the BIONETS system needs a "**service habitat**" in which services live and evolve. This habitat needs to be distributed over U-nodes somehow. The service habitat is not very unlike existing "run time environment" or "sandbox" but should include in addition to functionalities found in such environments, the aspects related to the lifetime of evolving services.

The services will also need some kind of "seed" services to be distributed before they can start to evolve.

As BIONETS services are expected to evolve autonomously we should not use words like "service deployment". The proposal is to use the bio-inspired word "**Service seeding**".

As the services are expected to evolve by themselves there is no need for actions like service maintenance external to U-nodes. In practice there still may be a need for some kind of "Service Police" or "weeding" to get rid of badly behaving BIONETS services from the BIONETS environment. This functionality should work like vaccination to enable self-protection from unwanted behaviour.

Potential service related actors:

1. Service habitat developer
2. Service habitat deployer

3. Service developer
4. Service seeder
5. Service police

4.5 Other potential Actors

There is a possibility have other actors within the BIONETS ecosystem that are not directly related to any architecture component or service. One such possibility could be a broker who aggregates data from different owners of T-nodes and sells access to this data to U-nodes/BIONETS services.

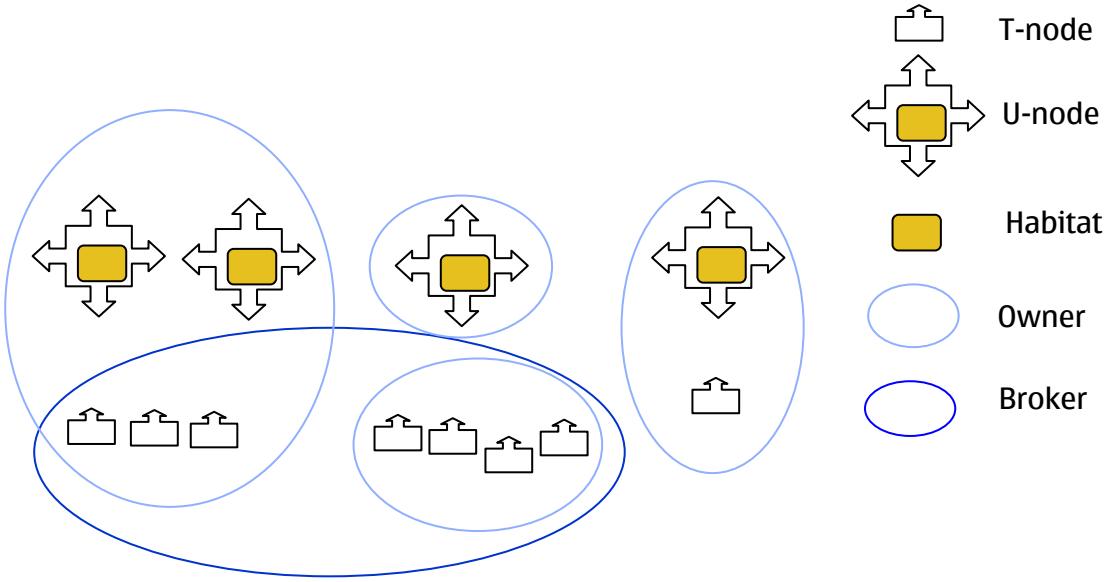

Figure 1 Main business objects and actors of BIONETS architecture

5. Business models for existing services

The business model discussion is initiated here from business models generally applied for web-based services since from the user interaction point of view they are not very different from expected BIONETS services.

Web-based business models can be categorized in ten main categories [MR06]. They are briefly described here and their applicability for BIONETS discussed in the following subsections.

5.1 Web based business models

The following subsections review main groups of business models used for services in the World Wide Web. Their applicability for the BIONETS environment has been analyzed briefly in these sections.

5.1.1 Brokerage

Brokerage is a market-maker. This can happen in many ways on the web. There are online marketplaces, demand collection systems, auction brokers, search agents etc..

In the BIONETS system marketmakers can have a role for example as a broker for access to T-node data from various owners of T-nodes. They can aggregate accesses to various generic T-nodes in different locations and make their living by selling to end-users or end-user organizations access to sensor data owned by various entities. A broker could also establish a marketplace for distributing BIONETS services/habitats from entities who have developed them. The model however is challenged by the fact that in BIONETS system services can evolve by themselves.

5.1.2 Advertising

The web advertising model is an extension of traditional broadcast model where a service that is free for end-users is financed by selling advertisements into the content/services. Advertising-based business models have flourished in the web and they can be classified at least to eight different categories according to Rappa.

This model can work for BIONETS especially if T-nodes could somehow deliver advertisements along with sensor data. This would be a very beneficial model especially if the T-nodes are owned by a location owner like a Mall whose purpose is to enhance commercial activity within a location.

5.1.3 Infomediary

Infomediaries do their business by selling information about consumers and their consumption habits or producers and their products.

On the one hand it is not clear if this type of activity would be relevant for the BIONETS architecture, but on the othe hand there is potential for mining relevant

data using BIONETS mechanisms. This however may cause problems with end-users willingness to allow this type of data collection about themselves.

5.1.4 Merchant

Merchants on the web usually sell real products, but can also sell purely digital products like iTunes or online software distributors.

Sensor data in T-nodes could be seen as a product that is sold to U-nodes. In this case there is a need to develop a very efficient way to do economic transactions between T-nodes and U-nodes. If this can be developed the mechanisms could be utilized also in transactions between U-nodes as U-nodes may also produce "sellable" processed information. This is an issue that could be studied more within the BIONETS project, e.g. how U-nodes could sell information and/or services between themselves.

5.1.5 Manufacturer (Direct)

This model is enabled by the fact that via the web the manufacturer of a product can get a direct contact with the end-user and sell the product without any intermediaries.

The BIONETS concept does not have the "manufacturer" concept so it is difficult to see any application of this model within the BIONETS ecosystem. To some extent this model is similar to the previous one in the BIONETS environment.

5.1.6 Affiliate

An affiliate model tries to reach buyers wherever they surf on the web. The main site pays to the affiliate based on the amount of revenue generated via the affiliate site.

As the BIONETS architecture does not have a "site" concept, services are based on local information and the BIONETS system as such is not a commercial transaction platform, this model will not apply to BIONETS.

5.1.7 Community

Community based business models are flourishing in the web. The Open Source phenomenon is one of the community models. Open content is a similar one applied for content. Public broadcasting and social networking sites belong also to this category.

Community models would be very suitable for BIONETS services. This is because BIONETS services are evolving and evolution creates problems especially on IPR side if something else than an open source concept is used.

This business model will also fit well with a "basic" BIONETS architecture where T-node data would be freely available for any U-node. In this case the benefit for establishing the T-nodes should come somehow indirectly for example as reduction of traffic and pollution as there would be do direct economic value for the owners of T-nodes for providing data for the U-nodes.

5.1.8 Subscription

Subscription model is based on a periodic payment for the service usage.

BIONETS actors could utilize the subscription model for some services. This would require for example a pre-distributed certificate which would enable the access to the relevant T-nodes and/or BIONETS services.

The payment for BIONETS services by subscription is somewhat problematic when services are evolving. Does this mean that subscription price shoud change if the service gets better? The subscription model is thus somewhat problematic when discussing BIONETS end-user services. On the other hand subscription model would fit fairly well for getting the access to the data from T-nodes.

5.1.9 Utility

Utility business model is based on metered usage and is commonly used for telecommunications services, electricity, gas etc. This model has been used for web access and somewhat for online services but has not been very successful there.

To be able to utilize this model BIONETS should develop a means to measure the transactions within the system. It would also be necessary to separate transactions related to various services which would make the measurement system relatively complicated. The ad-hoc nature of BIONETS communication would also make "meter reading" somewhat difficult, so this model does not suit BIONETS well.

5.1.10 Discussion related to BIONETS architecture

The following table sums up the suitability of previous business models for BIONETS architecture. The stars show the authors subjective view on the applicability of the previous business models within the BIONETS architecture.

Brokerage	**
Advertising	**
Infomediary	*
Merchant	*
Manufacturer (Direct)	-
Affiliate	-
Community	***
Subscription	***
Utility	*

*** = Fits very well
** = Fits fairly well
* = Fits somewhat
- = Model does not fit into BIONETS architecture

Table 1 – *Suitability of web business models to BIONETS architecture*

From the previous table it is clear that the community model would be suitable for operating the system as everything would be open. This model however is problematic from the value extraction point of view. It is very challenging to make money based on open-source type of business models. For the service evolution part of the system the community model seems to be most suitable.

The subscription model would also fit well into BIONETS architecture but it will need some mechanism/mechanisms to enable access to data/information based on some type of subscription.

The other two modes having relatively good fit with BIONETS architecture are the Brokerage model and advertising model. In a practical BIONETS business ecosystem there should be the possibility to apply at least all of these four above-mentioned models. If we could also enable the merchant model by creating an efficient “micropayment” system within BIONETS it would at the same time simplify the implementation of some of the other models.

The list of web-based business models used in this section is a first try at categorising possible business models for the BIONETS ecosystem. It is not expected to be an exhaustive list as new models may appear that could be utilized within BIONETS environment. Especially community based business models and novel ways of measuring the usage are of interest for the further work within WP3.3.

6. Business model proposals for BIONETS

From the previous section it can be concluded that community based business models would be suitable for evolving BIONETS services. The main problematic issue with this is that a pure open source approach does not give any actor within the community the possibility to charge for BIONETS services directly. If the earning logic is based on indirect revenues or value extraction only, the probability for successful ecosystem is low.

Subscription-based business models could be used by limiting the access to T-nodes using some kind of subscription mechanism. The service evolution could still happen based on open source principles. In this model users are not paying for the service logic but for the raw data from T-nodes.

If it is possible to develop a way for U-nodes to “pay” for the data they get from T-nodes this would enable the merchant model between U-nodes and T-nodes. It would also enable non-subscription based services between any actors of the value system. This type of merchant model can also be enhanced with the advertising based solution where payment is in the form of receiving advertising. This however is not very efficient model because it may be difficult to force the user to consume received advertisement.

As discussed in section 4 BIONETS services will most probably need a specific service habitat within which they will evolve. This habitat will take care of all external communication and “housekeeping” issues related to service life-cycle. This habitat can be seen as a valuable item and sales of these could be a way to make money in the ecosystem.

7. Conclusions and further work

From this document we can conclude that the subscription based business model could be the main way to monetize BIONETS services. It can be enhanced by some type of broker who could provide access to large numbers of T-nodes owned by different actors. In specific locations and for specific applications it will be possible to use vertical business models where service-specific T-nodes and service logic are provided by the same actor.

Evolving services are problematic from the business model point of view.
The most suitable business model for them is the community model. As community model does not enable monetizing the services directly, the value extraction could be enabled by the above-mentioned service habitat as a product or service. The service habitat could even include the subscription mechanism as one of its constituents.

As this document is only the initial approach to business models this study needs to be revised later in the project. Meanwhile the rest of the project should work towards enabling maximum flexibility for business models within BIONETS ecosystem.

This would be enabled by somehow enabling business transactions between different ecosystem components. One of the basic issues to be enabled is the subscription business model for T-node data e.g. capability to limit the access to the data based on some type of subscription identifier.

Additional work concerning business models within WP3.3 is foreseen on community based business models and non-traditional ways of measuring the transactions within the BIONETS ecosystem.

8. References

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