D2.2
Interfaces for required services

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# GloNet WP2

**Service-oriented system architecture for collaboration**

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Deliverable summary

The GloNet context requires user-customizable user interfaces dynamically adapting to the user-specific needs. This document describes technical concepts and user interface concepts of the GloNet platform to realize user-customizable user interfaces, which dynamically adjust to the users’ access, search and visualization needs. Some of the adjustments can be provided automatically, but most of the adjustments are made by the users themselves or by the software administrators on behalf of the users.

Our approach for defining suitable concepts for the GloNet context starts by collecting requirements for user interface adaptations from general sources and the requirement analysis already done in GloNet. These requirements are then categorized and generalized, before we define suitable concepts for these requirement categories.

The following logical concepts of user interface adjustments should be provided by software solutions based on the GloNet platform:

*Scalable user interfaces*: In order to provide a good user experience from smartphones up to desktop computers an overall UI layout and some UI guidelines are defined, which ensure that one UI concept scales up from small screen sizes to bigger ones without having to implement the UI multiple times and having the user to learn multiple UI concepts.

*Extensive UI customization possibilities* for users:

- **User-specific views**
  Users must be able to define their own user-/role-specific views on the whole wealth of VBE/VO data to filter out the relevant data in an adequate presentation.

- **User-specific information cockpits**
  Cockpits are overviews for specific users/roles containing different mini views. They enable accessing and aggregating different kinds of information in one overview, which is especially important for users with multiple monitoring tasks.

- **User-specific functionality**
  In the GloNet context the relevant functionality is also quite user-/role-specific and also changes over time. In order to support this, the GloNet platform provides innovative mechanisms to define more or less independent application modules, which can dynamically be added and removed by the users.

In order to implement these concepts efficiently in GloNet software solutions the GloNet platform will provide the needed basic technical adaptation and extension capabilities. So the GloNet platform plus the development guidelines of this document will ensure that the adaptation requirements will be met.
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This deliverable is the second deliverable of work package 2 on the logical architecture of the cloud-based software platform and services to support the management and operation of the target collaborative ecosystem. It represents the results of the corresponding task 2.2 on the specification of user-customizable user interfaces, which dynamically adjust to different stakeholders supporting their access, search and visualization needs.

The deliverable uses the requirement analysis results described in the deliverables D1.1 and D1.2 plus some general user interface requirements to analyze the GloNet specific requirements on adaptable user interfaces. The results of the first deliverable of this work package, D2.1 "Required Information/Knowledge Provision Services Specification", are used to analyze the spectrum of users, information types and user-specific access needs.

The technical concepts for adaptable user interfaces defined in this deliverable have to be supported by the GloNet platform specified in D3.1. Therefore the results have been developed in close collaboration with work package 3.

The deliverable has two main results being used in further work packages: The technical concepts to support user-specific and dynamically adaptable user interfaces will be implemented by the GloNet platform in work package 3. The accompanying development guidelines should be taken into account in the software development tasks performed in the work packages 4 "Customized Service-enhanced Product Specification", 5 "Consortium Formation and Operation Support" and 6 "Experimentation and Pilot Development".
1 INTRODUCTION

The software solutions developed in GloNet for supporting the management and operation of the target collaborative ecosystem cover an extensive spectrum of users, data and functionality. In order to still ensure ease of use and efficiently supporting the management and operation processes, the software solutions and the GloNet platform need to support user-specific user interfaces. For example a VBE administrator needs a quite different user interface than an employee of a business service company being part of a VO in the service provision space.

Collaborative ecosystems are quite dynamic: member may join and leave the VBE, new VOs are formed to reach a specific goal, a VO from the collaborative solution space is succeeded by another VO in the service provision space with some members staying and others changing, and so on. All these changes and the required user interface adjustments cannot be foreseen by the developers of the software solutions, so the software solutions and the GloNet platform should also be customizable dynamically by the users themselves.

This document describes technical concepts and user interface concepts of the GloNet platform to realize user-customized user interfaces, which dynamically adjust to the users' access, search and visualization needs. Some of the adjustments can be provided automatically, but most of the adjustments are made by the users themselves or by the software administrators on behalf of the users.

Our approach for defining suitable concepts for the GloNet context starts by collecting requirements for user interface adaptations from general sources and the requirement analysis already done in GloNet. These requirements are then categorized and generalized, before we define suitable concepts for these requirement categories.

The document starts with looking at some general requirements for user interfaces and selecting the important aspects for the scope of this document in chapter 2. Chapter 3 analyzes the user interface requirements of the various stakeholders in the GloNet context and concludes with a generalized set of requirements. For each of these generalized requirements chapter 4 presents logical user interface customization concepts while chapter 5 focuses on the automatic adaption of the user interface to different access device types. Chapter 6 revisits the logical concepts of the preceding chapters and describes the planned technical concepts in the GloNet platform. Additionally guidelines for developing user interfaces on top of the GloNet platform are given to meet the identified user interface requirements. To illustrate the concepts and guidelines chapter 7 gives an example of applying them to one of the use cases of the GloNet context. Finally chapter 8 concludes by summarizing the most important results.
2 MOTIVATION

For the GloNet platform to be successful, its user interface must provide a good user experience. Referring to ISO 9241-110 and usability engineering in general, this means that the dialogs of the GloNet platform should be

- suitable for the task,
- suitable for learning,
- customizable,
- conform with the user's expectations,
- self-descriptive,
- controllable, and
- fault-tolerant.

The following of these points seem to be the most important in the context of GloNet:

1. Generally, VOs consist of members located in different places around the globe. In practice, this means that at least some of the projects' stakeholders will have to travel to be on-site and require mobile access to the GloNet platform. For the UI to be suitable for the task, we need to focus on UI design concepts that embrace mobile clients such as tablets and smartphones, including the differences in the way they are typically used (scalability to different screen sizes).

2. As there can be various forms of VOs depending on their products, the number of stakeholders and their roles, the platform's UI must be suitability for individualization (customizability).

3. At least some of the VO's stakeholders may only occasionally use the system, for example because they are actively involved only at the beginning of a project's life cycle. We need UI concepts familiar to user in terms of presentation and interaction to be self-descriptive and meet the needs for these "Walk-In" users.

4. The GloNet platform needs a consistent user experience to make the UI suitable for learning.
3 STAKEHOLDERS AND THEIR NEEDS

In this chapter, we analyze the needs of GloNet’s stakeholders to identify which of them we have to take into account with regard to a framework for the GloNet platform's graphical user interface (UI).

3.1 Analyzing the GloNet Domain Context

Requirements from GloNet’s Domain Context Framework taken from the requirement analysis and their possible UI impacts:

- Networking among involved stakeholder organizations (Profiles, trust building, glossary, partner finder, negotiation support)
  ➔ Need for search capabilities and linking between different kinds of data.
- Support infrastructure for co-working & co-development (data sharing, communication)
  ➔ These requirements do not compulsory affect the UI in general. Data sharing targets access rights, which mainly affect the data layer. Communication can happen with traditional communication means (telephone, email etc.) or platform internal message types and can be supported by the GloNet platform by providing contact data (phone numbers, email-addresses) and persisting communication data (such as protocols and email attachments).
Task monitoring and management system (distributed process management)  
- (Business) process instances can be modelled as a special type of data that represent process instances. Depending on the current process step and the user's role, different information on the process instances and its linked data get the focus. This affects the view because multiple views on the same type of data are needed.

Shared bag of community assets (within VBEs)  
- Linking of arbitrary data may be a deducible need, for example to link a "best practice" with any kind of data, like projects, products, protocols or persons. Data sharing does not compulsory affect the UI. Data sharing targets access rights, which mainly affect the data layer.

Semi-automated learning-based decision support tools  
- Analysis and forecasting tools are specialized, data-centric application modules that have no impact on a framework for the GloNet platform's UI.

3.2 Generalisation of the actors requirements

Due to the analysis of the various user groups of GloNet, their tasks and required documents or information (UNINOVA, 2012), we determined three kinds of the actors needs. First, there is the need of access to the resources and information in GloNet. After getting access to the whole bag of information and knowledge assets (BOIKA), the user must be able to search for specific and relevant data. To gain the best search results as possible, this search functionality has to be powerful and easy to use. The need of visualization describes the requirement to display the search results (information) in the most suitable manner for the user. This means a high-performance, easy to read / understand presentation of the relevant data, information, knowledge etc.

3.2.1 Access needs

The access needs describe the general requirement to join the network and receive the data and information hosted on the GloNet platform.

On the one side, this aspect addresses the restriction of access due to a concept of certain roles and rights for users. However, the implementation of a role concept is not part of this document, but is part of the GloNet platform specification.

The other side of this requirement is the possibility to access the GloNet platform from different devices (e.g. desktop computers, smartphones and tablets) to be able to access the suitable information anywhere (mobility need). The possibility to log on to the application and obtain some needed data anywhere but the desktop, is advantageous due to certain use cases. Therefore, this requirement will be discussed closer in the aspect of UI scalability.

3.2.2 Search needs

For the usability and success of a collaboration platform like GloNet, users need to be able to acquire the right information to the right time. The generalisation of the certain use cases make clear, that finding the right information, partners, resources, etc. need to be a key feature of the future GloNet application. Therefore, the UI need to provide an easy but powerful
search feature. This feature needs to be implemented in a clear and structured navigation and presentation concept and the opportunity to find resources on the platform by searching for any free text terms.

3.2.3 Visualization needs

A further essential aspect is the opportunity to access the needed information in a suitable way of presentation. Depending on the individual task a user has to accomplish or the kind of information a user is searching for, the presentation of the data need to be customizable. Thinking of the list view of a search result for example, it is a state of the art feature to filter or to aggregate these items to additional parameters.
Graphical user interface (UI) is, from the end-user’s point of view, one of the most important parts of applications. Various users and groups of users have their own requirements on the UI dependent on their needs and goals.

In chapter 3, we identified the user-specific needs regarding the user interface adjustment capabilities of the GloNet platform. While the capability of the UI to adjust to different access devices can and should be automated (see chapter 5) the other adjustment needs require the user (or some application administrator on behalf the user) to customize the UI. In GloNet we strive for UI customization concepts that allow the user itself to customize the UI, so customization without using technical means like scripting or editing configuration files. And we strive for dynamically adjustable UIs, i.e., customization concepts that directly show the customization effect without restarting the system and without the user being required to log off and on again.

This chapter aims to elaborate customization concepts for the GloNet platform. In the introduction part some existing UI customization concepts are discussed. The second part is written with respect to stakeholder’s needs to outline customization concepts suitable for GloNet platform.

### 4.1 Examples of existing UI customization concepts

Of course there already exist various UI customization concepts. They range from very powerful concepts like autonomous user interface, which require programming skills to use, to automatically adapting UIs. In GloNet we want to find a good compromise giving the user the customization possibilities needed without requiring the user to have programming skills.

**Autonomous user interface**

"With traditional design methodologies, application code “owns” the particulars of UI implementation, determining the type, orientation, placement and other attributes of objects on the display (buttons, widgets, etc.), the flow of their use, and the call-back code that powers those elements. The attributes of a UI design are thereby set in the original design and are only minimally mutable by end users. Some UI and application frameworks support theming, or the customization of color schemes, menu text styles, window frames, widget sets, and other factors. However, the fundamental structure and flow of an application UI remains set in stone – a closed box as imagined by the original design team."

The autonomous user interface (AUI) is a revolutionary approach to UI design and implementation that goes beyond the custom themes, icon sets, and color schemes common on many various devices. Through scriptable, autonomous user interface coding, the AUI lets OEMs, developers, integrators, and even other ecosystem participants completely control and customize the look and feel of the end-user experience. The separation of applications and user interface code together with a unique AUI confers flexibility and opportunities for branding and adding value in channel." (Karp, 2010)

**Adaptive presentation**
The goal behind *adaptive presentation* is to display certain information based on the current user. This may mean that users with only basic knowledge of a system will only be shown minimal information. Conversely, a user with advanced knowledge will have access to more detailed information and capabilities. (Ramachandran, 2009)

### 4.2 UI customization concepts suitable for GloNet

In the GloNet platform we want to realize the following three kinds of UI customization concepts to fulfil the stakeholders’ UI adjustment needs identified in chapter 3: user-specific data views, user-specific information cockpits and user-specific functionality.

The user-specific customizations are stored as part of the user's account information in the GloNet platform. So the users can do the customizations themselves or they can be done by some administrator of the platform or even automatically. Especially role-specific UI customizations can be enforced in the latter ways.

#### 4.2.1 User-specific data views and searching

One basic yet important requirement for the GloNet platform is to provide each stakeholder with relevant information. Therefore, each user should be able to define its own views on the whole wealth of VBE/VO data to filter out the relevant data in an adequate presentation.

The filtering part of the view definition specifies the data type (for example product, document or equipment) plus filter criteria based on the data type's attributes (for example product category, product price, document type ...). For example, a VBE administrator may define a view showing all documents of type *request for proposal*.

Of course, the result set of such a filter definition contains only data, the current user has access to according to the access rights.

The presentation part of a view definition specifies which of the attributes of the selected data type are shown. One typical presentation of a view is a table view with columns per attribute and lines per resulting dataset. The user may further adjust the presentation by defining the sort order in which the datasets are listed.

Besides this standard view presentation, some data types and some GloNet use cases need additional presentation forms. For example time-based sensor data should be shown in a diagram instead of table. Or a VBE administrator may monitor the performance of the VBE by a pie chart showing the number of VBE members on a certain performance level.

**Searching**

Logically searching is an ad-hoc definition of a view with a standard result presentation, i.e., the user only specifies the filtering part of a view. Despite this fact, the GloNet UI should add some convenience features like searching in default fields per data type or searching in the default fields of all data types.

#### 4.2.2 User-specific information cockpits

Each user defines views to extract useful information. Typically, a user defines 5-15 views per user role depending on the role complexity. Especially for monitoring/controlling tasks it is very inefficient and error prone for a user to cycle through all the views. The situation even gets worse, if a user works in different roles with the GloNet platform.
Therefore, the GloNet platform will contain information cockpits. Cockpits are special overviews for specific users/roles. They are a compilation of different mini views (cockpit modules), similar to portlets in a web portal. Each user can define one or more cockpits (e.g. one cockpit per user role).

Cockpits enable accessing and aggregating different kinds of information in one overview. The customization capability here is to define an arbitrary number of cockpits, select the mini-views to show in each cockpit and to arrange the mini views within a two-column layout.

### 4.2.3 User-specific functionality

The customization concepts described in the preceding sections (4.2.1 and 4.2.2) control the data the user sees. These concepts are very useful to support the GloNet business scenarios and can also be found in existing information systems, albeit often in a less general way.

In the GloNet context the relevant functionality is also very user-/role-specific and also changes for one single user over time. For example, a VBE administrator needs a lot more functionality than a VBE member. And a VBE member being part of a VO A at a time may need other functionality when later being part of VO B.

For example, a company offering cleaning services for glass surfaces is first part of a VO operating a solar park. In this VO the company needs functionality to monitor the solar panels in order to know, when to clean them. The same company might be part of a VO providing facility management for big buildings. In this VO the company needs functionality to schedule the cleaning of the windows of the building, because it has to coordinate the cleaning with other companies providing maintenance services for the building's facade.

To support this user-specific and dynamic customization of functionality the GloNet platform will serve basic functionality for all users (documents, products, calendar, etc.) as well as specialized functionality. These additional features cover use-case-specific needs ( invoicing, for example) as well as optional extensions. These extensions may be of general nature (for example an extension that allows dialling phone numbers directly from a contact record) or may be specific to some VO like in the example above with the cleaning service.

To provide these different functionalities in an easy, maintainable and unified way, the platform serves the features in form of more or less independent application modules. This modularity allows each user to customize the functionality according to its role and personal needs. He can add and remove parts of functionality and thus customize his view on the platform (his account) by adding or removing such application modules from a module catalogue. A more detailed description of these application modules is given in section 6.2.
5 SCALABLE USER INTERFACES

5.1 What does scalability mean to the UI?

In electronics (including hardware, communication and software) scalability is the ability of a system, network, or process, to handle a growing amount of work in a capable manner or its ability to be enlarged to accommodate that growth. (Characteristics of scalability and their impact on performance, 2000)

Referring to the graphical user interface, scalability is the feature that enables an application to be displayed in best layout and resolution, in every supported device.

5.2 Why does GloNet´s UI need to be scalable?

One of GloNet's requirements is the accessibility to data and information via different (local and mobile) devices. The layout and design of the GUI of software solutions within GloNet need to come up with many different screen-sizes and resolutions. It is more difficult to display all important information in a small screen like on tablets or smartphones, than on local desktop computers with huge monitors.

One interesting approach to determine the most important information an application should display, is to develop "mobile first". This approach will be introduced later.

5.2.1 Multiple device support

As we derived the general access needs from GloNet´s stakeholders, the project data needs to be available everywhere for some participants. The layout-design has to fit its controls and views of data dynamically according to the available screen size, resolution and type of interaction.

5.2.2 Increase of data and different types of data (vertical scalability)

It is expected that the data and information of the individual projects increase due to the usage of the GloNet Platform. New participants could join a project team others could leave. They could import new documents or create new types of data depending on their tasks or role within a project. They could create even new projects, of course.

5.3 Supporting different Access Devices

Since the beginning of the Internet, the web page's browsing was designed for classical desktop devices. With upcoming new mobile technologies, Internet access got possible from virtually everywhere, and on-demand information access became more and more common. The greatest break in this area caused the smartphones. The PC is no more the only device that developers should consider for web applications. The mobile touch devices – tablets – play also a very important role in accessing the Internet, and together with PCs, they are the
most widespread devices for viewing internet pages. However, these devices have different attributes, having in mind their physical characteristics, functionality, users and kinds of usage. Before the beginning of UI design, there has to be considered, except for considering the web goals, these parameters of devices:

- Display area
- Interaction methods
- Environment of use
- Way of use.

5.3.1 Construction parameters of devices

There is no need to know all the construction parameters in details. For the UI design purpose the most important technical parameter is the screen, on which the application is displayed, and the interaction method.

5.3.1.1 Display area

The basis for a designer is the area within he or she can operate, it means the area, where the web page is displayed on. There are three parameters, that determinate the size of display area: physical size of the device display, resolution and the density of pixels.

5.3.1.2 Interaction Methods

The interaction method is based on various types of user input. There are three basic types of interaction:
- free motion of pointer
  - It is the classical type of interaction in PCs, using mouse, trackball and others, that enables very precise navigation.
- touch of fingers
  - This type of interaction involves devices like tablets and smartphones, this type of navigation is less precise and the medium of navigation (finger) hides used controls.
- highlighting of current item with possibility to move to next/previous item
  - This type covers the use of Tab key; it facilitates the interaction for people with certain kinds of disabilities.

5.3.2 Device characteristics in user context

Knowledge of physical characteristics of various kinds of devices is not sufficient for a UI designer. Next important information about the device is its setting to reality and assigning to the user.

5.3.2.1 Environment

The place of usage of some devices determines the final form of a UI. In the case of a calm, stable environment, the user has the possibility to concentrate and to keep track of multiple pieces of (visual) information. There is no need for a special visual guidance. On the other
hand, in a noisy, distracting or even dangerous environment, the user’s capability of concentration and interaction is limited.

5.3.2.2 Way of use

The way of use of a device can be affected by the gender and age of the user, usage environment and other factors. For the suitable UI design it is useful to know the most important feature: whether the user wants to get information in the shortest time, or in the most detailed form. (Coufal, 2012)

5.3.3 Typical display devices

There are many types of display devices, but some of them play a minor role regarding small number of their users. In the process of UI design, there are considerable these types of devices

- personal computer
- tablet
- smartphone.

5.3.3.1 Personal computers, notebooks

As mentioned earlier, personal computers are the most widespread devices for accessing the Internet. Displays of personal computers can be divided into two groups, according to their screen size: external monitors with size 19 to 30 inches for displaying big amount of information, and monitors of portable computers, whose sizes are typically 13 to 17 inches.

From the UI design point of view, the next important feature of display devices is their resolution. The current most widespread resolution is 1024x768 pixels (in the case of 4:3 ratio); the highest used resolution is 1920x1080 pixels. As to the spatial pixel density, the standard for PCs is currently from 72 DPI to 120 DPI. (Coufal, 2012)

A pointer with arbitrary motion in the display area, e.g. computer mouse or trackball, accomplishes the interaction of users with PCs. Alternatively many graphical user interfaces can be controlled by using the keyboard. To achieve this, many operation systems and applications implement the focus concept, where the focus indicates the component which is currently selected to receive input. The focus usually can be moved from one component to the previous / next.

Personal computers are intended for use in offices, homes, internet cafés or rooms. Most personal computers are statically placed, and the user has room for comfortable interaction with high precision. These devices are intended to provide most detailed information on the screen.

There is a huge amount of monitor types with various resolutions and aspect ratios, so what are the parameters to adjust the application’s UI to? The best solution is to consider the public statistics of Internet access. The statistics indicate that the most used resolution is 1024x768 pixels, which is typical for classic monitors with 4:3 ratios (Nr.1 in the picture). This should be the basis for a UI designer. The second most widespread is the wide-screen monitor with 1280x800 pixels and 16:10 ratio (Nr.2). The upper bound of resolution, which is meaningful to consider by UI design, is the Full HD with 1920x1080 pixels (Nr. 3). The number of monitors with higher resolution is negligible and currently it is not necessary to take these resolutions into account. (Coufal, 2012)
Designers typically adjust the screen content to the screen width, by the increase of the width there will be increased the left and right margins of the internet page.

**5.3.3.2 Smartphones**

In the latest years, smartphones became more and more popular and it is important to take their features into account. The screen size of these devices varies from 2 to 5 inches. The resolution is mostly 240x320 pixels to 720x1280 pixels. The spatial density of pixels can be very different at various devices. This parameter can be adjusted in the header of HTML document to a unified value, most often it is 160 dpi (Coufal, 2012). Great advantage of smartphones is the interaction by finger touch. Due to their small form factor, smartphones are used in many places, e.g. at home, in shops and restaurants, and they are often used during other activities, like shopping, eating, walking. Therefore, the environment is variable, noisy and possibly disturbing. Many users use their smartphones in cases they need some necessary information while not having access to the Internet via PC.

The most common resolution of smartphone screens is 320x480 pixels. This value should be the basis for the designer of UI for smartphones. These devices can be used in both portrait and landscape orientations. The default orientation is portrait. The other orientation can be used, when user needs to get more information in one line.

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1 (Coufal, 2012)
5.3.3.3 Tablets

The tablets are devices making transition between personal computers and smartphones. Their main features are portability and a good performance. The size of tablet is near the notebook’s size and users want to see on it the same amount of information (Coufal, 2012). The most widespread tablet types are these with 10 inches screen size, resolution 1024x768 pixels (iPad) or 1280x800 pixels (Android). It is recommended for the designers to concentrate on the smaller resolution. Their use in both portrait and landscape orientations also has to be taken into account.

![Figure 4: Recommended tablet display area for the UI design](image)

**Figure 4:** Recommended tablet display area for the UI design: 1) Portrait: 768x1024, 2) Landscape: 1024x768

5.4 Layout patterns for scalable UI concepts

There are a number of layout patterns often recommended to take advantage of how people scan or read through a design. Hereafter we introduce some of the more common patterns. These are the Gutenberg diagram, the z-pattern layout, and the f-pattern layout (Bradley, 2011).
5.4.1 The Gutenberg Diagram

For cultures who read from left to right, the Gutenberg diagram describes a general pattern the eyes move through when looking at information. This pattern works best for advertisements or web sites with huge amount of images.

The Gutenberg diagram divides the layout into 4 quadrants.

- **Primary optical area** located in the top/left
- **Strong fallow area** located in the top/right
- **Weak fallow area** located in the bottom/left
- **Terminal area** located in the bottom/right

This pattern's suggestion is that the eye will focus the upper left quadrant first. Then the eye will sweep down in a line to the bottom right section, the terminal area. This direction of sweeping is called the reading gravity. The upper right and lower left quadrant are called the fallow areas, where the user mostly better recognizes objects in the "strong" fallow area than objects in the lower left, the "weak" fallow area. Due to this pattern, logos are often placed in the top left or bottom right at web sites with huge advertisements of brands or products.

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4 (Bradley, 2011)
5 (Johnson, 2009)
5.4.2 The Z-Pattern

![Figure 6: The Z- Pattern](image)

The Z-Pattern describes the way the eyes move when reading an article line by line for example.

The main difference between this and the Gutenberg diagram is that the Z-Pattern suggests viewers will pass the two fallow areas as well. The similarity between the patterns is the starting and ending position.

Derived patterns are Zig-Zag and the "Golden Triangle" pattern, which are not needed to be described more detailed.

5.4.3 The F-Pattern

![Figure 7: The F- Pattern](image)

Articles on the web often mention this pattern. Eye-tracking studies with long web documents showed that people only read the first (upper) articles completely. The lower an article is positioned on a web page, the less the article is recognized, as the subject group took less and less time to read the followed articles.

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6 (Bradley, 2011)
7 (Bradley, 2011)
That is the reason why important information should be positioned at upper sections of a UI’s dashboard or cockpit to get recognized most effectively by the user.

![Figure 8: Heat map](image)

As you can see at this heat map, the "F"-shape seems to appear at best, on the text-heavy content sections of a web page. This shape doesn’t work for people who are interested in articles outside the content section as you can see at the third part’s right side.

In conclusion to these introduced layout patterns, there are some rules to be considered when we want to develop a usable and efficient graphical user interface.

Most important information has to be at first position to be recognized first. To enlarge this effect, information that are not helpful or doesn’t come up to the user’s (search) request, should be hidden.

### 5.5 Some approaches for developing scalable GUIs

In the following, we want to introduce some new approaches in GUI development. The goal of these approaches is to generate highly scalable user interfaces right from the first scratch. The first approach described relates to the presentation of an application. The second approach tries to optimize the aspect of interaction with the application’s GUI.

#### 5.5.1 "Mobile first"-approach

This approach addresses the constraints of displaying all relevant data in small-sized screens like on tablets or smartphones.

GUI developers have to design the UI of an application for devices like smartphones or tablets, before they design views for desktop computers or similar devices with big screens. This forces them to limit the shown information to the most important data for the current function. Goal is to develop a lean and simple to learn GUI architecture to navigate top-down at the data model. (Wroblewski, 2011)

A further requirement to the UI is an optimized performance, as the speed of network is strongly limited for mobile devices. The advantage of this approach is that the programmers set the focus on essential information, tasks and workflows. They will not implement unneeded information that could overload the screen and make it more difficult to read. The

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8 (Bradley, 2011)
particular views of the UI are clearly structured. They contain only needed or helpful information.

5.5.2 "Touch first"-approach

This approach relates to the way a user can interact with an applications user interface. User interfaces for most smartphones and every tablet need to be optimized for interaction by fingertips. Usually, there are no input devices like keyboard, mouse or stylus. Touch-support has to be considered in the design of almost every user control e.g. buttons, checkboxes and input forms.

![Figure 9: touch target size](image)

When designing user controls for touch sensitive devices, it is necessary to consider the limitations of the interaction with a touch sensitive screen by using the fingertip. Figure 9 shows a state of the art measurement of a button.

E.g. the current UI development guidelines from Apple Inc. for the creation of custom icons recommends a size of 57 x 57 pixels or 114 x 114 pixels (high resolution) for the iPhone and iPod touch devices (Apple Inc.).

So a positive side effect of this approach is that screens normally don’t get overloaded by controls and functions that are not necessarily needed to fulfil a particular task.

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9 (Wroblewski, 2011)
6 GUIDELINES FOR GLONET’S UI DEVELOPMENT

In this chapter, we propose general guidelines for GloNet’s UI development. These guidelines shall help the developer / designer of the GloNet platform’s UI to build customizable and scalable views that come up to the users’ needs.

6.1 Scalability

To ensure the scalability of GloNet’s UI there are some points to care about. The UI structure and order of the single views should be constructed in a way that web browsers on smartphones, tablets or desktop computers can display equally.

To receive the same behaviour in the presentation and positioning of the content modules we use the fluid layout grid (see 6.1.1.2).

6.1.1 Scalable layout

6.1.1.1 Structure / order of views

We use a horizontal navigation through the different UI views. That means every (deeper) navigation step to a more detailed view (e.g. of one list entry) is animated as a horizontal left to right swap of a views (whole screen).

The shown data on one screen belong to the same hierarchical tier. This could be a result list of a search query or any properties of a contact for example. These data are positioned vertically.

- Move horizontally for navigation, details or further functions.
- Move vertically for more data (content).

Figure 10: Horizontal navigation
6.1.1.2 Fluid Layout

Content items like forms or cockpit modules automatically fit in the best position within the layout-grid. To determine the best position, the actual heights and widths of the parent grid and the content items need to be recognized. The float direction is from left to right.

![Figure 11: Three column fluid layout](image)

Depending on the number of available columns and module sizes, the application positions the modules due to their priority vertically.

![Figure 12: Transformation to two-column fluid layout](image)

The transformation from "landscape"-mode to "portrait"-mode shown in Figure 12 could be triggered by twisting a tablet (e.g. the iPad) at 90 degrees. The fluid layout recognizes the change of available columns and set new positions and orders for its content items.

6.1.1.3 Relative positioning

We position every nested control element relative to its parent. This also enables a dynamic behaviour, as all elements stay in a content flow. If any content item is positioned fix on the screen, it is impossible to recalibrate it due to a changing size or resolution.
6.1.1.4 "More"-Button as design pattern

To provide a "more" or "read more"-Button is to understand as a best practice in website design and UI development. These buttons are important for several reasons. One reason is that compressing the content of a single article enables a small screen to display more articles at once.

Further, this compression of the articles allows users to track the interesting/important headings (e.g. search results) more easily and faster. (Friedman, 2009)

For example, if there are more list elements than the screen can display at once, than only that much items possible without scrolling shall be displayed. Instead of a scroll bar we implement a "more"- button at the bottom of the view. By clicking/tapping this button we navigate to the scrollable list which contains all list elements then.

6.1.2 Scalable content

A further approach to reach UI scalability is to define different views suitable for different devices. For example a single business contact (dataset) containing a name, address and phone number, can be displayed as simple view of the data for the smallest screens of smartphones. If a user wants to see the same dataset with a tablet, the UI presents not only the simple dataset, but provides a form next to these data to edit or enhance the contacts properties.

![Figure 13: Different views on one dataset](image)

Depending on the accessing device, the UI can provide different views on a particular dataset.

Devices are considered by creating one to n views for displaying a dataset and one to m views to edit a dataset. After that, a mapping between devices (smartphone, tablet, pc, etc.) and the views will be made.
6.1.3 Combination and optimization

To reach a highly scalable UI we recommend the combination of the approaches stated above.

Initially, a programmer could pay attention that a single view is able to set the position and order of its content dependent on the available dimensions by using suitable layout patterns like the fluid layout.

Depending on the kind of device this view is built for, it could be determined if it is useful to add further information or functions on that view (e.g. inline editing) regarding to the devices screen and concept of interaction.

A general optimisation is to hide empty fields. For example, hide a business contacts address-field, when it is not filled with information.

6.2 Technical UI concepts

Following the guidelines above, in this chapter we define a UI framework that shall be suitable for any kind of web devices.

The goal is to implement a control concept (interaction and presentation) that is easy to learn and use for average users, that is maintainable, customizable by users and extendable by developers who contribute functionality to the GloNet platform. It should facilitate a consistent user experience. The following sections describe the main concepts of the platform's UI framework. We call this framework "GloNet Smart Access". It should be suitable for implementing all needed functionality.

6.2.1 Members and Solutions

Members of the GloNet platform can log in to GloNet Smart Access UI. There they find a preconfigured working environment depending on their role. Actors, data types and use cases of VOs depend on the business area for which the VO develops or provides products and services. To address these special needs, the GloNet platform hosts multiple discrete member areas to which we refer as solutions. A solution defines the roles, data types and functionality required for constitution and operation of VOs in a specific business area.

6.2.2 Composition

The working environment that the user finds when he logs in to his solution, consists of a set of application modules. Following the term coined by popular mobile platforms, we call these modules apps. There are pre-"installed" apps, at least some core apps such as Contacts, Documents, E-Mails, Calendar. They already appear on the start screen. The user can choose to add further apps from a separate app catalogue. This approach allows a user-centric application design where separate apps exist for separate use cases.
6.2.3 Navigation

Navigation begins on the start screen, where users choose which app to start. Then the first page of the app itself slides in from the right. An app defines navigation between such pages in form of a finite-state machine (FSM). Such an FSM, that defines the possible navigation paths, we call *UI interaction pattern*. Each state (node) corresponds to a page. Events (e.g. user actions) trigger transitions (edges) between states. An example for such an action is opening a record from search results.

![Finite-state machine defines interaction pattern.](image)

Visiting pages while digging deeper into data generates a history of visited nodes. The user can navigate back and revisit all visited states in reverse order. For this purpose, a back but-
ton is integral part of the UI. It is also possible to quit the current app by directly “jumping back” to the start screen.

The GloNet Smart Access UI framework predefines common generic interaction patterns. App developers can reuse these patterns to provide a consistent user experience. However, developers are not tied to those patterns. They can extend them or even define their own interaction patterns from scratch to support specialized workflows. This supports a consistent user experience suitable for learning.

6.2.4 Screens and Pages

The GloNet Smart Access UI presents pages using frames. Frames contain one or more pages and span the whole screen. Their purpose is to group pages that logically belong together. For desktop PCs, usually not more than three pages are displayed at one time.

Figure 16: Pages in a frame in GloNet Smart access

The rightmost page always is the page that corresponds to the current navigation state of the app’s UI interaction pattern. The pages that may be shown at the left of the rightmost page are the pages that correspond to the preceding navigation states in the navigation history.
Usually, a navigation step navigates only one page further, and there is space for multiple pages to display in one frame. For this reason, frames may overlap. This is intended by the UI concept. It gives the user as much context as possible, shows him where he came from.

A page itself is a closed unit of information that typically contains a form (a view on some kind of data) or other (sub-) pages and interactive controls. Its appearance and structure is defined declaratively using a specific XML dialect. It can be composed of existing GloNet Smart access controls and of custom controls created by the app developer.

6.3 Loose coupling

Chapter 4 points out the benefits of autonomous user interfaces. The GloNet Smart access UI leverages this concept of loose coupling of data, views and interactions.
6.3.1 Data and Views

Every type of record has its default editing/reading view giving read/write access to all of its fields. In addition, there can be an arbitrary number of other specialized views for that type of record. An app defines a view mapping in its UI interaction pattern. A view mapping maps a view type to a concrete view that should be displayed. With that, for each page (i.e. state in navigation) the suitable presentation of data can be chosen. Third party app developers profit from that behaviour, because they can use existing data types without depending on predefined views for that data.

Figure 19: Conditional view mapping

Conditional view mappings are possible, too, and integrate into the app's UI interaction pattern. It allows showing different pages depending on a concrete record of a certain data type. For example, contacts of individuals and firms can be displayed in a different way, even if they have the same data type.

6.3.2 Linking different types of data

As described above, every type of record of any kind of data has its more or less generic or specialized view. Those record views have in common, that they have a toolbar at the top, with buttons that provide common actions on that data. With these buttons, the user can delete and edit the record. In addition, two more buttons embody the generic linking of data in the GloNet platform. One button can mark ("pin") the current record for linking (as shown in Figure 20). The user can continue navigating, even switching to another app. Then the other button can actually link the new current record with the marked one.

The record's dossier, which is typically presented on a page on the right of the record, lists the linked records. The dossier page has a toolbar that allows unlinking the listed records.
6.3.3 Interactions

In classic, monolithic applications, user-interactions are normally tied to technical events raised by controls like buttons and lists. The GloNet Smart access UI uses an event abstraction to decouple control flow and view definition. Control flow is defined in an app by a UI interaction pattern. Logical events trigger state transitions in the FSM. Pages can raise such logical events triggered by technical events of contained primitive controls (buttons etc.).

Examples:

- Click on edit button generates event "SwitchToEditMode".
- Click on element in search result generates event "OpenRecord"

6.4 Customization through extension

Unlike apps known from popular mobile platforms, users can customize apps in GloNet Smart access UI through extensions. Extending existing apps (at runtime) happens —from the user's point of view — by activating ("installing") optional apps from the app catalogue that insert additional functionality at so called extension points that other apps can offer. For example, a map app can integrate into the contacts form of the contacts app, so that the user can directly look up where the address is located on the map (see Figure 21). Other examples for form extensions are telephony integration and translation service.
Extension apps not only can extend forms. Forms also can be replaced as a whole if the extended app only defines a default mapping for the respective form type. This could be, for example, an animated document viewer ("cover flow") for documents that otherwise would only be represented by a view with just a download-button.

Another possibility of extending an existing app as a developer is to hook into its interaction patterns. This means that before/after transitions additional states (pages) can be included as shown in Figure 22.

Although extensibility is a great feature in many scenarios, developers are free to choose where their app can be extended or if it could be extended at all.
7 USE CASE EXAMPLE

In this chapter, we demonstrate how GloNet platform could support a special process by blocking out concrete views, which are integrated by the GloNet's Smart access UI framework.

As an example, we chose the process of consulting VBE’s product portfolio.

Figure 23: Consulting VBE's product portfolio (BPMN diagram)\(^{10}\)

In this specific process it is comprised the Potential Customer activities in consulting the VBE Products Portfolio.

7.1 Process steps and the GloNet Smart access UI

In the following, we describe the process step by step, explaining the views that could support this process.

\(^{10}\) (UNINOVA, 2012)
7.1.1 Start

The potential customer logs in into the GloNet Smart access UI of a specific domain. On his start screen, he finds the "Products" app, which he starts by selecting the app's icon. After selecting the app, the app's first page is displayed (on the right of Figure 24). It contains links to previously viewed products as well as links to predefined views on the products.

![Figure 24: Use case example – simple search form (without text entered)](image)

7.1.2 Search for a product

The user (the potential customer) can type or more keywords into a single search box and the search will start immediately. Results are listed below the input field (replacing the quick links) and the listed records are just displayed with a short summary. Only a fixed number of search results is presented (5, for example; see Figure 25). If the user likes to see all results or wants to see results with more details, he can click the "more"-button. That brings him to a frame with a single page that shows all results from the simple search in a table where each product property has its own column.
If the user wants to narrow down his simple search request, he can navigate to the "advanced search" page, and select from various product categories and filter specific fields by their value. The results of the advanced search are also presented in a table (see Figure 26).

Figure 25: Use case example – simple search form (with text entered and search results below)
In case of normal web browser access from a PC, the screen is large enough so that multiple pages can be displayed side by side in one frame: The start screen together with the simple search form’s page and the advanced search form’s page together with the search results page.

When the user selects a record from the search results, he navigates to the product page.
7.1.3 Viewing product information

Figure 27: Use case example – product (details) page

Figure 27 shows a frame with the product page in the centre and the search results page at the left (which highlights the selected search result). The product page shows all main information about the product. Further information about the product is attached (linked) to it. These linked records are grouped in the dossier page on the right.

The user can select a linked record and navigate to a page that will have a view appropriate to the respective data type. In this example, only documents are listed. But there may also be any kind of services associated to the product. When the user chooses a document, he moves to the document page as shown in Figure 28.
7.1.4 Requesting further information

Figure 28: Use case example – viewing a document

In case the potential customer needs further information on a product, he could contact the administrator responsible for the product using the contact information provided on the product page. Then the administrator can link the required documents (or other kinds of information) to the product and inform the potential customer.
8 CONCLUSIONS

The GloNet context requires user-customizable user interfaces dynamically adapting to the user-specific needs. In this document we have analyzed the specific access, search and visualization needs of the various stakeholders in the GloNet context of collaborative ecosystems. Based on this analysis we developed technical and user interface concepts to meet these requirements.

The following logical concepts of user interface adjustments should be provided by software solutions based on the GloNet platform:

- **Scalable user interfaces**
  Some of the typical GloNet stakeholders need to access the GloNet software solutions also from mobile devices. In order to provide a good user experience from smartphones up to desktop computers we defined a overall UI layout and some UI guidelines that ensure that one UI concept scales up from small screen sizes to bigger ones without having to implement the UI multiple times and having the user to learn multiple UI concepts.

- **Extensive UI customization possibilities for users**
  While the scalable user interface is an automatic user interface adaption provided by the GloNet platform plus development guidelines, most of the required user interface adaptations cannot be foreseen by the platform designers or by the developers. Therefore the software solutions must provide the following means of UI adjustment:
  - **User-specific views**
    Users must be able to define their own user-/role-specific views on the whole wealth of VBE/VO data to filter out the relevant data in an adequate presentation. Searching is then only an ad-hoc view definition with a standard result presentation and some convenience features.
  - **User-specific information cockpits**
    Cockpits are overviews for specific users/roles containing different mini views. They enable accessing and aggregating different kinds of information in one overview, which is especially important for users with multiple monitoring tasks like a VBE administrator.
  - **User-specific functionality**
    In the GloNet context the relevant functionality is also quite user-/role-specific and also changes over time. In order to support this, the GloNet platform provides innovative mechanisms to define more or less independent application modules, which can dynamically be added and removed by the users.

In order to implement these concepts efficiently in GloNet software solutions the GloNet platform will provide the needed basic technical adaptation and extension capabilities. So the GloNet platform plus the development guidelines of this document will ensure that the adaptation requirements will be met.
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