

# **Mainlimes Mobil – Presenting Archaeology and Museums with the help of smartphones**

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## **Abstract:**

The technological development of mobile devices such as smartphones opens new possibilities for the presentation of scientific data. Short films, audio sequences, stills and text can be displayed in good quality.

Archaeology in particular provides many opportunities to play a pioneer part in the field of mobile information systems. You can find archaeology in the landscape, but also in museums. The idea of the project is to merge the landscape with the museum and vice versa. The information system provides archaeological content right at the current location (either in the museum or in the landscape). And the smartphones provide a true multimedia experience for the user: short films (i.e.: interviews or 3D Animations) as well as audio sequences or texts with pictures. Through GPS navigation the smartphone will alert the user when approaching a hotspot with archaeological information.

The application will run offline. Therefore an internet connection is not mandatory. This is especially important for remote regions and also for users from different countries (roaming costs).

In Bavaria the Limes along the river Main has been chosen for the pilot project. The 50 km stretch of the river frontier is clearly defined. Also there are previous projects such as a concept for signposting and a web data base. Therefore the region provides ideal conditions for the development of a prototype. The platform of the pilot system will be Apple iOS and the iPhone (plus iPod Touch and iPad), but it will be possible to migrate to other operating systems such as Android or Windows Phone 7.

## **Keywords:**

GPS, Mobile Information System, Video, Limes

## **The development of an idea**

Besides studying Roman archaeology (DOBAT 2009) and other scientific work Boundary Productions / Boundary Media has published several documentaries about archaeology and history in the last decade. Our special interest is the presentation of archaeological information to a public audience with the help of modern technology. The digital revolution in the last 15 years made it possible to produce high quality video content at reasonable costs. Therefore the implementation of moving images became a standard even in small museums. The medium DVD also allowed a distribution of high quality video data to an interested audience. In 2004 we started to work on a DVD about the Limes in Germany. We tried to stretch the DVD standard to its limits and created a DVD video with a partly interactive main documentary. While watching the main documentary the user had access to special short films about certain topics that were only mentioned in the main documentary. After watching a short film the DVD program returned automatically to the last sequence of the main documentary (WALKSHOFER & DOBAT 2005) .

At the same time in 2004 slowly the first mobile phones with colour displays became available. Right from the beginning we experimented with video on mobile phones, but it became apparent that the user

experience with video on small color displays was not exciting at all. However from then on the idea that in the near future the viewer would have the hardware in his pocket to view multimedia content anywhere has constantly been on our mind.

With the development of smartphones in the last few years the vision became reality. It is now possible to present videos, audio sequences, stills and text-information in high quality on mobile devices. Based on our experience with documentary films we can now distribute video content to the audience in new ways. It will be possible to produce for example interactive documentaries for the audience, but we have to develop new narrative techniques and explore the possibilities of the new technology (WALKSHOFER & DOBAT 2006, p. 125). Furthermore most of the smartphones today provide GPS navigation (WIKIPEDIA 2011, GPS navigation device) and they have an integrated compass. This enables us to navigate users with his or her own mobile device to archaeological sites in the landscape and provide high quality information right on spot. Archaeology provides the perfect data and content to explore these new possibilities. It is possible to link an archaeological site with the museum, to link archaeological finds with the archaeological sites. These new location based services provide also a new experiences for the users. There is no need to rent technical devices from a museum or other institutions, it is possible to upload the information on your mobile device and use it as long as you want it. You get the information about a site, when you are at the site.

## **Archaeological Content: World Heritage Site „Frontiers of the Roman Empire“**

### **Defining a test region**

In 2009 we started to develop a concept for an archaeological information system on a mobile device. We started to think about platforms and technical requirements, but most important was to find a test region to develop a prototype. Together with the Landesstelle für nichtstaatliche Museen in Bayern and the CHC – Research Group for Archaeometry and Cultural Heritage Computing of the University of Salzburg (Austria), we were working on media content for the innovative web-based project [www.museen-mainlimes.de](http://www.museen-mainlimes.de). Within this project the archaeological information of the World Heritage Site „Frontiers of the Roman Empire: The Upper German Raetian Limes“ in the region of the river Main has been gathered in a complex web data base. The web interface allows easy access to content and information. Because of the advanced data base behind the interface the content is always displayed in a unique way and there are also many cross references between different archaeological sites of the region (SCHALLER, EGGER & UHLIR 2010). The project provided already a lot of information about the Main Limes and we have already created a lot of footage for the media section of the website. Furthermore it is a clearly defined relatively small region and therefore it suited perfectly to produce a prototype (Fig. 1). Finally the Bayerische Sparkassenstiftung and the Landestelle für nichtstaatliche Museen in Bavaria were convinced and we were able to start working on an archaeological mobile information system for the Main Limes. We then decided to concentrate on the Bavarian part of the Main Limes, the two northernmost forts of the Main region at Seligenstadt and Großkrotzenburg in Hesse were not included.



Fig. 1: The Main Limes from Miltenberg to Großkrotzenburg (map by K. Schaller)

### The archaeology of the Limes along the river Main (short description)

In 2005 the Upper German Raetian Limes became part of the UNESCO World Heritage Site „Frontiers of the Roman Empire“. The Limes in the region of the river Main (Main Limes) is part of the Upper German Limes. From Miltenberg in Bavaria to Großkrotzenburg in Hesse the river Main marks the frontier of the Roman Empire. Between the Odenwald forest and the Spessart forest the river runs for approximately 50 km from south to north.

Late in the reign of the emperor Antoninus Pius (AD 138 – AD 161) the final course of the Limes was set in the Main region. The so-called Odenwald Limes was abandoned and the Main Limes was extended either from the fort of Obernburg or the fort of Wörth to Miltenberg. From Miltenberg the new artificial frontier line ran for approximately 80 km straight to the south where the Upper German Limes met the Raetian Limes in the Rotenbach valley next to Lorch.

The Main Limes was supervised by nine forts. The fort of Großkrotzenburg in Hesse and the fort of Miltenberg-Bürgstadt (Ostkastell) guarded the transition from the artificial frontier over land to the river frontier line along the Main river. Six forts were occupied by regular *cohortes* (Großkrotzenburg, Seligenstadt, Stockstadt, Obernburg, Miltenberg-Altstadtkastell), while the three smaller forts were occupied by so called *numeri* (STEIDL 2008).

At present only two watchtowers just to the south of Obernburg have been discovered along the river frontier. Presumably most of the remains of watchtowers have been destroyed by floodings (Fig. 2).



Fig. 2: Flood of the river Main in 2011 with the town of Würth in the background

In general it is difficult to promote and demonstrate the remains of the World Heritage Site along the Main Limes. Usually the archaeology is invisible in the ground. In many cases modern towns have been built on top of the Roman forts and nothing can be seen today. There are only few sites where some archaeological remains are visible. At the so-called Altstadtkastell of Miltenberg for example the remains of the stone wall of the fort can be spotted in an orchard and the remains of the bath house of the fort have been preserved. The principia of the fort itself is not visible, but the remains of a medieval church built on top of the principia can still be seen today.

The forts of Stockstadt, Niedernberg, Obernburg and Miltenberg-Bürgstadt have been overbuilt. The fort of Stockstadt has been destroyed by the construction of a modern factory on top of the Roman remains. The *numerus* fort of Miltenberg-Bürgstadt lies beneath a residential complex. The forts of Niedernberg and Obernburg represent the centres of the town and village. Even today the streets follow the patterns of the ancient Roman forts and by walking through these centres it is still possible to experience the dimensions of the Roman forts. The archaeology of Obernburg is especially interesting. Here a beneficiary station has been discovered. Extensive archaeological excavations revealed the ground plan, many finds and inscriptions. Obernburg is the best researched beneficiary station in the whole Roman Empire. Of special interest are the inscriptions of the beneficiaries that allow to reconstruct a vivid picture of the Roman past in the region (STEIDL 2008, p. 108ff.). Many inscriptions and finds are on display in the local Roman Museum and the Bavarian State Archaeological Collection in Munich (see below). The *numeri* forts of Würth and Trennfurt are not overbuilt, they are located in a field and in an orchard. Nothing is visible above ground. The fort of Würth is of special interest, because the north-western stone wall of the fort dropped completely into the ditch. This enabled the archaeologists to reconstruct the height of the fort wall quite accurately. It had a height of approximately 6,35 meter.

The forts of Seligenstadt and Großkrotzenburg in Hesse are located in the centres of the villages (BAATZ & HERMANN 2008, p. 325ff & p. 477f.).

## **Museums in the region**

There are five museums with Roman collections in the region. The museums of Wörth, Stockstadt and Großkrotzenburg are relatively small museums. They open only once a week or on special request. The Roman Museum of Obernburg presents the epigraphic inscriptions of the beneficiaries and other finds from the fort of Obernburg.

The city museum of Miltenberg is currently the most important museum of the region. There is also a collection of Roman artefacts on two floors. Finds from the two forts in the region and from the Limes are presented.

The "Museums- and Communications Plan for the Limes World Heritage Site in Bavaria"

([http://www2.sbg.ac.at/chc/FRE\\_DOWNLOADS/LimesMusDevelopment\\_BY.pdf](http://www2.sbg.ac.at/chc/FRE_DOWNLOADS/LimesMusDevelopment_BY.pdf)) recommends the

establishment of a central "Main Limes Museum at an appropriate location at the Bavarian Lower Main".

The museums of the Main region are vital to present the World Heritage Site Limes to the public. They provide original artefacts from the region and therefore enable the people to identify with their history and archaeology (FLÜGEL 2008).

The archaeological information system tries to merge the archaeological site with its finds (that are usually located in the museum). The user will get information about finds immediately in the landscape, where it has been discovered. At the same time he gets the information where he can find the original artefact. The museums will probably also provide services such as WIFI connections to download the application in the region.

## **Technological requirements and distribution**

At the beginning of the project we had to make a decision for a platform. There are two important operating systems for smartphones that seem to dominate the future in that field. On the one hand is the innovative Apple iOS and on the other hand is the open source platform Android, promoted by Google.

For our prototype we chose Apple iOS. The reasons for that decision were:

- easy distribution through the AppStore
- limited hardware versions
- many users

The application should be optimized for the iPhone, but it should also run on the iPodTouch and the iPad. All functions including GPS navigation will be available on the iPhone. Therefore the iPhone is recommended for the best user experience.

Important is also that a migration to other platforms is possible. Currently the optimal solution seems to be a production for Apple iOS and for Android. Currently about 50-60% of the smartphone users could then access the application (if both platforms are covered) and the tendency is that there will be an increasing number of users for those two operating systems (WIKIPEDIA 2011, Smartphone).

We also decided that it is important to create an application that will work offline. The Limes sometimes runs through remote regions and therefore it is important that the internet connection is not mandatory. Especially videos and audio sequences would need a high speed internet connection to guarantee a good user experience. Therefore we integrated the content in the application, this ensures good video and audio quality everywhere. It is also important for international users, as data roaming costs in the EU are often very high. If there is an active internet connection the user will have access to additional content through the web click button on the top right. It provides access to the web data base [www.museen-mainlimes.de](http://www.museen-mainlimes.de) (see above).

## Realisation

### Development of the content

Even if you are using the most recent and exciting technology that is available on the market, the content should remain the most important concern. The technological devices are just vehicles to promote the content about archaeology to your audience.

You have to think about the development of your content even more carefully as new technology also provides the possibility to adapt or change narrative techniques for the content. This is especially true for multimedia devices like smartphones. It is possible to wrap your content in a video file, an audio sequence or text-picture information. Also people will use it in different ways. They will access the information in different situations such as standing, sitting, in a cafe or somewhere in the landscape, etc.

You have to carefully think about the best media to transport your message in each single case. Certainly there are also financial limitations, a text-picture information is cheaper to produce than an audio sequence. And of course a high quality video sequence is most expensive. And even within a video sequence an animated 3D model is of course more expensive in comparison with a landscape shot with just panning or tilting in different directions.

Therefore we defined at first, what we wanted to achieve with this application. Our aim is to enable the user to access valuable and interesting archaeological information, when he is visiting an archaeological site in the landscape. The GPS navigation should help the user to verify the location of a Roman fort (that is not visible) in the landscape for example (Fig. 3).

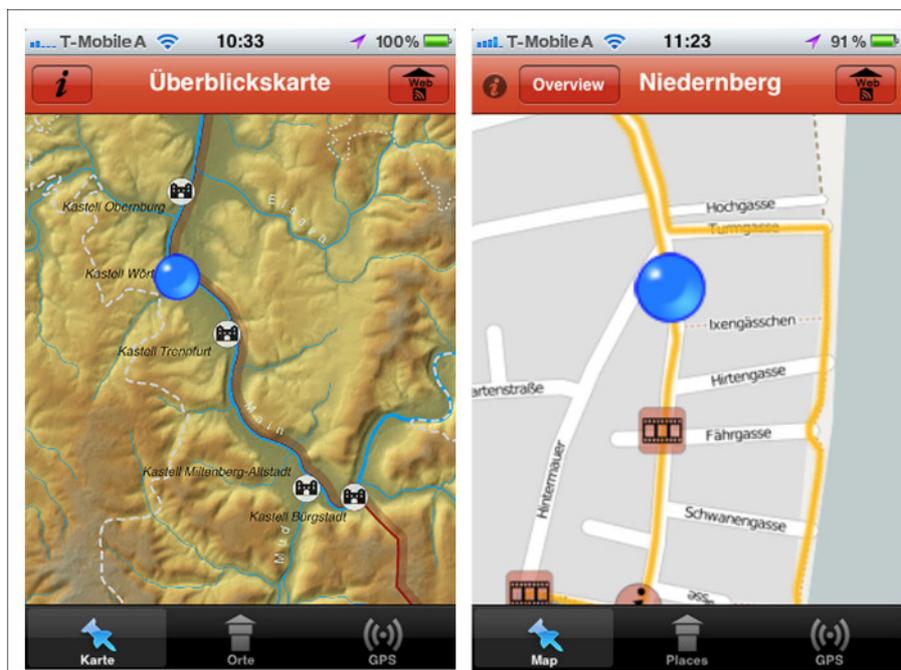


Fig. 3: Screenshot with overview map and detail map. Blue GPS location marker.

Therefore we defined 48 hotspots along the Bavarian part of the Main Limes from Miltenberg to Stockstadt. Each of these hotspots is related to an archaeological site or find or it provides important historical or epigraphical information. Then we had to define which is the best form of medium to transport the information for each of these hotspots. A descriptive example is the fort of Würth, which is located in a field (see above). Nothing is visible today. Therefore the decision has been taken to implement an animated 3D reconstruction as a video sequence. The user is standing next to the field and through the 3D model he is enabled to

envision the Roman fort in the landscape. Another interesting example is a hotspot in Obernburg. The house with number 41 has a Roman inscription in its wall. It is at eye level and the visitor can easily read the Latin inscription. Instead of forcing the user to look at a video sequence or a text information, we produced an audio sequence. While examining the original inscription in the house wall, the users gets the necessary information via audio.

The 48 hotspots of the Mainlimes Mobil application are:

- 16 video sequences (approx. length: ~ 01:00 – 03:00 min.)
- 14 audio sequences
- 18 text-/picture-information

Furthermore our aim was also that all 48 hotspots together describe the World Heritage Site Limes and the functioning of the frontier system. Therefore each of the hotspots focuses on different aspects of the frontier system. Together the hotspots form a picture of the Main Limes enabling the user to understand the function of a Roman frontier system based on current research.

### Technical implementation

The production of content is already demanding, especially if you include video and audio. Nevertheless it becomes even more complicated with the technical implementation of the content into the application. At first we had to solve the navigation within the application. Georeferenced maps provide the main access to the content. An overview map shows the whole region and several detailed maps provide access to the content. The maps are zoomable (pinch and zoom) and clickable. By choosing the fort of Wörth on the overview map, the user gets access to a detailed map of the city of Wörth. On this map the hotspots are available. By clicking on a hotspot the user gets direct access to the content of the hotspots. If the user has an iPhone, he can turn on GPS navigation. A blue spot marks his position on the map. It is now possible for him to explore the Roman archaeology in the vicinity of Wörth. When he approaches a hotspot an alert with a sound signal is triggered within 15 meters radius. The user can then decide, if he is interested in that particular information (Fig. 4).

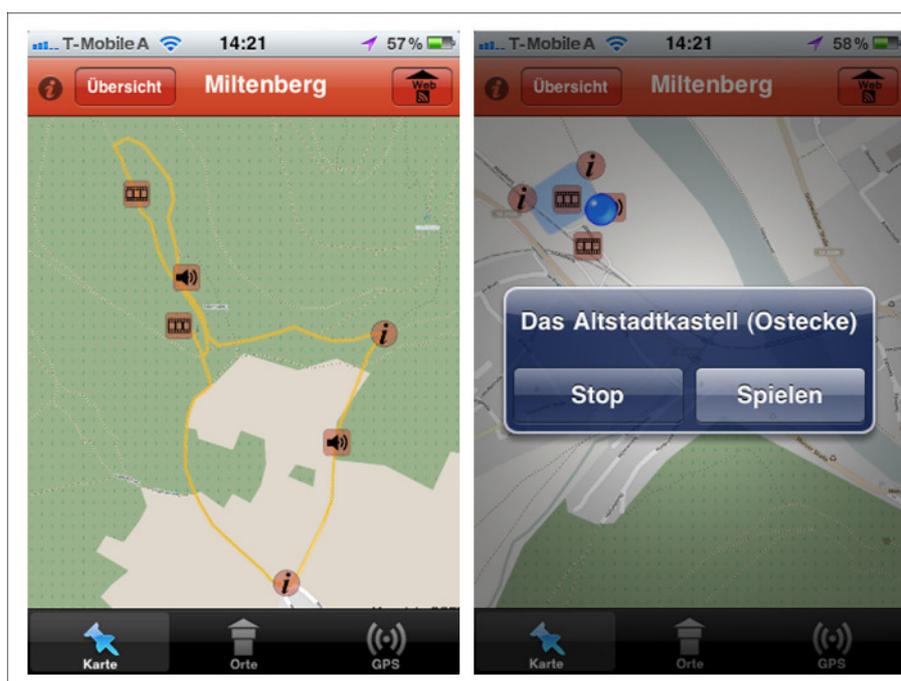


Fig. 4: Screenshots from Miltenberg. On the right side showing the alert function.

Additionally an alternative navigation in a table view is available for each town or village. This provides instant access and it is also a good overview.

To guarantee an accurate navigation and a correct alert each of the hotspots is geo-referenced.

### **Web Tool**

The so-called Web Tool allowed us to gather all the information and connect the content with the maps and hotspots. Each hotspot needed the correct longitude and latitude, then it was connected to the correct map. Finally the content was attached to the hotspot and the programmers were able to create the application. Certainly it needed a lot of testing. The most difficult part with a lot of trial and error was the correct location of the hotspots, when they were quite closely together (> 20 m).

The Web Tool also allows us to keep the application up to date. Once the geo-referenced hotspots are connected with the map and the content, it is quite straight forward to update the application. It is possible to integrate new results from scientific research at reasonable costs. For example we can envision the text-picture information within the application as mobile wall charts. In contrast to wall charts in the landscape they can be updated quite easily. In the future a combination with wall charts in the landscape and text-picture information might be the best way to present a monument with the content well-matched on both media.

Additionally the content was planned from the beginning in two languages. The web tool provided the possibility to record both languages at the same time. Finally there will be two versions of the application, one in German and one in English.

### **Future developments**

The archaeological information system Main Limes Mobil provides information about archaeological sites and finds in the region. It brings the museum with its finds into the landscape and it can also bring the landscape into the museum. An integrated GPS based alert system automatically informs the user, when he is approaching an interesting site with available information in the landscape.

The integration of different languages is very important within the European Union and we have integrated many languages in earlier multimedia projects (WALKSHOFER & DOBAT 2008). The mobil information systems on smartphones also enables us to use different languages. Therefore it is also possible with smartphone applications to promote an archaeological monument to an international audience.

In this version we have already integrated a riddle. If you are able to solve it, you will get a DVD about the Frontiers of the Roman Empire (BREEZE 2011, p. 76). The idea of the riddle is based on the popular geo-caching. It can only be solved, if you visit the sites. In a next step this geo-caching riddle will be integrated in the navigation of the application. It will be possible to monitor your progress in solving the riddle within the application. This feature is targeted especially on families spending a day or two in the landscape, discovering archaeological sites, solving a riddle and automatically learning more about the World Heritage Site.

Another important feature in future projects will be the implementation of augmented reality. With this technology it will be possible to mark archaeological monuments in the live view of the camera provided by the smart phones.

Those new features are planned for other parts of the World Heritage Site and other sites. Currently we are planning to extend the Main Limes Mobil application on parts of the Raetian Limes in Bavaria.

Certainly one of our future aims is to provide a version for Android and Apple iOS simultaneously.

The application has been completed in March 2011 and it will be available soon in the iTunes AppStore. The application will be presented by the Bavarian Minister of Science and Culture Dr. W. Heubisch, by the Bayerische Sparkassenstiftung and by the Landestelle für nichtstaatliche Museen in Bavaria in July 2011. Therefore the application will be available in the App Store for free in July 2011.

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