# Mobile Internet for the Multimedia Enterprise (MobIME)

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## Abstraction

As mobile devices have been widely developed and used, in the near future, multimedia content including 2D/3D graphics, images, voice, video and audio based applications will dominate various fields such as sales, customer services, maintenances, etc on mobile device. For example, Field Force Automation extends enterprise's existing systems into the field, allowing remote access to time-sensitive, mission-critical information in a variety of wired and wireless environment. In this report, we summarize some technologies that suitable for mobile field force automation and current researches in WINMEC. Currently, we have a going on project named Mobile Internet for the Multimedia Enterprise (MobIME) [1]. This project is sponsored by Intel.

## 1. Toolkits and specifications for mobile field force automation.

To completely implement Mobile Multimedia Engineering Enterprise Field Service data over wireless, we need to exploit various libraries and specification to build a mobile multimedia platform, which includes user-centric multi-mode interactive interface, multimedia engine, device resource management, content representation, optimization, delivery and management. Although brand new technologies and algorithms are critical to this project, existing technologies and development toolkits are also important for us. Thus we made a broad investigate on the existing technologies, available toolkits, and so on. The following are some toolkits and specifications that we have investigated.

### a) Intel PCA architecture and relative development toolkits

- CC/PP Client Profile for Intel PCA Devices (Mobile Profile Framework with CC/PP Tool Kit 2.0). It includes static and dynamic profiles of Intel

PCA device [2]. CC/PP is very important for applications such as content adaptation.

- Intel Evaluator Toolkit. Intel Evaluator Toolkit includes a set of technologies for information processing, extraction, retrieval, and classification [3][4].
- Intel DFM SDK. Intel Dynamic Frequency Management allows user change clock frequency of Intel Xscale Microarchitecture Application Processor dynamically [5].
- Intel Graphics Performance Primitive (GPP). Intel Graphics Performance Primitive is a rich set of graphics functions that optimized for Intel XScale Application Processors [6].
- Intel Integrated Performance Primitive (IPP evaluation). IPP provides a range of library functions for multimedia, audio codecs, video codecs, image processing, signal processing, speech compression, cryptography plus computer vision as well as math support routines for such processing capabilities. It optimized for Intel XScale Application Processors [7]
- Intel Persistent Storage Manager. PSM enables the combination of executable code, registry back-up, and file storage in a single Intel® Flash Memory [8].

**b) Specifications and standards**

- **SVG**, which has been developed by W3C, is a new standard for two dimensions vector graphics. Mobile Version and Tiny Version are developed for PDA and cell phone respectively [9].
- **VoiceXML** is A XML based markup language which represent voice/speech operations and information into XML format [10].
- **X3D** is an open 3D graphics standard based on XMLfor enabling real-time communication of 3D graphics across different applications. It can be used in engineering and scientific visualization, CAD and Architecture, Medical

visualization, Training and simulation, multimedia, entertainment, educational, etc. It is derived from VRML [11].

- **JSR 184 - Mobile 3D Graphics API for J2ME.** A Specification defines **a** scalable, small-footprint, interactive 3D API for use on J2ME based mobile devices [12].
- **Open GL ES,** A Standard for Embedded Accelerated 3D Graphics [13].

### c) Other Toolkits and Packages

There are some toolkits such as X-Forge, Diesel3D, PocketGL, etc. Some of them are property products, some of them are in developing. These toolkits won't give us too much help in our project.

## 2. Framework of MobIME

Based on our proposal and previous' investigation, we create the framework of MobIME. From functionality stand of point, the framework can be divided into three major components: Content Representation, Optimization, Delivery and Management; User-Device interactivities (User Interface); Device Resource Management and Bandwidth Management. Figure 1 shows the components of MobIME. From working flow stand of point, the architecture of MobIME has been divided into three Layers. We also define a new multimedia content representation language called µ3dML to exchange data and information. Fig 2 shows the Architecture of MobIME.

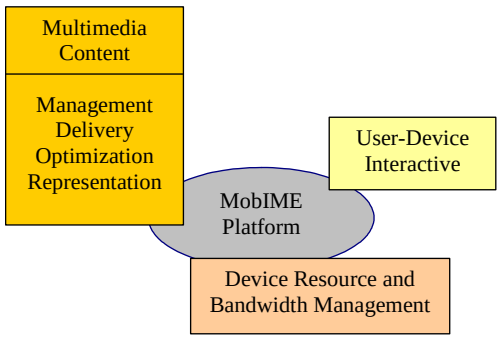


Fig 1. MobIME Components

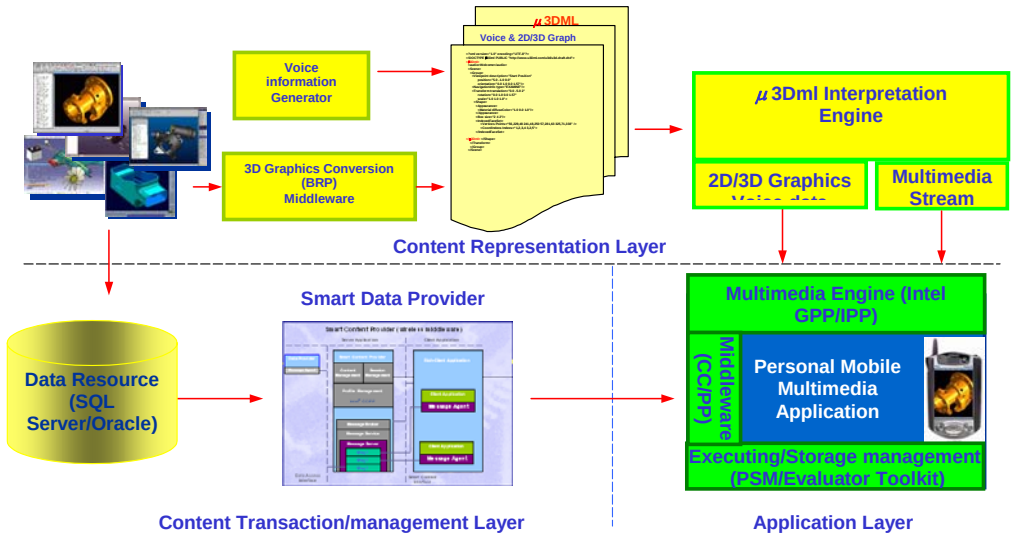


**Fig 2. MobIME Architecture**

At Content Representation Layer, Voice, 2D/3D Graphics, Text information have been integrated into μ3dML format. μ3DML is the basic media carrier for MobIME. Application Layer takes charge of interpreting and representing multimedia content on mobile device (Intel GPP and IPP will be used for creating multimedia engine), Application executing and data storage management (Intel PSM and Evaluator Toolkit will be used), Mobile Device Management and Mobile Content Adaptation (CC/PP toolkit will be used). Content Transaction/Management Layer provides content and maintains user-session status for each application. In this layer, a smart content provider will be created.

## 3. 2D Graphics viewer and SVG specification implementation

Scalable Vector Graphics (SVG), which has been developed by W3C, is a new standard for two dimensions vector graphics. SVG was written in XML and usable as an XML namespace. SVG contains six main types of graphic object: vector graphic shapes (include line, polyline, polygon, path, ellipse, circle, rectangle), images, gradient fills, filters, reusable components such as symbols and markers, and text. SVG has rich set of event handler make it interactive.

SVG can be used in Graphics Design; Location-Based Services such as traffic and weather reports; Mapping and Positioning, that's useful for navigating; Animated Picture Messaging; Multimedia Messaging include voice, video, animation and interactive graphics; Entertainment; Industrial Applications; eCommerce and User Interfaces.

We propose using a multimedia file format µ3dML to represent multimedia content. To create our own file format, SVG specification is a very good reference for us. To get better understand SVG, we created a SVG client. It implemented most basic features of SVG including Document Structure Parsing, Styling, Coordinate System, Transformations, Paths, Basic Shapes and Text. Figure 3 shows the snapshot of Our SVG Client. Table 1 lists the comparison between existed commercial SVG toolkit and our SVG client.

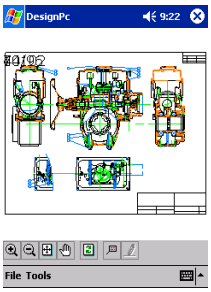


Fig. 3 SVG Viewer

**Table 1**

| SVG Essential | eSVG | PocketSVG | Our SVG Client |
|---|---|---|---|
| DOM | Full Control | Full Control | Pasring |
| Style | Yes | Yes | Yes |
| Metadata | Yes | Yes | Limited |
| Group | Yes | Yes | Yes |
| View | Yes | Yes | Yes |
| Polygon | Yes | Yes | Yes |
| Polyline | Yes | Yes | Yes |
| Rect | Yes | Yes | Yes |
| Circle | Yes | Yes | Yes |
| Ellipse | Yes | Yes | Yes |
| Path | Yes | Yes | Yes |
| Line | Yes | Yes | Yes |
| Text | Yes | Yes | Limited |
| Animation | Yes | Yes | No |
| Image | Yes | Yes | No |
| Super Link | Yes | Yes | No |
| Fill | Yes | Yes | No |
| Transformation | Yes | Yes | Limited |
| Event | Yes | Yes | No |
| Filter | Yes | Yes | No |

## 4. 3D Graphics based on GPP Library

We investigated existed Mobile 3D engine such as X-Forge, Diesel3D etc. All these mobile 3D engines are designed for 3D game and work only in full screen mode. They don't support rich user interface features such and menu, button, dialog etc. Thus, they are not suitable for engineering field service. To render 3D graphics on mobile device, we have to create our own 3D graphics engine. Intel Graphics Performance Primitive (GPP) provides a broad range of 3D graphics functions including date-type conversion, arithmetic, trigonometric, vector, matrix, and raster primitives to us. Based on GPP, we created µ3d engine. The basic elements of µ3d engine are camera, light and objects. Figure 4 shows the structure of µ3d engine and Figure 5 is the screen snapshot of µ3d engine.

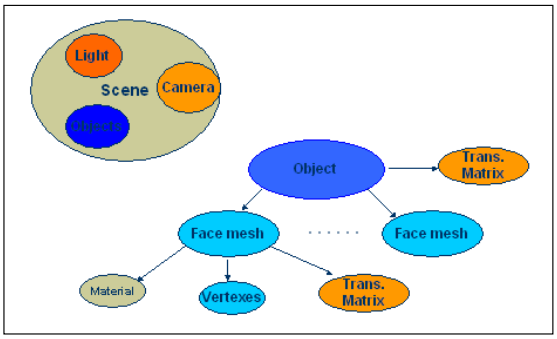


Fig. 4 Hierarchy of u3d engine


Fig. 5 Snapshot u3d engine

Table 2 is the comparison of existed commercial 3D engines and µ3d engine.

**Table 2**

| **Features** | **Diesel 3D** | **PocketGL** | **µ 3D Engine** |
|---|---|---|---|
| Foot Print | Large | Small | Small |
| Speed | Fast | Slow | Fast |
| GPP optimized | No | No | Yes |
| Face Mesh | Yes | Yes | Yes |
| Display mode | Full Screen | Full Screen | Windows |
| Shading | Flat/Gouraud | Flat/Gouraud | Flat |
| Color | Yes | Yes | Yes |
| Texture | Yes | Yes | No |
| Alpha | Yes | Yes | No |
| Fog | Yes | Limited | No |
| Camera | Move | Move | Move |
| Light | Multi-Lights | Multi-Lights | Multi-Lights |
| HSR | Z-buffer | BSP | Z-buffer |

| | | | |
|---|---|---|---|
| Display/Rendering | GAPI | GAPI | GDI(off-screen) |
| Collision Detection | Yes | Yes | No |
| Application | Game | Game | Engineering |

## 5. µ3DML definition

µ3DML is hybrid file format that contains voice, text, image, and 2D/3D graphics in a single file. It based on XML and Document Object Model (DOM). We investigated specifications including SVG, VoiceXML and X3D, and absorbed features from these specifications to form µ3DML format. In this schema, 2D graphics represented by using same elements from SVG; 3D graphics represented by face meshes; image and audio has been encoded to base64 format; voice can be represented as base64 or text.

The basic objects of µ3DML are: Graphics, Image, Voice, Audio, Text. The following is an example of the µ3DML file format.

```
<?xml version="1.0" encoding="UTF-8"?>

<µ3dml>

<voice encode =“base64”>pcEATSAJBAAA8BK/AAAAAAAABAAAiau</voice>
<voice encode = “TextSpeech”> welcome to use µ3dML </voice>
<image encode =”base64”>
   <data>/9j/4AAQSkZJRgABAQEAYABgAAD/2wBDAAgGBgcGB</data>
</image>
<graphics>
        <3dgeometrics>
           <facemesh name = “face1” ……>
           </facemesh>
        </3dgeometrics>
</graphics>

<text value = “test”></text>

</µ3dml>
```

## 6. Mobile Database Application Prototype

Content management is a big issue in engineering field service. We Created a Mobile Collaborative System (MCS) based on Microsoft SQL Server/SQL Server CE. In this mobile collaborative system, mobile user can communicate with group members, exchange information, share documents and access enterprise database, etc. The basic modules of the system including Process Monitoring, Work Assignment, Member Management, Documents Sharing/Representation and Communication. Processing Monitoring is a module that a group leader can use it to monitor progress of a project or design and make some actions. Group leader uses work assignment and member management to manage members, create schedule and assign duty to members. Documents Sharing/Presentation is the key in this system. It's a server-client application. Server side consists of SQL Server 2000 Database, SQL Server 2000 CE Agent and middleware, which provide content to client. Client offer read, write, and manipulate data and communication functions through agents. Data Replication provide both online and offline data Operation. Figure 6 is the snapshot of the mobile collaborative system.

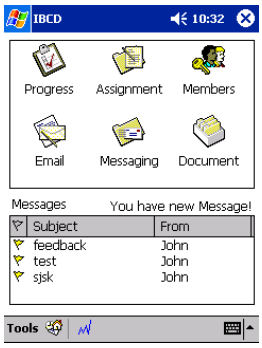


Fig. 6 Snapshot of MCS

## 7. A Message Oriented Mobile Middleware (Smart Content Provider) Conceptual Design.

Compare to fixed computer, wireless connected mobile device has more restraints. On device side, the screen is small; computational capability is weak (although it is been improved rapidly) and lack of 3D even 2D functionality; lifetime is short because of battery; Storage space is limited; and so on. On the connection side, no matter which communication method is been used (802.11 protocol family or Public Wireless Communication Protocols like CDMA, GSM, 3G, etc), wireless connection suffers low bandwidth and unreliable connections (some times will lose connection). We worked out a Message Oriented Middleware (MOM) based content generation/delivery service that handles the content generation and delivery for MobIME. Figure 7 shows structure of the Middleware.

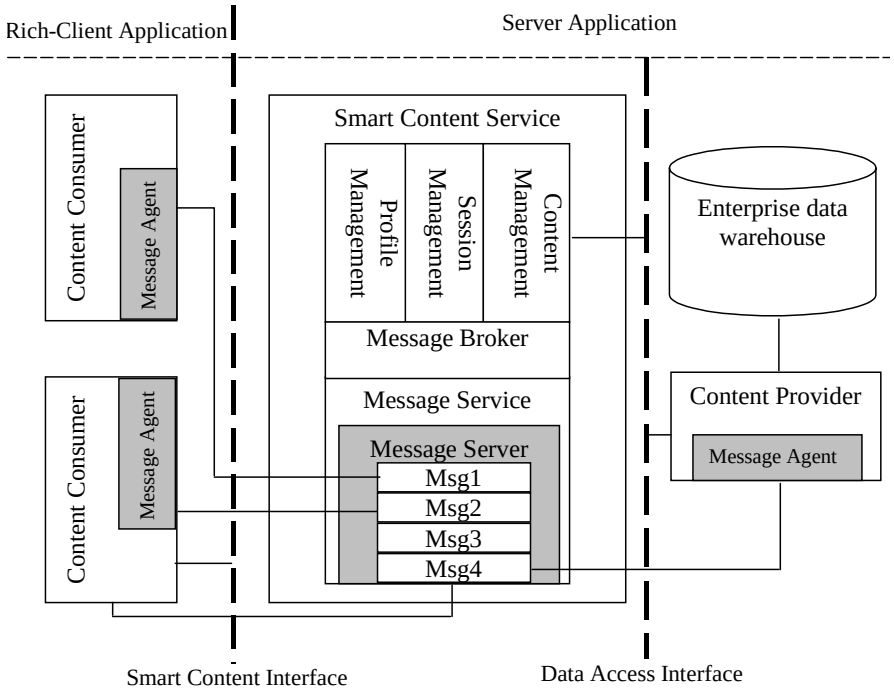


Figure 7. Architecture of Smart Content Service

In this architecture, contents are generated by Content Provider or Content Consumer based on current connection status and client device profile. Multimedia information has been separated and embedded into µ3DML. Then, Contents have been sent to Message Agent. Message Agent negotiates with Content Service to finish the content delivery, forward or buffering. Content service provides a way for application to communicate with each other. Session Control Management is used to keep the setting of an application and its status. A profiles database that keeps the hardware configuration of the mobile device platform is also maintained. Each time when a client sends a request to the content service, the platform of the mobile device is identified and server will generate the application content based on different profiles. Content Operation executed on Content Provider (Server Side) and Content Consumer (Server Side).

## 8. Conclusion and future work

Mobile Multimedia is playing very important role in enterprise. Using merging technologies to apply multimedia content into enterprise business operation such as field service automation could bring huge benefits to industry. We just started our work based our vision of future enterprise. There are still lots of uncertain issues may change the whole world. Currently, we implemented some prototypes. In the near future, we will try to consummate these ideas. We will also investigate technologies such contents and services registration, persistent/consistent content organization, optimized content delivery, rendering, etc.

## Acknowledgement

We acknowledge sponsorship from Intel and UCLA-WINMEC (http://winmec.ucla.edu) in the support of this project.

## Reference:

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