

## Chapter XV

# Mobile Image Communication: New Concepts Using JPEG2000

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### ABSTRACT

*Imagery must be adequately processed and adapted to be used in mobile environments. This contribution shows that this can be reached by a rigorous combination of all stages of the image communication pipeline to the task at hand. To achieve this, the modern imaging standard JPEG2000 serves as a foundation for compression and streaming. Based on the concept of regions of interest (ROI) and levels of detail (LOD), powerful generic strategies for content handling are proposed. The task is represented by one of three common problems in mobile environments—image browsing, viewer guidance, and content exchange. Besides new ideas to accomplish these tasks on application level, appropriate strategies to combine the respective visual representation with compression and streaming are introduced. In addition to a much better content representation, the achieved results show that the consumed resources can be strongly decreased by the proposed new concepts for mobile image communication using JPEG2000.*

### INTRODUCTION

The enthusiasm for mobile computing is still unbroken. With the ability to access information every time and everywhere, mobility allows for completely novel and out breaking solutions, applications, and services. Due to their form factors and the application environment, however, mobile devices are still restricted by *low computing power* and *bandwidth*. As imagery is one of the most important but also most resource-

demanding media within multimedia it must be adequately processed and adapted to be used in such environments (Rosenbaum, Tominski, & Schumann, 2006). How to achieve this by efficient JPEG2000-based image communication strategies designed to solve a task at hand will be the focus of this contribution. To be able to provide the big picture on the topic, of main interest are the features and performance gains provided by the strategies rather than a detailed technical description of their components. However, all

underlying technology will be introduced and carefully referenced.

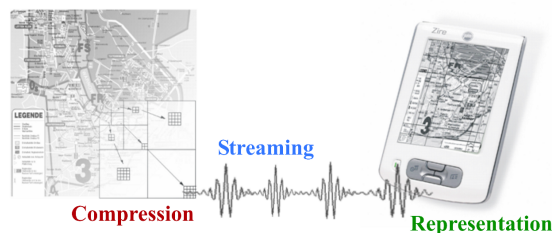
A meaningful image communication strategy requires the integration of the two disparate research fields, “multimedia” and “communication,” and consists of the stages *compression*, *streaming*, and *representation* (cf., Figure 1). Although numerous, often quite sophisticated techniques for each stage have been proposed, an arbitrary combination of single solutions does usually not lead to an appropriate result. A high-performing system can only be guaranteed if all involved techniques can be tightly coupled (Rauschenbach, 1999; Rosenbaum & Schumann, 2005). Founded on an appropriate visual representation at the mobile client, this should lead to an image communication strategy that ensures that *only data contributing to the current representation is handled and transmitted*. All ideas proposed in this contribution are founded on this principle, significantly reducing the required system resources at all communication stages. Although similar ideas have already been proposed, they are either based on proprietary solutions (Owen et al., 2001) or discuss a specific task only (Deshpande & Zeng, 2001; Ortiz, Ruiz, & Garcia, 2004). The ideas proposed in this publication are fully compliant to the international standard JPEG2000 (ISO, 2002), which allows for an easy migration of the introduced strategies into existing systems, and founded on a generic description of current

demands by regions of interest (RoI) and levels of detail (LoD) for a broad applicability. Thereby, the adopted principle of a progressive refinement avoids the redundant data transfer in case demands change during interaction.

Although the applicability of the proposed JPEG2000-based compression and streaming technology extends far beyond the discussed tasks, this publication will focus on three common problems in mobile environments: *image browsing*, *viewer guidance*, and *content exchange*. Beside the proposal of new ideas for appropriate visual representations and the underlying data handling, of major interest is their coupling with compression and streaming to high-performance communication systems and the resulting decrease of the consumed resources.

This contribution gives an overview about the proposed ideas and achieved results for each single communication stage. The second section is concerned with image compression using the new international standard JPEG2000, reviews the idea of RoIs and LoDs, and introduces options for their support within a JPEG2000-compressed image. The third section covers the demand-driven streaming of the data based on dynamic RoIs and LoD. In focus are the calculation, sequencing, and signalization of individual data containers. The fourth section is dedicated to introduce new ideas for image representations for each of the discussed tasks, to propose related communication strategies, and to present the performance of the resulting systems. The contribution closes with a summary in the fifth section.

Figure 1. The image communication pipeline



## FLEXIBLE IMAGE COMPRESSION WITH JPEG2000

Image compression is the foundation for an effective and efficient data handling. Although there are numerous image compression approaches, the JPEG2000 standard represents the current state-of-the-art and combines a superb compression

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