

Chapter 67

Large Imagery on Small Screens: Novel Technology for Device Adaptation in Mobile Services

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ABSTRACT

With the focus being on digital imagery, this chapter proposes novel technology that is able to cope with the heterogeneous viewing hardware and user requirements in mobile services. With the aim to present an image at a detail level that is most appropriate for a given device and user, the main approach takes advantage of scalable image compression, transmission, and display. A scalable image is created once and multiply used for different kinds of devices and user requirements. By progressive refinement, the image is successively enhanced in detail until the device capabilities are used up to capacity. A framework that considers the most important resource types in mobile computing: computing power, bandwidth, and screen space, are introduced. Two different applications - on-the-fly adaptation at client side and profile-based adaptation at server side - are proposed leading to solutions for different application environments. Due to its flexibility and low-complexity, the proposed framework is a much more general solution compared to related approaches. This is underpinned by empirical results obtained from experiments and a discussion of the properties of the framework and its applications. Due to the novelty of the approach, some of the many possibilities for future work in this area are also discussed.

INTRODUCTION

Emerging industries taking advantage of mobile viewing technology, such as smartphones, tablet devices, or e-readers, are predicted a bright future. The small form factor and application domain

of such gadgets, however, impose a number of drawbacks compared to stationary environments. Limited screen space and large response times are probably the most serious issues that must be overcome to lead mobile services to success. To achieve this, the displayed contents must be tailored to the capabilities of the used viewing device. Appropriate content adaptation is still an

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unsolved research question. Due to the complexity of the problem, available solutions are either too resource-intensive or inflexible to be applied broadly.

The convergence of internet and wireless technology and the recent boom in the smartphone and data tablet market have stimulated and simplified accessing data anytime and anywhere. This truly led to a shift from desktop-centric to data-centric computing. These technological developments have contributed to the impressive growth of mobile services as messaging, information browsing and retrieval, entertainment, navigation, advertising, social interaction and many more. Central to all of these services are digital images, nowadays often available in high resolution and quality. As the small form factor of mobile hardware and wireless communication strongly constrain image transfer and display, strategies to adapt imagery to the respectively available resources are needed. Meaningful adaptation reduces the image in the available detail leading to less data to be transmitted, processed, and displayed at the resource-constrained client device.

Existing adaptation strategies can be divided into two main classes:

1. Server-side adaptation creating a individual image for each device and user before transmission and
2. Client-side adaptation transmitting all data and applying the adaptation right before display.

Adaptation strategies of the first class usually create and store many different image versions at server side which is resource consuming. Interactive changes often require a re-transmission of the contents. Techniques associated to the second class require a full transfer of the image before adaptation. Considering the fact that often most of the content and details cannot be shown on mobile devices, this leads to a highly redundant data transmission. The additional computing power

required to apply adaptation further aggravates resource constraints at client side. As these drawbacks dramatically decrease user acceptance (see Korsah, 2009), the development of novel device adaptation technology is timely.

As shown by Thiede et al. (2009) and Rosenbaum et al. (2009), most issues of existing adaptation technology can be overcome by taking advantage of *scalable image coding* and *progressive refinement*. Thiede proposes an on-the-fly approach that is fully client-based. Thereby, it makes use of a single scalable image that is incrementally transmitted and processed to provide the viewer with continuous image previews. The technology proposed by Rosenbaum is based on profiles. Adaptation is fully accomplished on server-side allowing for high adaptation accuracy. The associated research, however, limits itself to geometry data only. An overarching framework for the adaptation of raster imagery using scalable imagery and progressive refinement and taking advantage of commonalities of both strategies is still missing.

In this publication we generalize the strategy proposed by Thiede et al. to a general framework for raster imagery. The framework takes full advantage of progressive refinement. Progressive images are inherently scalable and thus allow for flexible adaptation to heterogeneous devices using a single "*multi-purpose*" data-stream. The main idea is to refine the contents as long as the respective device is able to provide the resources required for their appropriate transmission, decoding, and display. Only the data that can be handled is processed at the client device. If the resources required to enhance image detail can no longer be provided, the refinement is stopped and the best content representation for the respective client is considered to be found. The implementation of this framework is shown by two different applications: *on-the-fly (OTF)* and *profile-based (PB) adaptation*. In OTF adaptation, resource estimation based on the assessment of past consumption is used to predict whether the data associated to

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