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Michael P. Peterson *Editor*

Online Maps with APIs and WebServices

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Part I
Background

Chapter 1
Online Mapping with APIs

Michael P. Peterson

Abstract Bringing maps to users has been made much easier with the World Wide Web. Millions of maps now make their way through a world-wide network of computers. A major change occurred in 2005 in how those maps were delivered when Google Maps implemented a tile-based mapping system based on AJAX that facilitated interactive zooming and panning. The following year, an Application Programmer Interface (API) was released that gave programmers access to the underlying mapping functions. It was now possible to place data on top of the Google base map and make this map available to anyone. This system was created at tremendous expense. It is calculated that the number of tiles required at 20 zoom levels is nearly 1.5 trillion. At 15 KB per tile, this equates to 20 Petabytes or 20,480 TB and a data storage cost of between US $2 million and US $2 billion per data center. This expenditure indicates the level of importance that online companies place on maps. It also represents a shift in how maps of all kinds are delivered to users. Mobile devices are a further indication of this change in map delivery.

1.1 Introduction

This book is about new approaches for online mapping, a form of map presentation that can trace its origins to the introduction of the graphical World Wide Web in 1993. The Web drastically expanded the use of the Internet for the distribution of maps. Apps on mobile devices have since become a primary way that maps are delivered to users.

Since the introduction of Google Maps in 2005, online mapping has been defined by Application Programming Interfaces (APIs). These online software libraries provide the means to acquire, manipulate and display information from a variety

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of sources. Although APIs are used for many different types of applications, the creation of maps is one of the major uses. The relative ease of overlaying all types of information with online mapping APIs has further transformed cartography from a passive to an active enterprise.

APIs are the basis of map mashups. The term mashup was first used for a movement in pop music that involved the digital mixing of songs from different artists and genres. In technology, the term is used for a melding of web resources and information. A mashup combines tools and data from multiple online sources. The most common mashup application is the mapping of data.

Mashups are an integral part of what is commonly referred to as Web 2.0. Beginning about 2004, the term Web 2.0 began to be used for a variety of innovative resources, and ways of interacting with, or combining web content. In addition to mashups, Web 2.0 also includes wikis, such as Wikipedia, blog pages, podcasts, RSS feeds, and AJAX. Social networking sites like MySpace and Facebook are also seen as Web 2.0 applications.

The advantage of using a major online mapping site is that the maps represent a common and recognizable representation of the world – a base map. Overlaying features on top of these maps provides a frame of reference for the map user. A particular advantage for thematic mapping is the ability to spatially reference thematic data. In the past, thematic maps have limited the display of spatial reference information such as cities and transportation networks partly to emphasize the distribution being mapped. The inclusion of these features provides valuable locational information to the thematic map user.

This chapter provides an overview to online mapping with APIs, and an overview of this volume.

1.2 The Online Base Map

Google Maps changed the online mapping landscape. Known for its search engine, Google effectively added a map-based search through Google Maps. In the process, they found a more effective way to indirectly make money from online maps by charging businesses to be found. In addition, by not including ads around the map, like MapQuest, they left more room for the map on the computer screen. More importantly, from a map user's perspective, Google Maps changed the way we interact with maps.

The delivery of a Google Map is based on image tiling. This technique had been used since the early days of the World Wide Web to speed the delivery of graphics. In comparison to text, images require more storage and therefore take longer to download. A solution is to divide the image into smaller segments, or tiles, and send each tile individually through the Internet. These smaller files often travel faster because each can take a different route to the destination computer. The tiles are reassembled on the receiving end in their proper location on the web page. With a moderately fast Internet connection, all of this occurs so quickly that the user rarely

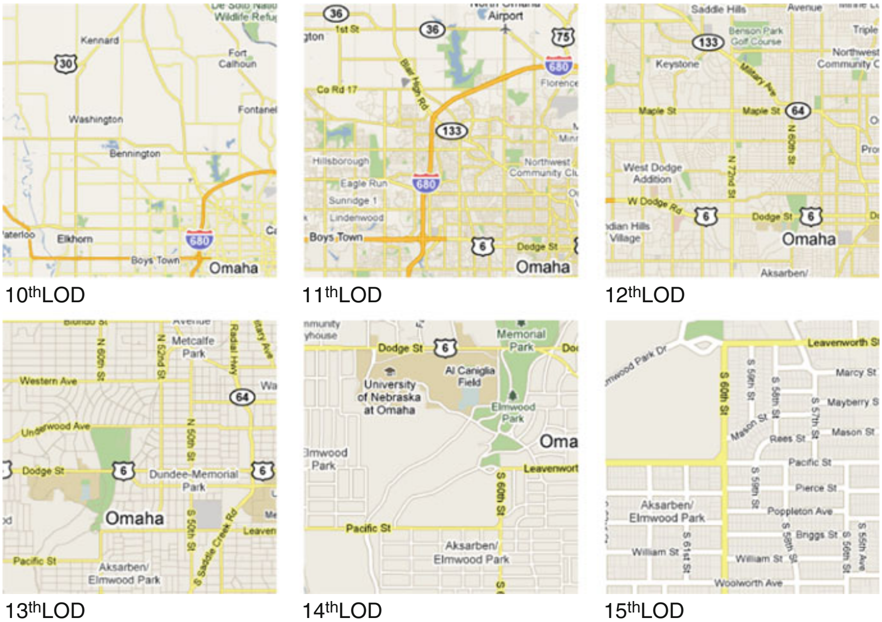

Fig. 1.1 Individual map tiles from Google Map at six different levels of detail (zoom levels). In 2005, Google introduced a tiling system to deliver online maps. Over a trillion tiles are used for Google's 20 zoom levels

notices that the image is actually composed of square pieces. With slower connections, the individual tiles are clearly evident.

Figure 1.1 depicts a series of map tiles at different levels of detail (LOD). All tiles are 256 × 256 pixels and require about 15 KB a piece to store in the PNG format. Table 2.1 shows the number of tiles that are used in a tile-based mapping system for 20 levels of detail (LOD), or zoom levels, and the associated storage requirements and estimated storage costs. With 20 LODs, approximately one trillion tiles are needed for the whole world. At an average of 15 KB per tile, the total amount of memory required is 20 Petabytes, or 20,480 Terabytes. No single computer currently has this much storage capacity.

The cost of storing this much data has not been made public by Google or any other company. It is estimated in Table 1.1 based on a cost of about US $100 per Terabyte, the cost of a hard-drive in 2011 that does not include the housing or computer connection. As can be seen from Table 1.1, storing the entire one trillion tiles on disk drives would be about US $2 million ($100 × 20,480 TB). This assumes that all of the tiles are pre-made and stored. It is likely that many of the less popular tiles are 'made-on-the-fly' when they are requested.

In order to achieve faster response times, there is strong indication that data centers use faster random-access memory (RAM) to cache the most popular map tiles. At the current US $30 for 1 GB of RAM, storing the entire map of the world