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G. Brent Hall · Michael G. Leahy (Eds.)

Open Source Approaches in Spatial Data Handling

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Preface

During the last several years there has been a significant coalescence of interest in Open Source Geospatial (OSG) or, as it is also known and referred to in this book, Free and Open Source for Geospatial (FOSS4G) software technology. This interest has served to fan embers from pre-existing FOSS4G efforts, that were focused on both standalone desktop geographic information systems (GIS), such as GRASS, libraries of geospatial utilities, such as GDAL, and Web-based mapping applications, such as MapServer. The impetus for the coalescence of disparate and independent project-based efforts was the formal incorporation on February 27th, 2006 of a non-profit organization known as the Open Source Geospatial Foundation (OSGeo). Full details concerning the foundation, including its mission statement, goals, evolving governance structure, approved projects, Board of Directors, journal, and much other useful information are available through the Foundation's website (http://www.osgeo.org).

This book is not about OSGeo, yet it is difficult to produce a text on FOSS4G approaches to spatial data handling without, in some way or another, encountering the activities and personalities of OSGeo. Of the current books published on this topic the majority are written by authors with very close connections to OSGeo. For example, Tyler Mitchell who is the Executive Director of the Foundation, is author of one of the first books on FOSS4G approaches ('Web Mapping Illustrated' (2005)). Another member of the Board of Directors of the Foundation, Markus Neteler, is co-author of the book 'Open Source GIS: a GRASS approach' (2007), which is in its third edition.

Hence, not coincidentally, the current text has contributions from a number of authors with close connections to the Foundation. The importance of OSGeo in all aspects of FOSS4G development is unquestionable and unparalleled in the development of Open Source software within the spatial data domain. As OSGeo has established itself firmly at the centre of what is described by David McIhagga in Chap. 3 of this book as the Open Source Web mapping ecosystem, FOSS4G technologies and concepts have permeated into many diverse areas of application development. One area where recent interest in the spirit and 'openness' of FOSS4G software is apparent is the tertiary education sector. This interest is likely to increase in the

future as the tools, which are already of quite an incredible level of maturity, become better known and ever more widely used, and as curricula evolve to explore opportunities other than those that are tightly coupled with the dominant proprietary GIS software vendors.

The idea for this book evolved from working with FOSS4G tools on projects within an academic environment. Other than the two texts referred to above and one or two others, prior to the appearance of OSGeo the dominant reference source for FOSS4G projects was and substantially still is the Internet. This is perhaps the way it should be as, with projects that are in a constant state of evolution, the use of the printed word is inevitably associated with a limited shelf-life. This is especially true for texts that are 'cook book' oriented, containing instructions on how to do this or that with a specific software package. These sorts of texts are essentially only relevant to the versions of software that they relate to, yet there is a huge international market for them. Hence, the approach sought and largely implemented with this book was not to provide readers with information on how to use a specific FOSS4G tool or project, but rather to focus on several projects more from a conceptual rather than a 'how to' point of view. The purpose is to introduce readers new to FOSS4G software to the nature, purpose, evolution and characteristics of a number of projects, while also discussing important issues such as the role of standards in OS software development, the business models that can allow 'free' software development to sustain the developers, and the general need for a spirit of co-operation and partnership building that is often absent from the closed software marketplace.

The book is generally divided into three sections. The first three chapters focus on the topics noted immediately above. New business models have had to be created or have evolved to promote and sustain core FOSS4G projects, and companies, such as DM Solutions Ltd., Refractions Research and others that have grown on the back of FOSS4G inspired ideas. Hence, market niches have been identified that allow these commercial entities to provide FOSS4G services and FOSS4G solutions that remain freely accessible to any and all who are interested, while remaining commercially viable. Equally, issues such as the use of standards, improving documentation, making tools more accessible to end-users who are not programmers, improving FOSS4G interoperability, co-ordinating collaboration within the developer community, and controlling code release frequency through use of best practice management standards are all now substantially more important than beforehand, with the groundswell of support for and involvement in project development. Respectively, these three initial chapters are written by Tom Kralidis on standards, Arnulf Christl on new business models, and David McIhagga on what he aptly describes as the Open Source Geospatial Web 'ecosystem'.

The second section of the text comprises the majority of the chapters. In this section focus is given to a variety of key FOSS4G projects. For the most part the authors of these chapters are individuals who, for the most part, have been either the catalyst of the project or have played a prominent role in its development. Each chapter is generally built around a discussion of the objectives of the project, the architecture of the tool(s), how the project evolved to satisfy its initial objectives, or alternatively how the objectives morphed as the project unfolded into its current

state. There is some technical discussion in these chapters, however the intention of the text was not to produce a manuscript shrouded in technical language. While this is inevitable to some extent with technical subject matter, the intention, as noted above, was to make the book accessible to those new to FOSS4G, while also providing information of interest to established members of the FOSS4G community.

The chapters are illustrated to varying extents, some richly and some not at all, with design diagrams and screen captures. Clearly, it was not possible to cover all of the core or key FOSS4G projects that have evolved, but the chapter selection does a fair job at spanning the field. In fact, chapters discuss five of OSGeo's 13 established Web mapping, desktop, or geospatial library projects. Respectively, Chap. 4 is authored by Steve Lime and focuses in MapServer, perhaps the most successful Web-based mapping tool yet developed. Chapter 5, by Frank Warmerdam, discusses the Geospatial Data Abstraction Library (GDAL), which also is possibly the most successful such library to have yet been produced. The 6th Chapter is by Rongguo Chen and Jiong Xie and it deals with Open Source databases and their spatial extensions, most notably PostGIS, produced by Refractions Research. Chapter 7 is by Robert Bray and it is important as it deals with MapGuide Web mapping software, by Autodesk Inc., which was converted to OS in November 2005. The software was contributed to OSGeo in March 2006 as a foundation project. Chapter 8 is by Ian Turton and focuses on GeoTools, which is Java-based and is used as the base for several other well known FOSS4G projects. Chapter 9 is by Markus Neteler and his colleagues from the GRASS development team, and it discusses probably the oldest and most firmly established FOSS4G desktop application available.

The third section of the book comprises the same number of chapters as the first. These chapters discuss applications of some of the tools described in section two, with the addition of the impressive array of FOSS4G libraries and applications packages developed by Gilberto Camara and his colleagues from various institutions in Brazil. Specifically, Chap. 10 discusses one of two University-based FOSS4G projects reviewed in the book, namely GeoVISTA *Studio* developed by Mark Gahegan and his colleagues at Penn State University. Chapter 11, by the Editors, discusses a second University-based tool which utilizes several of the other FOSS4G projects discussed in the text.

Compiling these chapters was an interesting exercise. It became very clear very quickly, and remained clear throughout the project, that the one element that is in very short supply in FOSS4G software development in general is free time. Hence, for several of the contributors finding time to complete their chapter proved to be difficult. In addition, it seems also that outstanding programmers enjoy doing what they do best, but do not necessarily enjoy writing about it! Given this, we would like to thank the contributors for their forbearance in my persistent 'nagging', which was required in order to get the book finished. In the final analysis, the chapters together weave a very useful tapestry of activities within this general field.

It would be remiss of us not to complete this preface without noting thanks to a number of individuals who have helped along the way. First, we would like to thank the series editors, Drs. Shivanand Balram and Suzana Dragicevic from Simon Fraser University, British Columbia, Canada, who liked the initial idea of doing a book on

this theme. Chris Bendall, the editor from Springer was also very helpful in moving the idea into a reality. We would like to thank our colleagues at the University of Waterloo, Ontario, Canada, where the bulk of the editorial work for this book was done. In particular, we wish to thank Dr. Rob Feick, as well as the following graduate students who worked on the MapChat project, namely David Findlay, Taylor Nicholls, John Taranu and Brad Noble. Last but certainly not least we thank our wifes Masha and Ally, whom we dedicate this effort to.

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Chapter 1
Geospatial Open Source and Open Standards Convergences

Athanasios Tom Kralidis

Abstract Geospatial information has become a ubiquitous resource. The proliferation of the Internet and information technology has resulted in an enormous volume of information exchange and a growing global geospatial data infrastructure presence. Interoperability is increasingly becoming a focus point for organizations that distribute and share data. Standards are an essential aspect of achieving interoperability. This chapter illustrates the benefits of using open standards for geospatial information processing. It also discusses various free and open source for geospatial software (FOSS4G) packages that support open standards. Finally, the chapter illustrates how open source software and open standards can be easily integrated in a number of scenarios.

1.1 Introduction

Laying the groundwork to establish a framework for the interoperability of spatial data has been an ongoing activity for at least three decades. The 1970s saw the emergence of a growing requirement for national mapping and surveying agencies to create policies, agreements and processes for normalizing access to and applications of spatial data. In Canada, for example, the origins of a spatial data infrastructure emerged in the 1980s as an effective means of facilitating data access (Groot and McLaughlin 2000). Following from this there has been an ongoing effort worldwide to produce standards-based specifications for the discovery, evaluation, access, visualization and exploitation of spatial data resources (Global Spatial Data Infrastructure Association 2001).

This chapter discusses the concept of interoperability, the roles and activities of open standards bodies and organizations, and provides examples of free and open source software for geospatial (FOSS4G) projects which exemplify standards-based approaches to spatial information exchange and processing.

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Advances in Geographic Information Science 2,

1.1.1 Geographic Information

Over the last three decades, governments and industry have invested billions of dollars in the development of geographic information systems (GIS) to serve various information communities including forestry, marine studies, disaster management, natural resources, health, and numerous others (Groot and McLaughlin 2000). The information collected by organizations from within these communities has the potential for multiple uses and sharing between users, activities, systems and applications. Despite significant decreases in the cost of computer hardware and software over time, spatial data are ever more voluminous and an expensive resource to develop and maintain. One means that has become popular to organize spatial data resources is the concept of a spatial data infrastructure.

1.2 Spatial Data Infrastructure

This section discusses the concept of a spatial data infrastructure (SDI) by focusing on digital networks and the Internet as the foundation global data infrastructure and discusses how SDIs leverage the presence of the Internet to establish data sharing and data exchange mechanisms. This discussion also illustrates how the concept of interoperability drives the functionality of an infrastructure and is a core requirement for information exchange of any kind.

1.2.1 The Internet and the Digital Age

A data infrastructure can be defined as a transparent, robust computer environment, which enables access to information using common, well-known and accepted specifications, standards and protocols (Global Spatial Data Infrastructure Association 2001). To use a simple analogy, a telephone network can be thought of as an interoperable infrastructure, in that it provides users with connectivity and services to communicate with each other, while the details behind the communications, including the physical telecommunications infrastructure such as networks, wiring, switches, and exchanges are transparent and relatively unimportant from an end user perspective. Such an infrastructure can be seen as an underlying building block to enable communications by products such as specialized applications, as well as the development of sub-networks to be built and deployed for specific purposes. Although a critical aspect of networking and communications, this form of interoperability is also mundane in its ubiquity. However, the very existence of the infrastructure required to facilitate communications makes enabling objects, technologies, and analysis possible (Harvey 2000).

A data infrastructure is also the result of many nodes around which data and services are decentralized. This process of dispersion of data and service points on a