Preface

Have you ever thought of the Internet as a ‘Thing’? A physical object that you can hold, measure the dimensions, visualize and so on. You may suggest that the Internet is a combination of physically and non-physically existent ‘Things’ such as communication rules, messages, information sent from A to B, which is also true. But how many of you think of cables and satellites, when you send an e-mail or start a video conference? Actually we use a ‘Thing’ to do that, a global ‘Thing’ that has physical and non-physical components. However, regardless of the technology behind it, we concentrate on if it gets the job done, and mostly it does. Thus the main focus is not on the ‘Thing’ itself, but on information, and it concerns the success of the sharing and exchange of information. Do you think this vision is enough? Maybe not, we also want to receive information as soon as something happens. We want real-time information. Actually we do not care too much about physical ‘Things’, but we do care about the states of ‘Things’. We are curious. We would like to learn what is happening all around us. As soon as possible!

The key technologies we elaborate on in this book are the Internet of Things (IoT), Web services and building information modelling. The first technology, IoT, aims to answer the questions discussed until now. IoT does not care about the existence of ‘Things’. ‘Things’ can be real, ‘Things’ can be virtual; what IoT really focuses on is the state of ‘Things’. The approach concentrates on making every physical and virtual ‘Thing’ a publisher of information, like the nerve cells in the brain. The IoT approach enables ‘Things’ to publish information when a state change occurs. For instance, in a home that implements the IoT approach, a door will publish information such as ‘I am locked now!’, a light bulb will indicate ‘I am in a morning blue color at the moment’. Are these the only cases of all the hype about the IoT? There are more. The ‘Things’ will also become capable of taking actions based on messages coming from other ‘Things’ or humans. For example, you can use a ‘Thing’ (a cell phone) to control your home lighting while you are far away, or you can turn your TV set off from another country when you think it is time for the children to sleep. These ideas were the science fiction of yesterday, but are the science of today; a reality that has been a part of our lives for just a few years, but will be in our lives for many more. It is inevitable that the technologies

termed within the context of IoT will be a part of our lives. This is so with the other two technologies that this book focuses on. Web services for one. The Internet came into our everyday life around 20 years back. At that time it was viewed as a new way of speaking with friends, new way of sending mails, a new way of marketing and selling goods and a new way of expressing oneself to the world. Over the past 20 years, although we are still confronted with issues of digital divide, things have significantly changed. For instance, mobile devices are now of no use if they cannot connect to the Internet. It is the same with tablet computers. The question is how do we interpret a situation where the role of a single technology, such as the Internet or a 'Thing' becomes useless if it does not benefit from a certain technology. Let us take the analogy of electricity/water and dishwashers. 'Things' need to benefit from utilities in order to work; however, once a technology comes to the level that a 'Thing' cannot work without that technology, the latter is no more a technology but a utility. The situation is the same today for the Internet. The Internet will become a key utility in the future. From this perspective Web services can be thought of as interaction endpoints of this utility. Today, there are architectural advancements on the implementation of these endpoints (such as Representational State Transfer). In fact it should be noted that these endpoints are not entry/exit points (such as plugs for electricity), but they enable us to interact with (hardware/software) components that make use of this utility. Thus, Web services are endpoints for interaction. It is our choice actually to use these endpoints (or not) for interaction, as there are also other choices that we can use such as sending messages from one component to another, or from a human to the components. Message brokers are middleware tools that help us to distribute these messages. Finally, building information models is another hype that has been a buzzword in the construction industry for the past 15 years. These models have emerged as a result of a thrust by software companies to tackle problems of inefficient information exchange between different softwares and to enable true interoperability. An industry standard schema (namely Industry Foundation Classes) was developed to facilitate information exchange between construction industry applications. Later, the industry noted that models produced within a common schema could be utilized to enable shared use of information with the help of shared databases. Thus, BIM became the data sharing technology, where the most up to date and accurate models of a building are stored in shared central databases. This opened new doors. Industry started to focus on making pre-construction simulations using these models, accompanied by multiple stakeholders, which is now termed the nD modelling approach. Later, the information residing in the models was maintained following the construction phase, and the models started to act as the virtual ID cards of the buildings. In parallel, developments in city modelling led to information requirements from these models, which have now become the information providers of the digital city. The city is a living entity and city-level applications require information from 'Things' (i.e. real and virtual) and from 'Models' in real time. Thus, today emerges the requirement for real-time information regarding buildings, indoors and all other city elements in order to efficiently monitor and manage a city. In essence, the construction industry applications (such as smart buildings) and city monitoring/city management

applications require the fusion of information acquired from multiple resources, 'Things', models, virtual objects and real objects.

This book focuses on providing approaches and software architectures for (i) facilitating interaction with building information models through Web services and (ii) enabling and facilitating the fusion of building information residing in 'Models' and information acquired from the 'Things'. The proposed architectures are presented in the form of design patterns. The patterns utilize IoT technologies, Web services and BIMs. Once this information fusion is accomplished, many fields ranging from emergency response, urban surveillance, urban monitoring to smart buildings will benefit. The book will be beneficial for researchers and developers in the fields of building information modelling, IoT and systems integration. The book consists of eight chapters. Chapters 1 and 2 focus on building information modelling. Chapter 3 provides foundational service-oriented architecture patterns (SOA) for complex information models (such as BIM); in fact, the implementation of these patterns can also be accomplished using other information models. Chapters 4 and 5 elaborate on the hardware and software sides of IoT. Chapter 6 provides advanced SOA patterns for BIMs. Chapter 7 elaborates on patterns for IoT and patterns for BIM and IoT information fusion.

This book has taken a whole year to complete, although the actual schedule was 7 months. I would like to thank my wife Zeynep Isikdag for her patience and support during the process and for many weekends during which we stayed at home, and to my parents, Dr. Ugur Isikdag and Zuhal Isikdag, for always supporting me in my academic life. I thank all academics, who supported me and from whom I have learned a lot, including my Ph.D. supervisors Jason Underwood, Ghassan Aouad, Nigel Trodd, and Sisi Zlatanova, Volker Coors, who contributed a lot during my Ph.D. Thanks also to my M.Sc. supervisors Keith Jones and Robert Falconer. Special thanks to all members of the 3D GeoInfo Community, who have always supported me, and especially to the initiator of the 3D GeoInfo Conference, Alias Abdul Rahman. Also, special thanks to the editorial board members of the International Journal of 3D Information Modeling (IJ3DIM), I learned a lot from their knowledge and experience, and also to Jack Goulding for his academic support in the construction management field. I would also like to thank Ralf Gerstner from Springer for his excellent support and patience, without whom this book could not be possible.

May 2015 Umit Isikdag

Springer

http://www.springer.com/978-3-319-21824-3

Enhanced Building Information Models
Using IoT Services and Integration Patterns

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2015, XII, 121 p. 56 illus., Softcover
ISBN: 978-3-319-21824-3