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Applications and Markets for Cooperating Objects

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Preface

The book you have in your hands focuses on the applications and markets for Cooperating Objects. Although the Cooperating Objects domain is relatively new, and shares common ground with other domains such as Internet of Things, Sensor Networks, Ubiquitous Computing, Cyber-Physical Systems and Systems of Systems, we can already clearly distinguish the key aspects of "cooperation" as being the key driver behind several application developments.

The applications depicted in this book constitute some of the examples in this promising new domain, and most of which have also been demonstrated within the Cooperating Objects Network of Excellence (CONET). CONET (www.cooperating-objects.eu) is a European project co-funded by the European Commission with the aim to identify and produce work on the main research topics in Cooperating Objects, thus shaping the academic and industrial research in the short, medium and long-terms.

The hereby included applications depict not only futuristic scenarios, but also hands-on experiences and results. To what extent these applications will pave their way to commercial products in the future is too early to tell. We try to take an overview of the market as such, that could influence the Cooperating Objects domain, or vice versa, that could be impacted by Cooperating Objects.

We hope you enjoy a more practical view under the prism of application development in the domain of Cooperating Objects, and that these example applications may spark some new ideas for future innovative approaches.

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Contents

Acronyms

AAO	Autonomous Aircraft Operations
ADS-B	Automatic Dependent Surveillance—Broadcast
ANSP	Air Navigation Server Providers
AOC	Airline Operation Center
ASAS	Airborne Separation Assurance System
ASD	Accumulated State Density
ATC	Air Traffic Control
ATCO	Air Traffic Controllers
ATM	Air Traffic Management
billion	10^9 = one billion (short scale number naming system)
CDM	Collaborative Decision Making
CNS	Communication, Navigation and Surveillance
CO	Cooperating Object
CONET	Cooperating Objects Network of Excellence
COTS	Commercial off-the-shelf
CR	Collaborative Routing
DPWS	Devices Profile for Web Services
FPGA	Field Programmable Gate Array
GPS	Global Positioning System
GUI	Graphical User Interface
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
IP	Internet Protocol
LiFo	Last in First out
MANET	Mobile Ad Hoc Network
million	10^6 = one million (short-scale number naming system)
ODMRP	On-Demand Multicast Routing Protocol
OoS	Out-of-Sequence
ORS	Open Route Service
OSM	OpenStreetMap
pdf	Probability density function
REST	REpresentational State Transfer

RGCS	Review of General Concept of Separation
RSSI	Radio Signal Strength Indication
SESAR	Single European Sky ATM Research
STMP	Sensor Data Transmission and Management Protocol
SUA	Special Use Airspace
SWIM	System Wide Information Management
TBO	Trajectory-Based Operations
TCO	Total Cost of Ownership
trillion	10^{12} = one trillion (short-scale number naming system)
UAN	Underwater Acoustic Network
WLAN	Wireless Local Area Network
WMN	Wireless Mesh Network
WS-DD	OASIS Web Services Discovery and Web Services Devices Profile
WSN	Wireless Sensor Network

Chapter 1
Introduction

1.1 Cooperating Objects Context

The core idea behind amalgamating the physical and virtual (business) world is to seamlessly gather useful information about objects of the physical world and use the information in various applications in order to provide some added value. In the last years we have witnessed a paradigm change, where the rapid advances in computational and communication capabilities of embedded systems, are paving the way towards highly sophisticated networked devices that will be able to carry out a variety of tasks not in a standalone mode as usually done today, but taking into full account dynamic and context specific information, and following dynamic collaborative approaches.

These "objects" will be able to cooperate, share information, act as part of communities and generally be active elements of a more complex system. The close interaction of the business and real world will be achieved by auxiliary services provided in a timely fashion from networked embedded devices. These will be able to collaborate not only among them but also with on-line services, that will enhance their own functionality.

As already defined [1], one can consider the that :

> "Cooperating Objects are modular systems of autonomous, heterogeneous devices pursuing a common goal by cooperation in computations and in sensing and/or actuating with the environment."

The domain of Cooperating Objects is a cross-section between (networked) embedded systems, ubiquitous computing and (wireless) sensor networks. There are, therefore, several flavours of Cooperating Objects depending on the degree in which they fulfil different features. Some of them can process the context of cooperation

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