

## COMP6324 – Internet of Things Service Design and Engineering

Created: 22 Nov 2016

Proposal Last Updated: 03 May 2017

## Offering Details:

## Key Details and Contacts

## Key Course Details

<b>Course Name (Official)</b>	Internet of Things Service Design and Engineering		
<b>Standard Name (SIMS)</b>	IoT Services Engineering		
<b>Course Code</b>	COMP6324		
<b>Units of Credit (UOC)</b>	6		
<b>Career</b>	Hybrid		
<b>Course Offerings</b>	<b>Offering Number</b>	<b>Career</b>	<b>Course Code</b>
	1	PG	COMP6324
	2	UG	COMP6324
<b>Level</b>	4		
<b>First Semester and Year the Course will be offered</b>	2018 Semester 1		
<b>Does this new course replace another existing course?</b>	No		

## Contact Details

<b>Proposal Proponent</b>	<b>Name</b>	<b>Email</b>	<b>Role</b>
	Boualem Benatallah	boualem@cse.unsw.edu.au	Professor, School of Computer Science and Engineering
<b>Proposal Author(s)</b>	<b>Name</b>	<b>Email</b>	<b>Role</b>
	Boualem Benatallah	boualem@cse.unsw.edu.au	Professor, School of Computer Science and Engineering
	Cassandra Nock	cassandra@CSE.UNSW.ED U.AU	Administration Manager, School of Computer Science and Engineering
	Fethi Rabhi	f.rabhi@unsw.edu.au	Professor, School of Computer Science and Engineering
	Hye-Young Paik	hpaik@unsw.edu.au	Senior Lecturer, School of Computer Science and Engineering
	John Shepherd	jas@cse.unsw.edu.au	Deputy Head of School (Education), School of Computer Science and Engineering
<b>Proposal Contact</b>	<b>Name</b>	<b>Email</b>	<b>Role</b>
	Boualem Benatallah	boualem@cse.unsw.edu.au	Professor, School of Computer Science and Engineering
<b>Optional Additional Endorsers</b>	<b>Name</b>	<b>Email</b>	<b>Role</b>
	Fethi Rabhi	f.rabhi@unsw.edu.au	Professor, School of Computer Science and Engineering
	John Shepherd	jas@cse.unsw.edu.au	Deputy Head of School (Education), School of Computer Science and Engineering
<b>Academic Unit responsible for course</b>	School of Computer Science and Engineering		
<b>Parent Academic Unit</b>	Faculty of Engineering		

## Proposal Concept

## Summary of Proposal

<b>Summary of Proposal</b>	<p>The course covers :</p> <ul style="list-style-type: none"> <li>• An overview of the Internet of Things (IoT) services concepts</li> <li>• IoT impacts on different application domains in both industry and government</li> <li>• A software engineering framework for IoT solutions</li> <li>• Design of software architectures for IoT solutions</li> <li>• Development of services and analytics on an existing IoT infrastructure</li> <li>• Pitching of an IoT solution to a group of senior executives in an investment committee</li> </ul> <p>Students from other disciplines are welcome to enrol in the course. This course is an additional instalment of the three-part series of the service-oriented systems engineering stream, namely COMP9321, COMP9322 and COMP9323.</p>
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<b>Justification for proposal</b>	
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<b>Justification for Proposal</b>	<p>The Internet of Things (IoT) has become the quintessential paradigm for connecting digital services to physical devices (e.g., household appliances, health- monitoring devices, ticket barriers). IoT services are poised to play a fundamental role in advancing this digital strategies and enable individuals and organisations to get the most out of digital technologies and online services. IoT solutions will play a central role for organisations to improve productivity, operational effectiveness, decision making and innovation.</p> <p>The growing importance of IoT services implies that development of IoT based solutions and initiatives a solution should be a major priority by both government and private organisations. Yet, there is an acute shortage of people, both in Australia and worldwide, with the appropriate skills to meet the current needs of the IoT services sector and the future demands placed on it by rapid change and newly emergent technologies. Even though IoT devices are multiplying, most organisations still do not have the knowledge, skills, or understanding to craft a successful strategy to take full advantage of changing markets and keep up with the proliferation of online opportunities. Meanwhile, the complexity of engineering IoT solutions is increasing dramatically as development becomes ever more distributed across multiple heterogeneous, autonomous, and evolving IoT services.</p> <p>It is this nexus of serious shortcomings, made alarming by general recognition that the task of overcoming them continues to grow and becomes more complex, that calls for new education initiatives. We propose a new course, namely engineering of IoT services. We see significant shortfalls in both the complementarity and breadth of services IoT services education. While IoT is now recognised in both research and education, exiting efforts including courses, has so far focussed on networking and programming aspects. This course focuses engineering and management aspects of IoT Services, providing complementary skills and knowledge to what is offered by existing courses. It is important to complement existing courses and initiatives with the equivalent of software engineering for IoT services.</p> <p>The primary aim of the new course is identify and disseminate critical knowledge and skills related to engineering IoT services to industry professionals, under-graduate and post- graduate students.</p>
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<b>Anticipated Enrolments</b>			
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<b>Anticipated Enrolments for next 3 years</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>
	50	80	100

<b>Attachments</b>		
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<b>Attach documentation to this proposal</b>	<b>No</b>	<b>Description</b>	<b>File(s)</b>
	.		
	1	Endorsements from Michael Crouch Innovation Centre and UNSW innocation	UNSW_IoT_Course_Endorsements.pdf
	2	Endorsements from Michael Crouch Innovation Centre and UNSW innocation	UNSW_IoT_Course_Endorsements.pdf
	3	Course_Outline_Schedule	CourseOutline - IoT-Service.pdf

<b>Learning and Teaching</b>	
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<b>Learning &amp; Teaching development and support</b>	
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<b>Are there Learning &amp; Teaching space requirements for the course beyond those that can be accommodated by CATS spaces?</b>	No
<b>Have you discussed with the Learning Centre and Learning and Teaching what language and/or academic skills development resources and/or which teaching and learning strategies might be suited to this course?</b>	No

Are many students in this course at a key transition point where their academic skills are likely to need development, e.g. from one kind of educational institution or type of program to another or into education after a significant break?

No

## Consultation

### Internal consultation

#### Internal Consultation

##### Consultants

None specified

##### Details

This course was developed in collaboration with **IoE Community Network** under the leadership of **Peter Klement**. It is part of a software as a service stream of courses at CSE. There was wide consultation with:

Academics from the Service Oriented Computing Research Group

Academics from Networked Systems and Security Research

The deputy head education, CSE, Dr. John Shepherd

The head of School, Prof. Maurice Pagnucco

The postgraduate coursework director, Dr. Eric Martin

Feedback from the IoT community

We developed this course in conjunction with Peter Klement, who is an international leader in the field of IoT and adjunct senior lecturer at CSE. Peter started an IoT community in 2015 in Sydney, called the IoE Community Sydney. The term IoE (IoE = Internet of Everything) was chosen, as an end to end IoT solution does not only consist of the Things, but also require data, people and processes. From the local Sydney community, Peter grew the IoE Community Network to a global network of IoT communities that work together to educate people around the benefits and risk of IoT and also drive IoT adoption in relevant industries. The IoE Community Network is a volunteer organisation with around 10,000 members in **10 locations** on **5 continents** and is rapidly growing. Major organisations like SAP, KPMG, CBA, Microsoft, Cisco, CSIRO/Data61 and others are supporting the local communities.

Peter is currently leading the global community network. He is working closely with the Industrial Internet Consortium (IIC) to make sure the latest IIC content can be used as basis for the course material and is also an active member of the IoT Alliance Australia with a focus on industry engagement and IoT start-ups. The IoT course is a global community project involving around 20 community members from institutions like MIT in Cambridge, USA and the Fraunhofer Institute in Karlsruhe, Germany. This is an important initiative by the SOC group in CSE and I am delighted to be involved. It will provide an important educational opportunity to develop experts to work in this rapidly growing area of IoT.

Feedback from Dr Wen Hu in the Networks group:

*The course I taught last semester is available*

*<https://webcms3.cse.unsw.edu.au/COMP6733/16s2/>. It focuses on how to program and connect embedded IoT devices to the Internet to enable interesting applications and I can see that the course offered by your group will be complementary to the comp6733 as it focuses on cloud/service side."*

We also have endorsements from **MCIC (Michael Crouch Innovation Centre, UNSW)** and **UNSW innovation** (ref, attached PDF file, UNSW\_IoT\_course\_endorsements.pdf)

##### Attachments

UNSW\_IoT\_Course\_Endorsements.pdf

### External consultation

<b>External Consultation</b>	<b>Consultants</b>	None specified
	<b>Details</b>	<p>Prof. Fabio Casati (University of Trento, Italy) provided input to the revised curriculum based on his expertise and experience in teaching similar courses.</p> <p>As mentioned above:</p> <p><i>'We developed this course in conjunction with Peter Klement, who is an international leader in the field of IoT and adjunct senior lecturer at CSE. Peter started an IoT community in 2015 in Sydney, called the IoE Community. The term IoE (IoE = Internet of Everything) was chosen, as an end to end IoT solution does not only consist of the "Things", but also require data, people and processes. The IoE Community is a global network of IoT communities that work together to educate people around the benefits and risk of IoT and also drive IoT adoption in relevant industries. The IoE Community Network is a volunteer organisation with around 10,000 members in 8 locations on 4 continents and is rapidly growing. Major organisations like SAP, KPMG, CBA, Microsoft, Cisco, CSIRO/Data61 and others are supporting the local communities. Peter is currently leading the global community network. He is working closely with the Industrial Internet Consortium (IIC) to make sure the latest IIC content can be used as basis for the course material and is also an active member of the IoT Alliance Australia with a focus on industry engagement and IoT start-ups.</i></p> <p><i>The IoT course is a global community project involving around 20 community members from institutions like MIT in Cambridge, USA and the Fraunhofer Institute in Karlsruhe, Germany. This is an important initiative by the SOC group in CSE and I am delighted to be involved. It will provide an important educational opportunity to develop experts to work in this rapidly growing area of IoT.'</i></p>
	<b>Attachments</b>	None specified
<b>Interested Parties</b>	Not specified	

## Related Proposals

Related Proposals	Code	Proposal Name	Type	Date	Status
	COMP6733	Internet of Things Experimental Design Studio	New Course (HY)	Jun 2015	Approved
	COMP9321	Data Services Programming	Course Revision (HY)	Apr 2017	Submitted
	COMP9322	Software Service Design and Engineering	Course Revision (HY)	Apr 2017	Submitted

## Endorsements and Comments

<b>Endorsement history</b>	No endorsements have been recorded for this proposal (yet).
<b>Comments</b>	No comments posted

Administration:

**Key Course Details**

**Key Admin Details**

Course Name (Official)	Internet of Things Service Design and Engineering
Student System ID	N/A
Can course be taken as General Education elective?	No
Field of Education	020199 – Computer Science not elsewhere classified

**Course Review**

Next course review date	January 01, 2019
Provide details of any particular factors that need to be considered at that review.	A Student System ID will be generated once this course has been published to SiMs.

**Delivery and Attendance**

Campus administering the Course: Sydney

Teaching Shares by School/Faculty	<b>School</b>	<b>Teaching Share (%)</b>
	School of Computer Science and Engineering	100
	<b>Total Share</b>	<b>100</b>

Semesters the course is offered		<b>Summer Semester</b>	<b>Semester 1</b>	<b>Semester 2</b>
	2016	No	No	No
	2017	No	Yes	No
	2018	No	Yes	No
	2019	No	Yes	No
	2020	No	Yes	No

Teaching mode and contact hours: Standard Offering Mode

Standard offering contact hours per week	<b>Learning Activity</b>	<b>Hours/Week</b>
	Lecture	2
	Tutorial/Laboratory	0
	Tutorial	0
	Laboratory	3
	Web-based Online Learning Activity	0
	Clinical/Fieldwork	0
	Distance Learning	0
	Seminar	0
	Studio	0
	Meeting/Consultation	0
<b>Total Hours per week</b>	<b>5</b>	

Primary delivery mode: Classroom

Secondary delivery modes: Online

Additional information about the delivery modes for this course: This course will mainly be delivered through a mix of face-to-face lectures, online videos, self-guided online lab activities and online forum (Q/A).

**Staff**

**Staff associated with course**

Course Convenor	<b>Name</b>	<b>Email</b>	<b>Role</b>
	Boualem Benatallah	boualem@cse.unsw.edu.au	Professor, School of Computer Science and Engineering

Administrative Contact	Name	Email	Role
	Hye-Young Paik	hpaik@unsw.edu.au	Senior Lecturer, School of Computer Science and Engineering

## Supplementary Information:

### Resources

#### Student Resources

<b>Prescribed Resources</b>	<b>1.</b>	<b>Lecture notes</b>	<b>Other</b>
	<b>Resource Type</b>	Lecture notes	
	<b>Additional Details</b>	Lecture notes are provided for each topic (weekly)	
	<b>2.</b>	<b>Project activity notes</b>	<b>Other</b>
	<b>Resource Type</b>	Notes	
	<b>Additional Details</b>	Project notes for the practical weekly activities	
	<b>3.</b>	<b>A Course Homepage</b>	<b>Other</b>
	<b>Resource Type</b>	Web site	
	<b>Additional Details</b>	A Web site will be maintained	
<b>Recommended Resources</b>	None specified		

### Experience and Assumed Knowledge

#### Industrial Experience Component

<b>Industrial Experience Component</b>	Not specified
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#### Assumed Knowledge

<b>Assumed Knowledge</b>	Students will need an understanding of basic Web and network architecture.
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Academic Structure:

**Academic Structure**

**Prerequisites**

<b>Prerequisite courses</b>	Not specified
<b>Prerequisite programs</b>	Not specified
<b>Prerequisite streams</b>	Not specified
<b>Prerequisite conditions</b>	For Undergrad: COMP1531, COMP2041. For Postgrad: COMP9021, COMP9311

**Exclusions**

<b>Excluded Courses</b>	Not specified
<b>Excluded Programs</b>	Not specified
<b>Excluded Streams</b>	Not specified

**Equivalent**

<b>Equivalent courses</b>	Not specified
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**Assessment**

**Assessment**

<b>Grading Basis</b>	Standard UNSW grades (e.g. HD, DN, CR, PS, FL)
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Assessment items and their relationship to Course Learning Outcomes	Assessment Title	Assessment Type	Weight (%)
	1 project activities	Assignment	60%
	Assessment Description:	Requirement, design, implementation assignments tacking different phases of developing IoT solutions. This will assess the student's ability to apply the learned theory and concepts of IoT service Engineering services. The assignments will be marked against a clearly specified marking criteria.	
	2 quizzes	Test	20%
	Assessment Description:	<ul style="list-style-type: none"> <li>• Understand IoT concepts, techniques, platforms</li> <li>• Describe IoT business strategy, business requirements, and architectures</li> <li>• Identify and apply design and implementation patterns</li> </ul>	
3 Project meetings participation	Attendance	10%	
Assessment Description:	Student participation in group / mentor meetings to work on understanding project activity requirements and discuss solutions		
4 Project Sprint Log	Portfolio	10%	
Assessment Description:	<ul style="list-style-type: none"> <li>• individual journal on contributions to planning, feedback, idea generation, etc.</li> </ul>		
<b>Total Weight</b>			<b>100%</b>
<b>project activities</b>			
<ul style="list-style-type: none"> <li>• Development of services and analytics on an existing IoT infrastructure. Pitching of an IoT solution to a group of senior executives in an investment committee.</li> <li>• Design of software architectures for IoT solutions, and apply the software engineering framework for IoT solutions. Development of services and analytics on an existing IoT infrastructure. Pitching of an IoT solution to a group of senior executives in an investment committee.</li> </ul>			
<b>quizzes</b>			
<ul style="list-style-type: none"> <li>• Understand the important Internet of Things (IoT) services concepts, and the overall impact of IoT on different application domains in both industry and government.</li> </ul>			
<b>Project meetings participation</b>			
<ul style="list-style-type: none"> <li>• Design of software architectures for IoT solutions, and apply the software engineering framework for IoT solutions. Development of services and analytics on an existing IoT infrastructure. Pitching of an IoT solution to a group of senior executives in an investment committee.</li> <li>• Development of services and analytics on an existing IoT infrastructure. Pitching of an IoT solution to a group of senior executives in an investment committee.</li> </ul>			
<b>Project Sprint Log</b>			
<ul style="list-style-type: none"> <li>• Development of services and analytics on an existing IoT infrastructure. Pitching of an IoT solution to a group of senior executives in an investment committee.</li> <li>• Design of software architectures for IoT solutions, and apply the software engineering framework for IoT solutions. Development of services and analytics on an existing IoT infrastructure. Pitching of an IoT solution to a group of senior executives in an investment committee.</li> </ul>			

## Curriculum Mapping

### Course Learning Outcomes

Specify the learning outcomes that students should achieve upon successful completion of this course	
1	Understand the important Internet of Things (IoT) services concepts, and the overall impact of IoT on different application domains in both industry and government.
2	Design of software architectures for IoT solutions, and apply the software engineering framework for IoT solutions. Development of services and analytics on an existing IoT infrastructure. Pitching of an IoT solution to a group of senior executives in an investment committee.
3	Development of services and analytics on an existing IoT infrastructure. Pitching of an IoT solution to a group of senior executives in an investment committee.

### Teaching strategies and Rationale

Teaching Strategies and Rationale	
	The course is designed to encourage the students to learn by doing. We provide timely feedback for learning via small, step-by-step weekly practical project activities and tests that gradually build up knowledge and practical skills. Through face-to-face lectures and online videos, we introduce concepts and theory with practical examples. In project mentoring meetings, we discuss problems and solutions using an agile software engineering methodology.

## Course Aims

### Course Aims

The primary aim will be to identify and disseminate critical knowledge and skills related to engineering IoT services to industry professionals. This course will examine the concepts and economy surrounding IoT, with a knowledge about the business benefits versus technology risks of IoT.

The engineering process for IoT will involve understanding the IoT Strategy. Accordingly, students will learn about the IoT Business Innovation Framework and Opportunity Management. Armed with this knowledge, students will be encouraged to administer critical thinking and work in teams on practical projects in order to strengthen expertise in both architecting as well as implementing an IoT solution. Moreover, students will be given the opportunity to pitch potential IoT solution to a group of senior executives in an investment committee.

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## Publications and Marketing:

### Publications

#### Course Description

**Description of course that can be used in online publications (e.g. Handbook website, Faculty websites or other online catalogue systems)**

This course aims to introduce the students to core concepts and practical skills for designing and engineering IoT services and applications. Specifically, the course aims to expose students to IoT business strategy, requirements, solution design and implementation.

#### Key Search Terms

**List key search terms that might be used to search for this course (e.g. via the Handbook or Google searches).**

Internet of Things  
IoT  
IoT solutions  
IoT design  
IoT implementation  
IoT engineering  
IoT applications  
Internet of Everything