Institiúid Teicneolaíochta Chorcaí
Cork Institute of Technology

Physical Layer

Module Details

Short Title:	Physical Layer DRAFT
Full Title:	Introduction to Physical Layer
Module Id:	4636

Official Code:		**NFQ Level:**	9	**ECTS Credits:**	5

Coordinator:	JOHN BARRETT

Description:	Physical Layer has the objective of introducing learners from diverse backgrounds to the hardware building blocks of a wireless sensor node and how they work together with embedded software to make a node that can function in a wireless sensor network. Overall aim: Understanding of the design, construction and application of a wireless sensor node through "reverse engineering" of pre-designed nodes and hands-on practice with a functioning wireless sensor node. The physical layer is the hardware of an embedded system and the base layer on which a network of embedded systems is built. By examining the design, building, programming and testing of an embedded sensor node, this module will examine, at a systems integration and test level: - the reduction of application-level specifications to a set of physical layer specifications - sensors and sensor interfacing - selection and use of microcontrollers - selection and use of wired/wireless transceivers and antennas - communication between node and network/PC - node testing - issues of power supply, packaging/interconnection and reliability - the interdependencies and the interaction of the physical layer with the higher levels of a network

Learning Outcomes:

On successful completion of this module the learner will be able to…

1. Explain how knowledge, techniques and components from sensors, microcontrollers, embedded software and wired/wireless transceivers, along with specifications of power supply, packaging/interconnection and reliability, influence the design, cost and deployment of a wireless sensor node are integrated to develop a sensor node
2. Explain how the mutually influential interactions between the physical layer and the rest of the sensor network iterate to a final sensor node physical design
3. Analyse a set of application-level specifications for a wireless sensor node for specific needs in engineering and non-engineering applications and reduce them to a set of engineering specifications for the physical layer
4. Develop a block-level model for a wireless sensor node

Pre-requisite learning

Module Recommendations
This is prior learning (or a practical skill) that is strongly recommended before enrolment in this module. You may enrol in this module if you have not acquired the recommended learning but you will have considerable difficulty in passing (i.e. achieving the learning outcomes of) the module. While the prior learning is expressed as named CIT module(s) it also allows for learning (in another module or modules) which is equivalent to the learning specified in the named module(s).

No recommendations listed

Incompatible Modules
These are modules which have learning outcomes that are too similar to the learning outcomes of this module. You may not earn additional credit for the same learning and therefore you may not enrol in this module if you have successfully completed any modules in the incompatible list.

No incompatible modules listed

Module Requirements
This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed. You may not enrol on this module if you have not acquired the learning specified in this section.

No requirements listed

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Module Content & Assessment

Indicative Content

- **Specifying the Physical Layer**
  a. The function and building blocks of the physical layer. b. Interdependencies and the interaction of the physical layer with the higher levels of a network. c. Extracting specifications for the physical layer from a set of application-level specifications.
- **Systems integration**
  a. Packaging, assembly, power supply and reliability of wireless sensor nodes; b.Selection of components, packaging/interconnection methods and power sources.
- **Sensors and sensor interfacing to microcontrollers**
  a. Discrete and integrated sensors, microsystems/MEMS sensors, power consumption, sensor packaging. b. Amplification and data conversion, noise, ICs for sensor signal conditioning. c. Microcontroller analog and digital data inputs, data sampling and storage. d. Microcontroller programming (overview), power consumption. e. Block level models for wireless sensor nodes
- **Interfacing of microcontrollers to transceivers**
  a. Wired transceivers and communications protocols. b. Wireless transceivers and antennas. c. Wireless transmission and wireless propagation.
- **Power consumption, security and reliability of the physical layer**
  a. Estimation of power consumption and battery life b. the importance of and approaches to low power design in wireless nodes c. fundamentals of hardware reliability. d. the role of the physical layer in network security

Assessment Breakdown	**%**
Course Work	100%
End of Semester Formal Examination	0%

Coursework Breakdown

Type	*Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Written Report	Hardware review of wireless sensor nodes from literature	1,2,3	30	Week 6
Project	Analysis, modelling and test of a pre-defined wireless sensor node	1,2,3,4	50	Sem End
Written Report	Project report	1,2,3,4	20	Sem End

The institute reserves the right to alter the nature and timings of assessment

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Module Workload & Resources

Workload	**Full-time mode**			
Type	*Description*	*Hours*	*Frequency*	*Average Weekly Learner Workload*
Lecture	Formal lectures on wireless sensor nodes	2	Every Week	2.00
Lab	Assembly and testing of a wireless sensor node using pre-defined building blocks	2	Every Second Week	1.00
Independent & Directed Learning (Non-contact)	Literature research and preparation of reports and presentation	4	Every Week	4.00
			Total Weekly Learner Workload	7.00
			Total Weekly Contact Hours	3.00

Workload	**Part-time mode**			
Type	*Description*	*Hours*	*Frequency*	*Average Weekly Learner Workload*
Lecture	Formal lectures on wireless sensor nodes	2	Every Week	2.00
Lab	Assembly and testing of a wireless sensor node using pre-defined building blocks	2	Every Second Week	1.00
Independent & Directed Learning (Non-contact)	Literature research and preparation of reports and presentation	4	Every Week	4.00
			Total Weekly Learner Workload	7.00

Resources

Recommended Book Resources

- **Kieran Delaney 2008, *Augmented Materials and Smart Objects: Building Ambient Intelligence Through Microsystems Technology*, Springer [ISBN: 0387462635, 9780387462639]**

Recommended Article/Paper Resources

- **Selected relevant papers from the recent and most relevant literature will be made available*n/a***