

Energy & Environmental Informatics (E&EI)
Lecture 7 : E&EI Technologies

NGT : BSc.(CS&IT)

CT108

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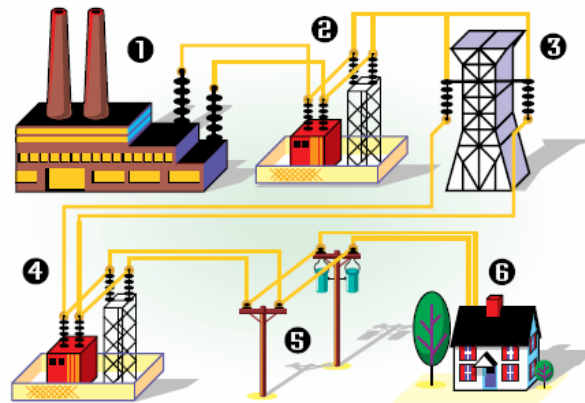
Technologies

- SCADA/SmartGrid
- Modelling
- Sensor Networks & Applications
- GIS

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Traditional Grid (src: Mick Mackey ESBI)



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Traditional Grid

- One directional & predictable power flows
- Generator → HV → MV → LV → Consumer
- SCADA
 - Limited need for data communications

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Smart Grid : Definition ?

- Visionary → Revolutionary
 - Complete Infrastructural Overhaul
- Engineer → Evolutionary
 - By necessity
 - Continuity, Robustness, Safety Critical concerns

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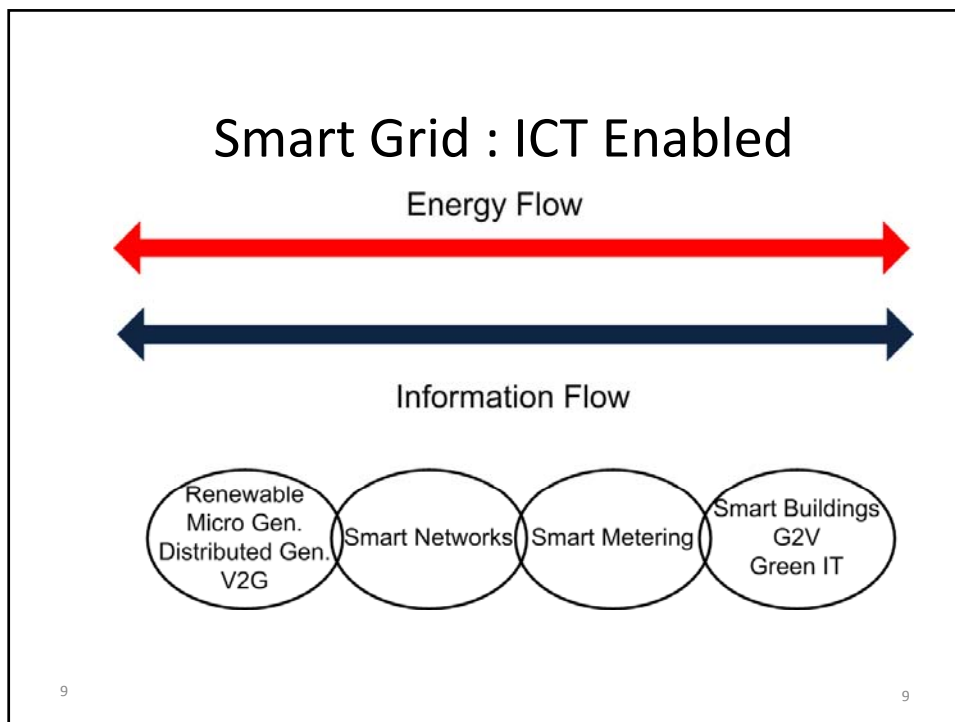
Smart Grid : Context

- Over-reliance on fossil fuel sourced energy
- Diminishing fossil fuel reserves
 - Focus on renewables
- Security of supply
- Deregulation
- Environmental Concerns

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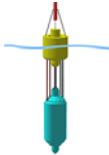
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Generation

- Renewable
 - Predictable ?
- CHP
- Microgeneration
- V2G
- ➔ Distributed generation
- ➔ New grid design & operation required
 - Grid Infrastructure Investment

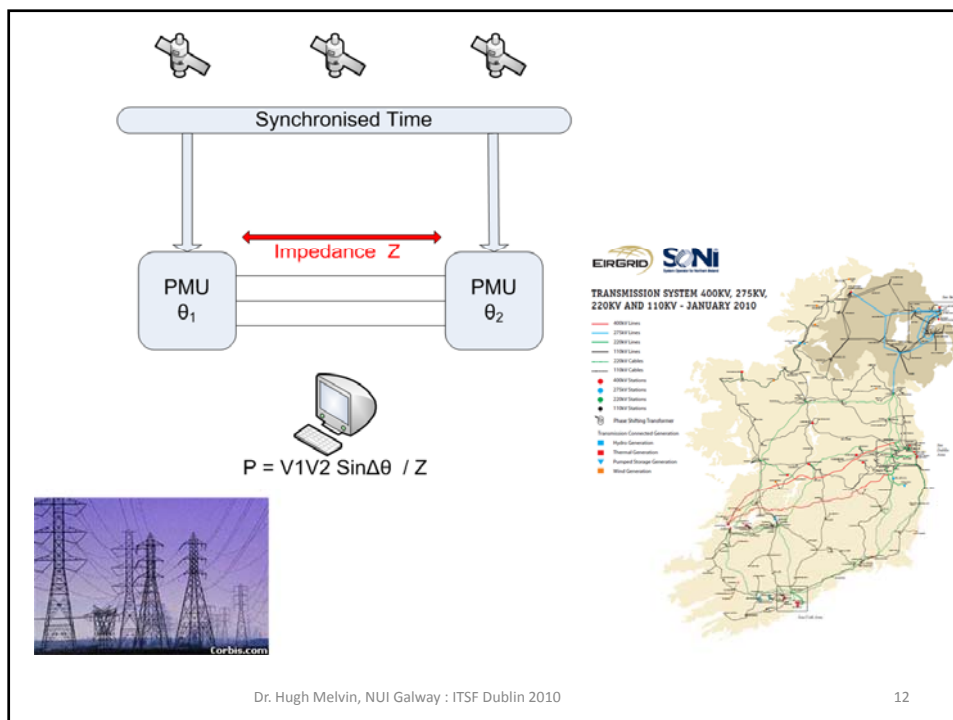



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Smart Networks

- Radically different generation landscape
- Much more dynamic
- Need for precise realtime measurement, control & protection
- Hierarchical SCADA systems
- Phasor Measurement Units

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Smart Metering



- *You cannot control what you don't **understand***
- Realtime energy demand profile
- Realtime pricing
- Realtime incentives

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Smart Buildings

- *You cannot **control** what you don't understand*
- Energy Management Systems
- Building Management Systems
- Demand Side Management
- Sensor networks

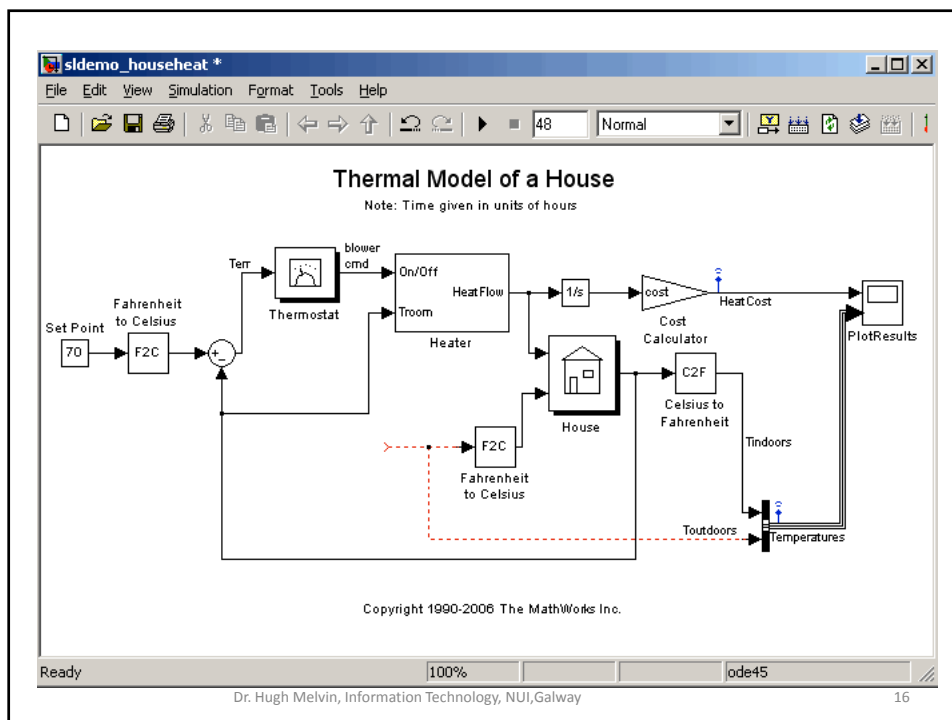
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Modelling

- Critical role in both energy & environmental informatics
- Why model a system?
 - Allows you abstract unnecessary complexity
 - Assists in contingency planning / what-if scenarios
 - Can simulate extraordinary real life events to test physical system
 - 800 year flood
 - Results in better decision making
- Warning : Rubbish in → Rubbish out !
- Systems Theory covered in 4th year BSc(CS&IT)
 - Related topic

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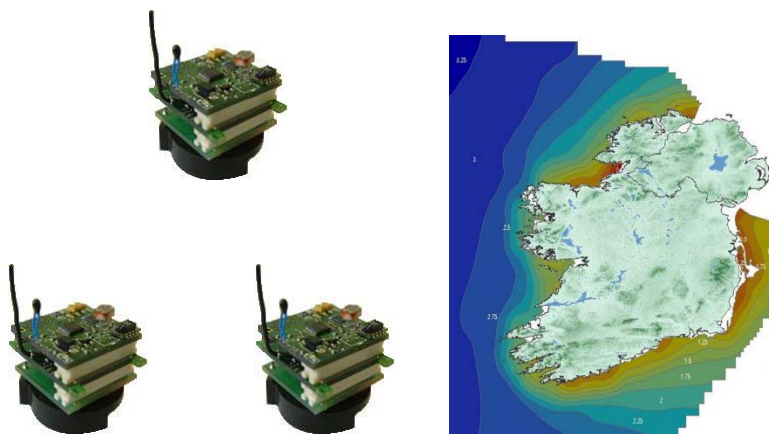
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Sensor Networks & Applications

- Features
 - Low power consumption
 - Low data rate
 - Long battery life
 - → Useful for environmental monitoring
 - Based on IEEE 802.15.4 MAC layer protocol

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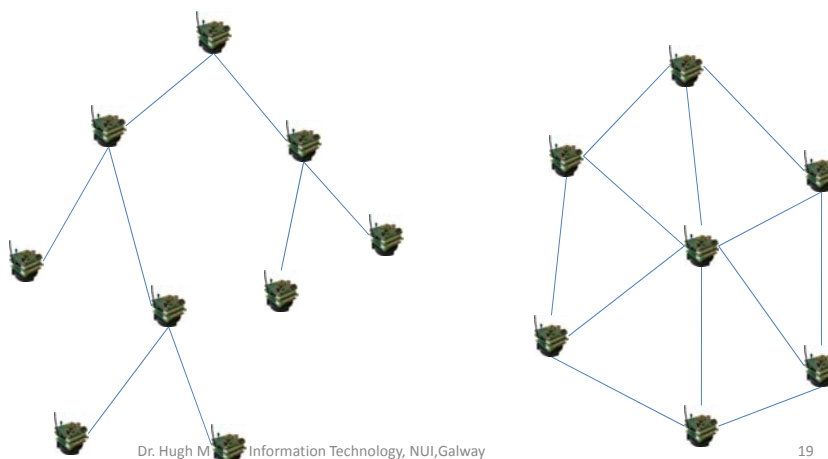
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Sensor Networks Architecture



GIS

- Geographic Information Systems
- Broad term for system that ..
 - Stores, analyses, abstracts, summarises **geographic** data
- Merging of cartography and database technology
- Widely used for..
 - Scientific studies
 - Where is best location for a wind farm?
 - Where will natural gas most likely be found?
 - Environmental Impact Assessment
 - What impact will a tidal farm have on an estuary?
 - Logistics & Navigation
 - How to get products from A to B
 - Marketing
 - Where is best location to advertise a product?

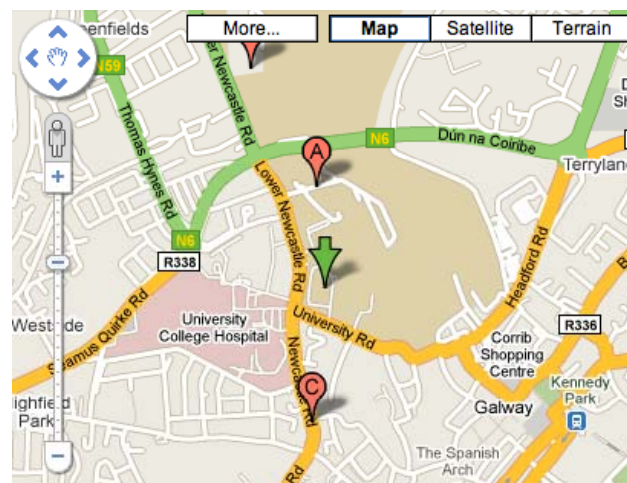
GIS

- Different data types related through position can be stored, integrated and queried to assist in decision making .. Eg.
 - Physical location
 - longitude, latitude, elevation
 - Rock formation & Soil Type, drainage potential
 - Rainfall characteristics
 - Wind characteristics
 - Road access
 - → All used to identify optimum area for certain crop cultivation

- Increasingly an Internet-based technology
 - Accessed via a browser
 - Eg. Google maps
 - Satellite images → Raster data
 - Maps → Vector data

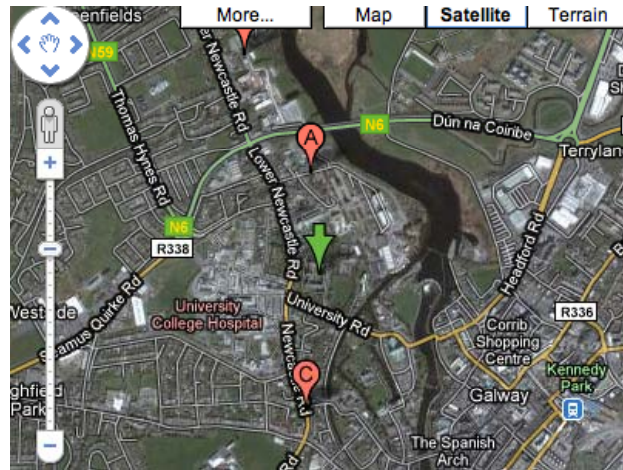
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Summary

- Information & Communication Technologies (ICT) are foundation blocks for E & EI
- BSc(CS&IT) provides core ICT skills
 - Database & Information Management, Programming, Networks, Distributed Systems, Web Technologies, AI, Realtime Systems
- SCADA/ Modelling / GIS / Sensor Networks & Applications are technologies with significant relevance to E&EI
- SmartGrid : combination of diff technologies

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