

# WIRELESS RF COMMUNICATION IN THE NEXT GENERATION OF MEDICAL DEVICES

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# OVERVIEW

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- Background
- Medical device development in Bioengineering Unit
- Implantable devices - Cardiovascular
- Applications and Requirements for SpeckNet



# BACKGROUND

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- Advances in healthcare = increasingly aging population
- Financial constraints
- Role of NHS is changing
- Prevention and early diagnosis
- Monitoring and management of chronic conditions
- High patient expectations
  - Rapid diagnosis and treatment
  - Minimally invasive surgery

# IMPLICATIONS FOR MEDICAL DEVICE DEVELOPMENT

- Diagnostic devices
  - Reduce impact on patient
  - Miniaturisation
  - Implantable
  - Non-invasive
  - Long term monitoring
- Patient measurements
  - Physical parameters
    - Pressure, flow, temperature, pH
  - Biosensors
    - Glucose, cholesterol
  - Device/tissue interface
    - Foreign object in body
    - Tissue reaction – Inflammation, infection



Glucowatch Automatic Glucose Biographer  
[www.glucowatch.com](http://www.glucowatch.com)



Medtronic Reveal Implantable Heart Monitor  
[www.medtronic.com](http://www.medtronic.com)



Given Imaging PillCam Capsule Endoscopy  
[www.givenimaging.com](http://www.givenimaging.com)

# MEDICAL DEVICES IN BIOENGINEERING UNIT

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- Glucose monitoring
  - Diabetic patients
  - Non-invasive, external device
  - Applied current
  - Quantifies blood glucose
  - Indicates action
- Cardiac markers biosensor
  - In hospital diagnosis
  - Measures analytes in blood
  - Heart attacks
  - Degree of cardiac injury
- Wound dressing monitor
  - Bandage that monitors hydration of wound
  - Important to wound healing
- Applications of SpeckNet
  - Specks in devices
  - Transmit data from patient to computer/mobile phone/doctor/hospital central monitoring network
  - Short transmission distances between Specks
    - Reduce interference with other hospital equipment?

# IMPLANTABLE MEDICAL DEVICES

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- Implantable sensors
  - Cardiovascular system
    - Implanted in blood vessels
  - Flow – detect blockages
  - Pressure – blood pressure
  - Inflammation – adverse tissue reaction
- Application of SpeckNet
  - Device makes measurements inside patient's body
  - Specks connected to implanted devices
  - Transmit data from inside the body to Specks on skin, or in external devices
- Low voltage, low current sensor in laboratory testing
  - Monitors device/tissue interaction
  - STENT – cardiovascular device for treating coronary artery disease
- SpeckNet will allow sensor to make jump from lab into people

# REQUIREMENTS

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- Periodic interrogation
  - Low bit rate
- Ultra low power
  - Battery requirement?
- Frequency band width
  - Low frequency measurements
  - Modulation?
- Medical implant communication service (MICS) regulations
  - Power < 25 $\mu$ W
  - Authorized bandwidth 402 – 405 MHz
- Challenges
  - Miniaturisation
  - Transmission through tissue
  - Biocompatibility
  - Degradation of Specks over lifetime
  - Started to address these issues in collaboration with EEE at Strathclyde

# CONCLUSIONS

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- Next generation medical devices developed by interdisciplinary research
  - Clinicians
  - Scientists
  - Engineers
- Future devices
  - Implantable sensors for monitoring chronic conditions
  - Combine sensors with existing devices
    - Monitor device status
  - Non-invasive monitoring
    - Wireless hospital
- Wireless communication is critical
  - Collaboration with EEE at Strathclyde
  - Involvement with SpeckNet

# ACKNOWLEDGMENTS

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