ADAPTIVE TRANSMISSION & DYNAMIC ROUTING IN WIRELESS NETWORKS

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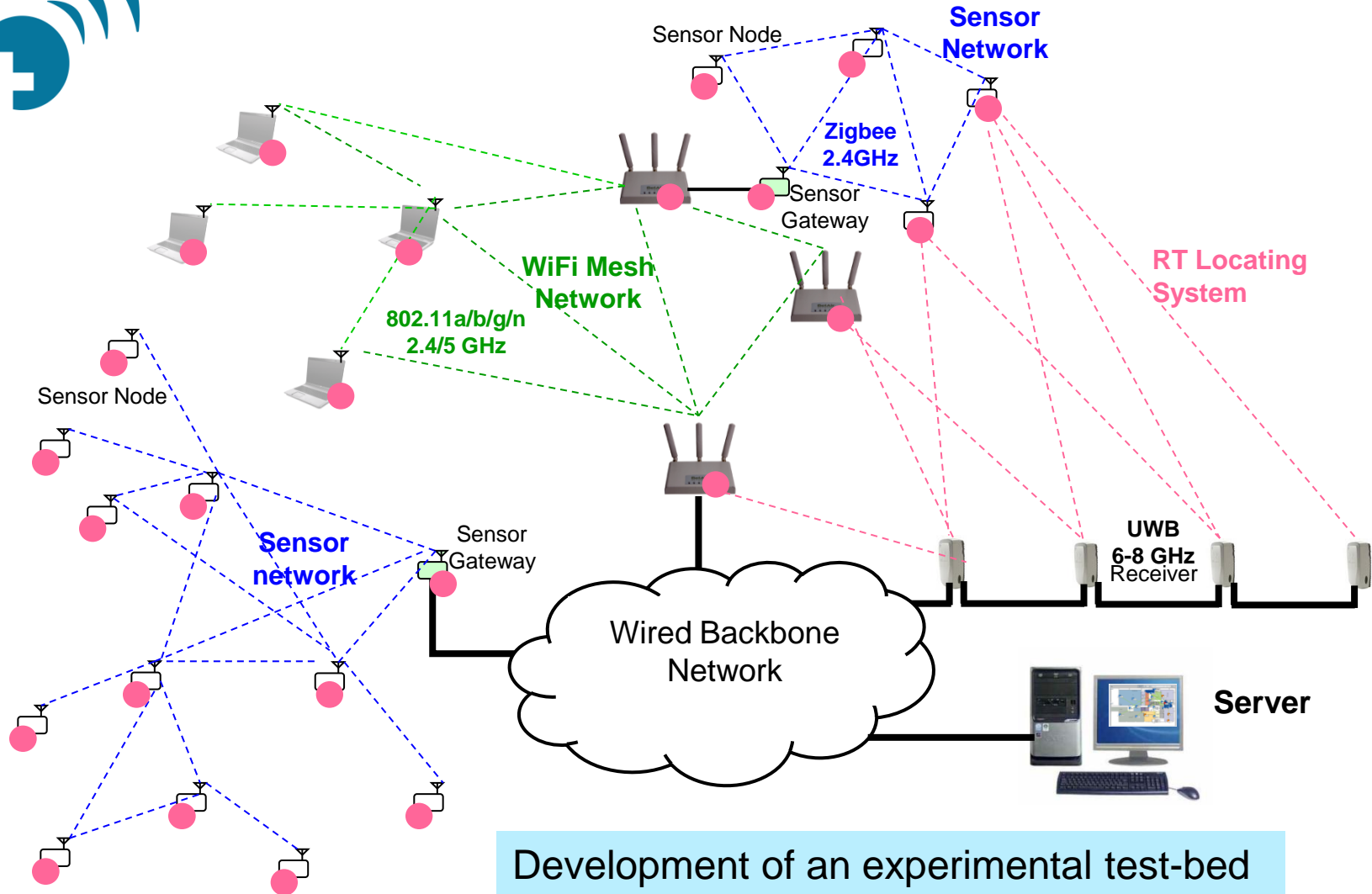**Department of Electrical & Computer Engineering**

McGill

objectives

- studies and development of adaptive transmission and dynamic routing for wireless and sensor/ad-hoc networks in clinical environments:

  - robust and reliable communications,

  - power/energy efficient,

  - *low electromagnetic radiation*

- exploring

  - spatial multiplexing, multi-user diversity, cooperative relaying applicable to wireless and sensor/ad-hoc networks

  - relevant side information: location, contexts.

- This research work is for Task 3.1.3: *Sensors and Ad-hoc Networking*, and Task 3.2.1: *Multiple-antenna Wireless Communications* of Theme 3: *Enabling Networks and Technologies*

Heterogeneous Networks

Sensor Node

Sensor Network

Zigbee 2.4GHz

Sensor Gateway

WiFi Mesh Network

RT Locating System

802.11a/b/g/n 2.4/5 GHz

Sensor Node

Sensor network

Sensor Gateway

UWB 6-8 GHz Receiver

Wired Backbone Network

Server

Development of an experimental test-bed consisting of integrated, heterogeneous networks: xDSL, 802.11 (mesh), 802.15, RTLS.
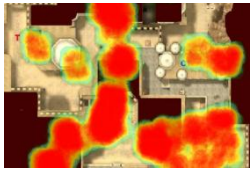
Real-time Locating System for Healthcare Applications

Collaborator: Dr. Marc Beique, MUHC, RVH

Workflow Analysis and Organizational Setup Improvement

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Visual statistical results

Movement heat map

Statisticcal data
- Movement pattern
- Site visit statistics
- Total walking distance

Map

Internet + VPN

(I,x,y,z)

Server

GUIs

API

(I,x,y,z)

online

RTLS Data Proc.

RTLS Data Capture

offline

Database

Patient wandering alert system: provide patient tracking and alerting for those cognitively-impaired patients who have an AWOL potential.
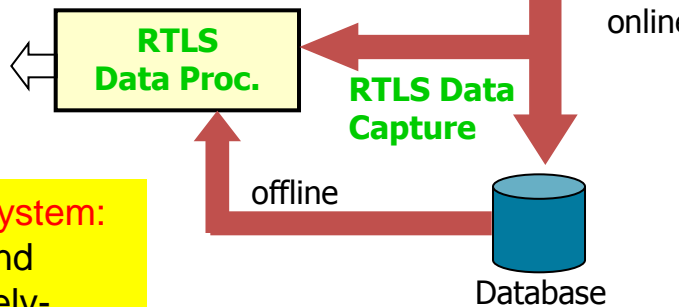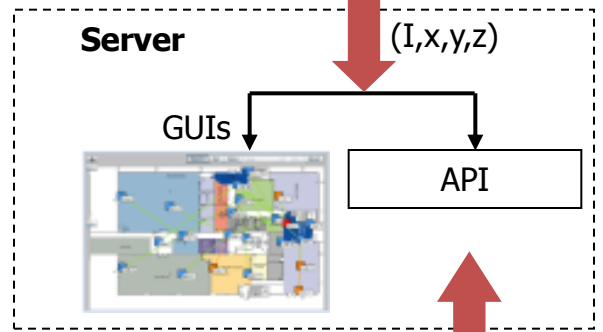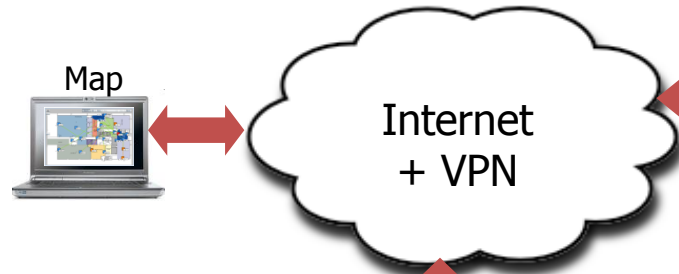
Collaborator: Dr. Allen Huang, MUHC, RVH
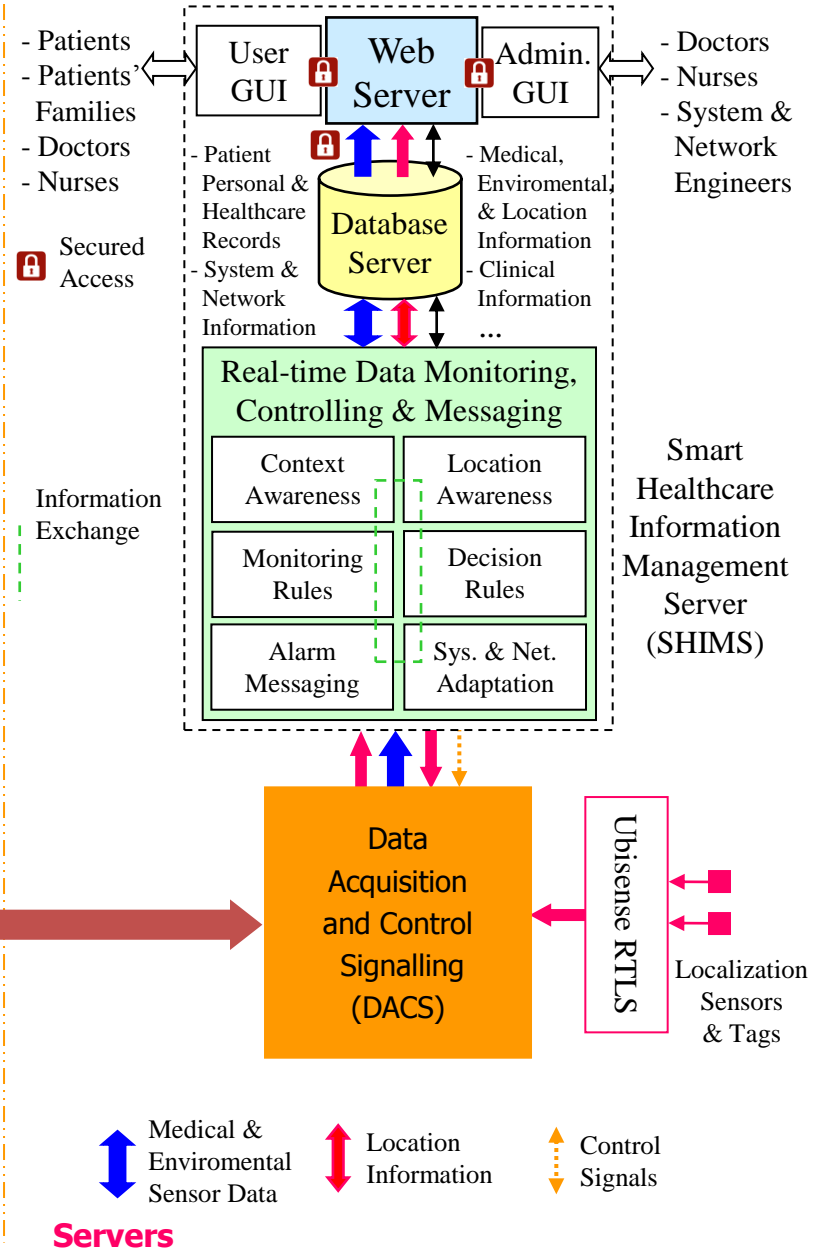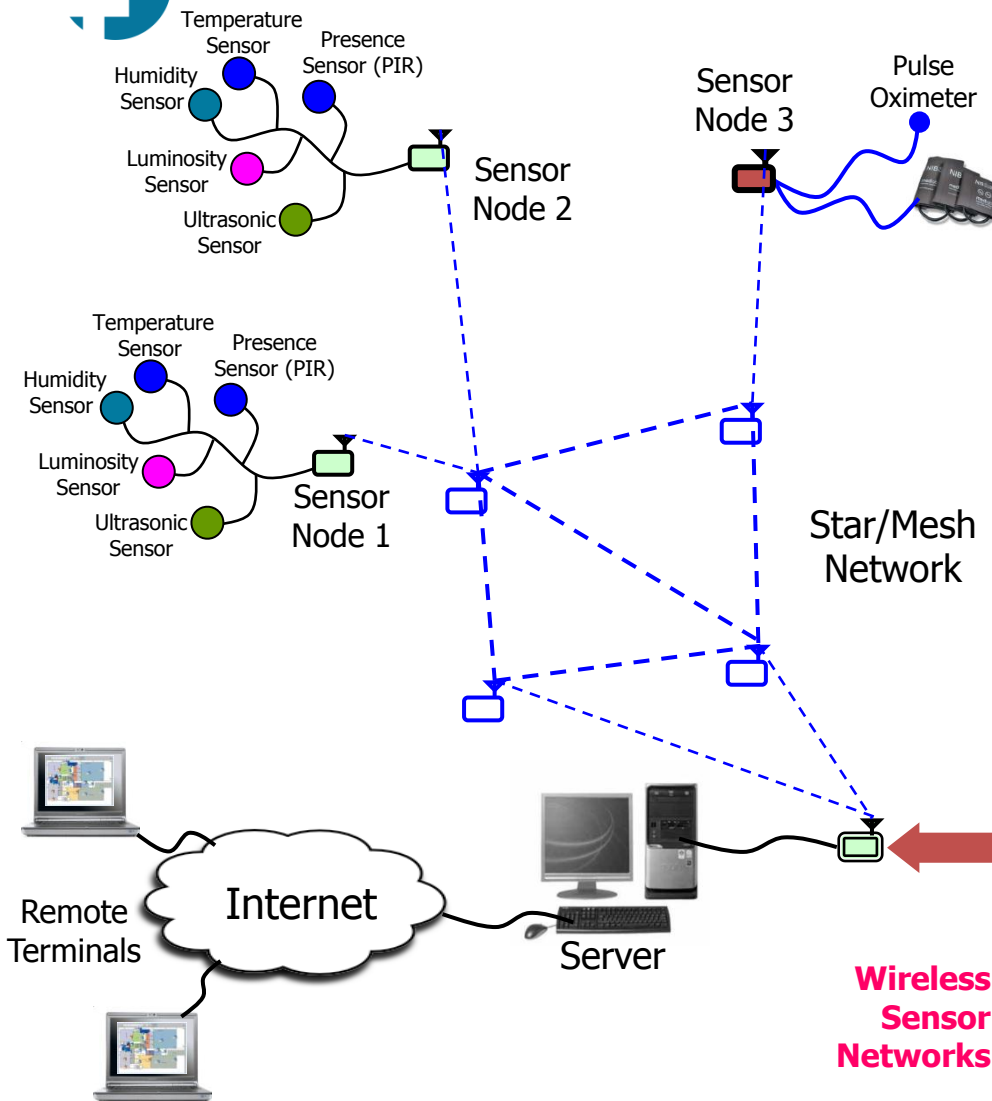
Personal Tag

UWB RTLS
2.4GHz
6.0GHz

Medical staff

Receivers

Equipment Tag

Device
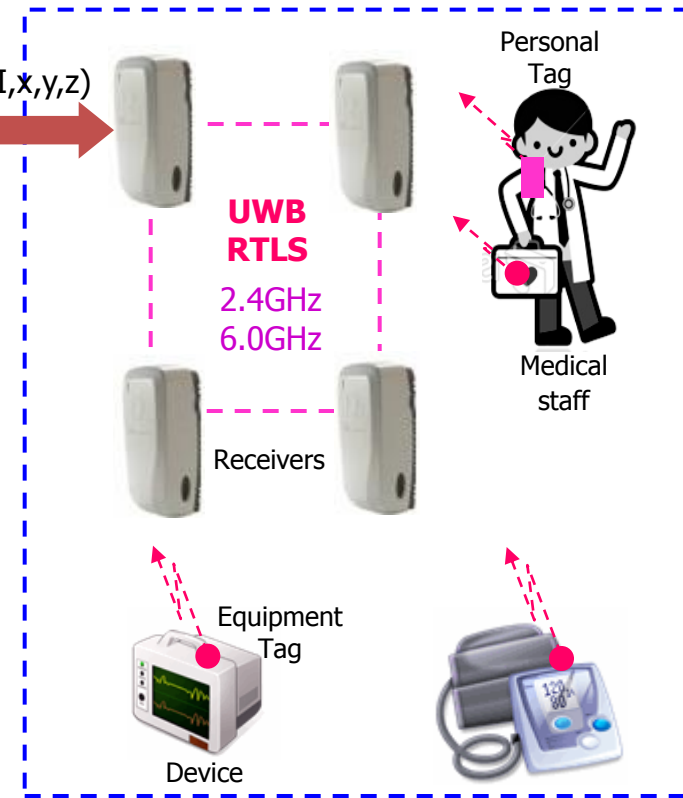
Studies, development, implementation and evaluation of post-processing algorithms to improve the accuracy of real-time locating systems.

Wireless Sensor Network for Healthcare

Temperature Sensor
Humidity Sensor
Presence Sensor (PIR)
Luminosity Sensor
Ultrasonic Sensor
Sensor Node 2

Sensor Node 3
Pulse Oximeter

Temperature Sensor
Humidity Sensor
Presence Sensor (PIR)
Luminosity Sensor
Ultrasonic Sensor
Sensor Node 1

Star/Mesh Network

Remote Terminals
Internet
Server

Wireless Sensor Networks

- Patients
- Patients' Families
- Doctors
- Nurses

User GUI
Web Server
Admin. GUI

- Doctors
- Nurses
- System & Network Engineers

- Patient Personal & Healthcare Records
- System & Network Information

- Medical, Enviromental & Location Information
- Clinical Information
- ...

Database Server

Secured Access

Information Exchange

Real-time Data Monitoring, Controlling & Messaging

Context Awareness	Location Awareness
Monitoring Rules	Decision Rules
Alarm Messaging	Sys. & Net. Adaptation

Smart Healthcare Information Management Server (SHIMS)

Data Acquisition and Control Signalling (DACS)

Ubisense RTLS

Localization Sensors & Tags

Medical & Enviromental Sensor Data
Location Information
Control Signals

Servers

EMI-aware Routing Algorithm (EMIR)

- Distributed routing framework for scalability.
- Every network node is assigned with a potential value that represents its EMI and its proximity to gateways
- EMIR can evenly distribute EM radiation and thus can significantly reduce the EMI effects to the surrounding area where the wireless network is deployed.

shortest path routing (SPR)

EMIR
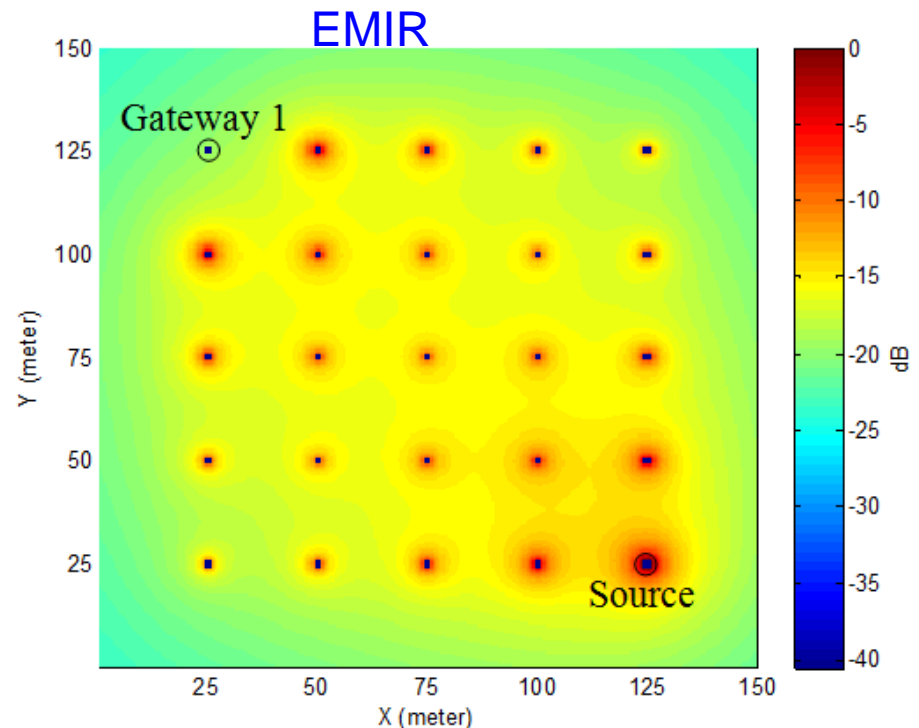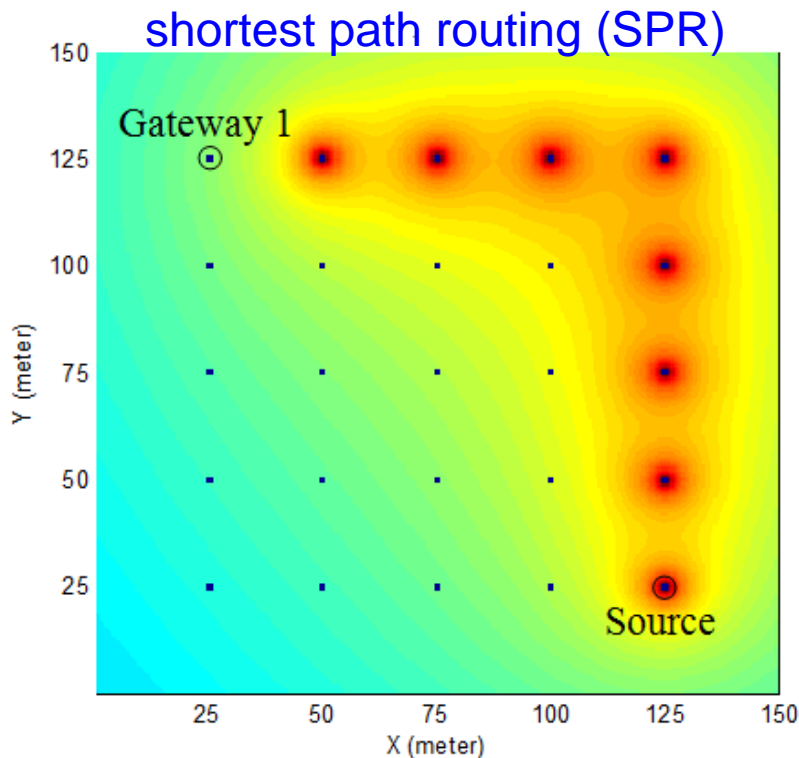
2-hop Information-Based Energy-Efficient Geographic Routing Algorithm

- Distributed routing algorithm aims to prevent the deadlock situations
  - by predicting and avoiding the "isolated" nodes
  - while considering energy efficiency and EMI by the means of effective node residual energy balancing
- Selects candidate node using a metric based on 2-hop information:
  - 1st hop: considering a combination of link quality, geographic distance and node residual energy
  - 2nd hop: considering only node-connectivity for simplicity

GPSR: greedy perimeter stateless routing