WEEK 1 LECTURE 2
### Tele-healthcare Engineering: System Overview

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SOME JARGON

- **Telemedicine** is the use of telecommunication and information technologies in order to provide clinical health care at a distance. **It involves secure transmission of medical data and information, for the prevention, diagnosis, treatment and follow-up of patients.**

- Telehealthcare [From WiKi] is an expansion of telemedicine, and unlike telemedicine (which more narrowly focuses on the curative aspect), it encompasses preventative, promotive *and* curative aspects. Originally used to describe administrative or educational functions related to telemedicine, today telehealth stresses a myriad of technology solutions. For example, physicians use email to communicate with patients, order drug prescriptions and provide other health services.

THIS COURSE

- This course is called TeleHealthcare Engineering (THE)
- That means – we will focus on "engineering" design of telehealthcare technologies. It is unlike other schools that talk about telehealthcare from "info science" viewpoint. Here we target:

    - Medical sensor hardware;

    - Medical signal processing;

    - Medical signal transmission;

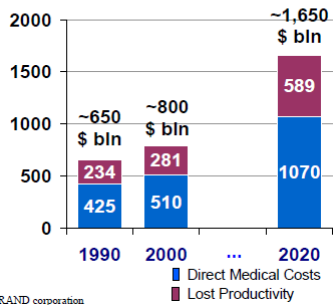   - Medical security and privacy, etc.

WHY THE?
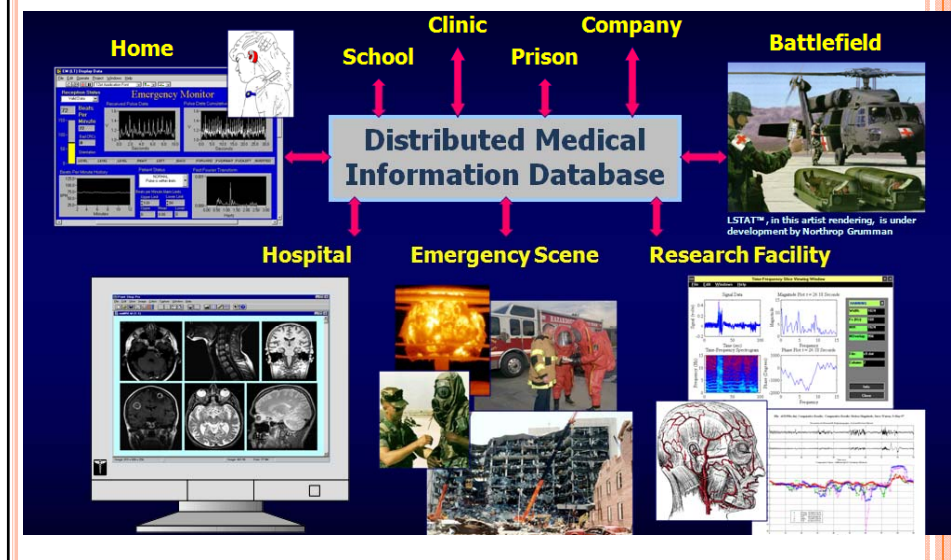
TARGETS ECE STUDENTS

- ECE Topics –

- - Signal Processing
- - Communications
- - Sensor hardware
- - Pattern Recognition

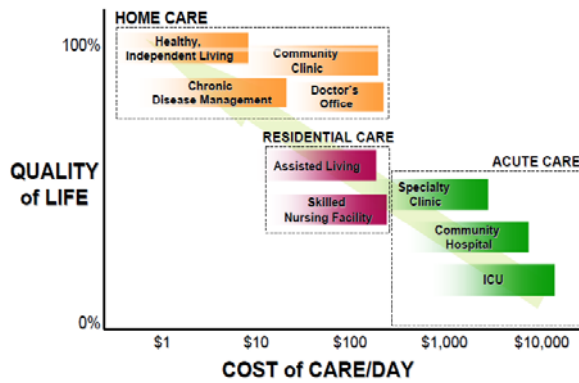*The Tower of Babel*
Pieter Bruegel the Elder (about 1525 - 1569)

## INCREASED DEMAND AND COST

Costs of Chronic disease* (USA)

RAND corporation

Direct Medical Costs
Lost Productivity
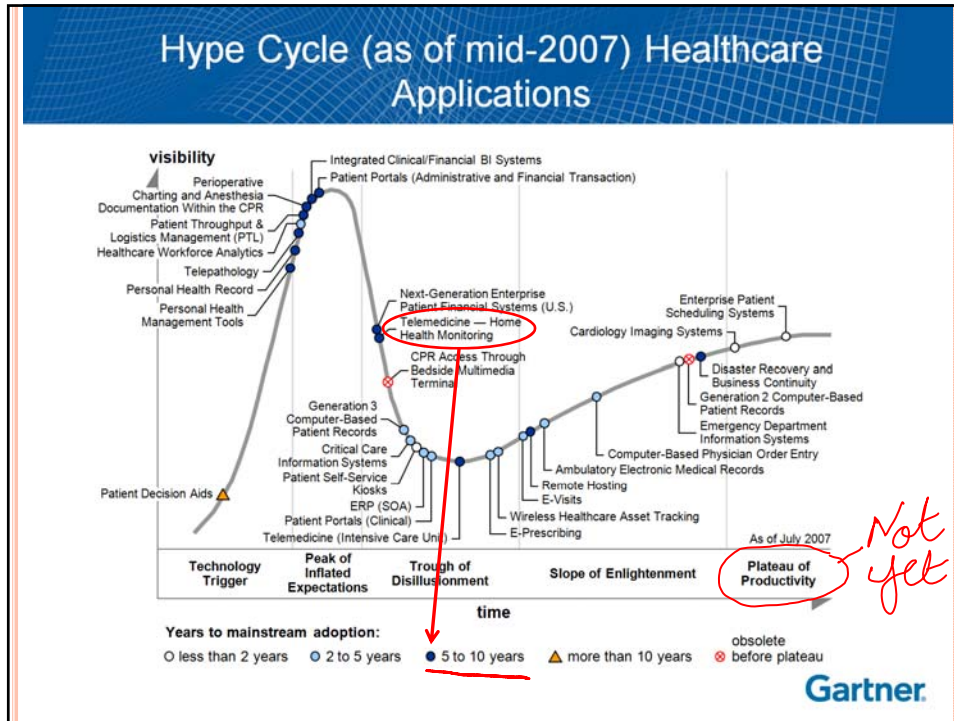
1) from Intel, and Center for Aging Services Technologies (CAST)

Chronic Diseases* include: cancer, diabetes, alzheimer and other dementias, parkinson, multiple sclerosis (MS), cardio-vascular disease (CVD), chronic obstructive pulmonary disease (COPD), asthma, benign prostatic hypertrophy, rheumatoid arthritis, and osteoarthritis.
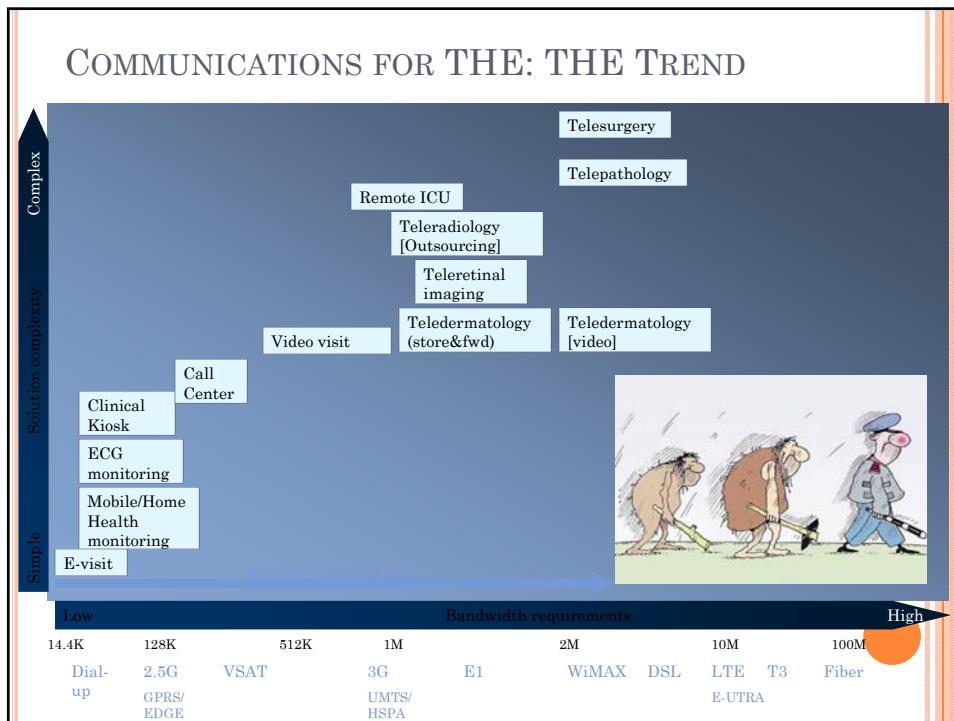
MOBILE HEALTH MONITORING (PART OF THE)

- *Definition:* Mobile health monitoring is the use of IT and mobile telecommunications to monitor the health of patients remotely, and to help ensure that appropriate action is taken. Patients are given devices that measure variables such as blood pressure, pulse, blood oxygen level and weight and that transmit the data to clinicians. Other devices are used for messaging — gathering information from patients on their symptoms and behaviors, and sending them information and advice. As opposed to home health monitoring, which typically uses devices that plug into the wall and transmit data through a fixed telephone line, mobile health monitoring uses devices that communicate wirelessly, and that have a battery life at least that of a mobile phone. In mobile health monitoring, as with home health monitoring, it is essential that the devices send data to an intelligent system that can check for abnormal ranges and alert clinicians. The clinician who receives the alert uses it to take appropriate action, such as telephoning the patient to schedule a clinic appointment or to offer advice. Sometimes, the devices can take action without human intervention. For example, electronic medication containers can alert patients if they did not take their medication.
- **Solution**: wireless medical devices, connecting to IP either directly, or through a base station. A remote station collects vital signs for analysis.
- **Bandwidth requirements:** > 56Kbps
- **Networking components**:
  - VPN (on public nw)
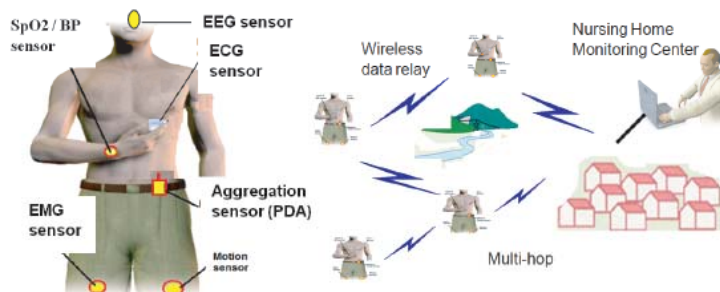 - Home router (Linksys)

MY OWN PAPER IN TOP JOURNAL
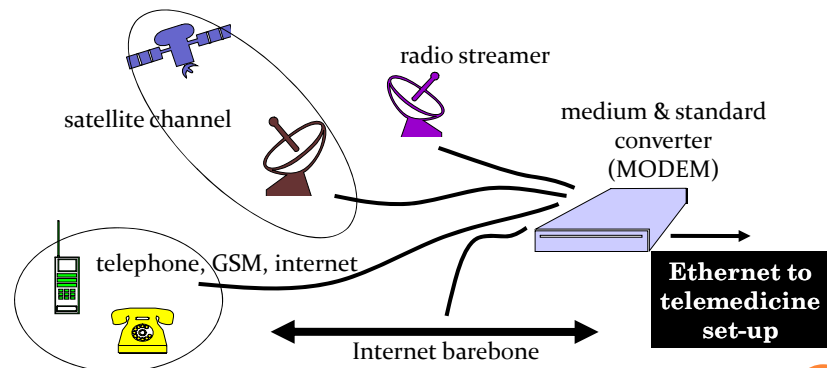
IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS

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Congestion-aware, Loss-Resilient Bio-monitoring Sensor Networking for Mobile Health Applications
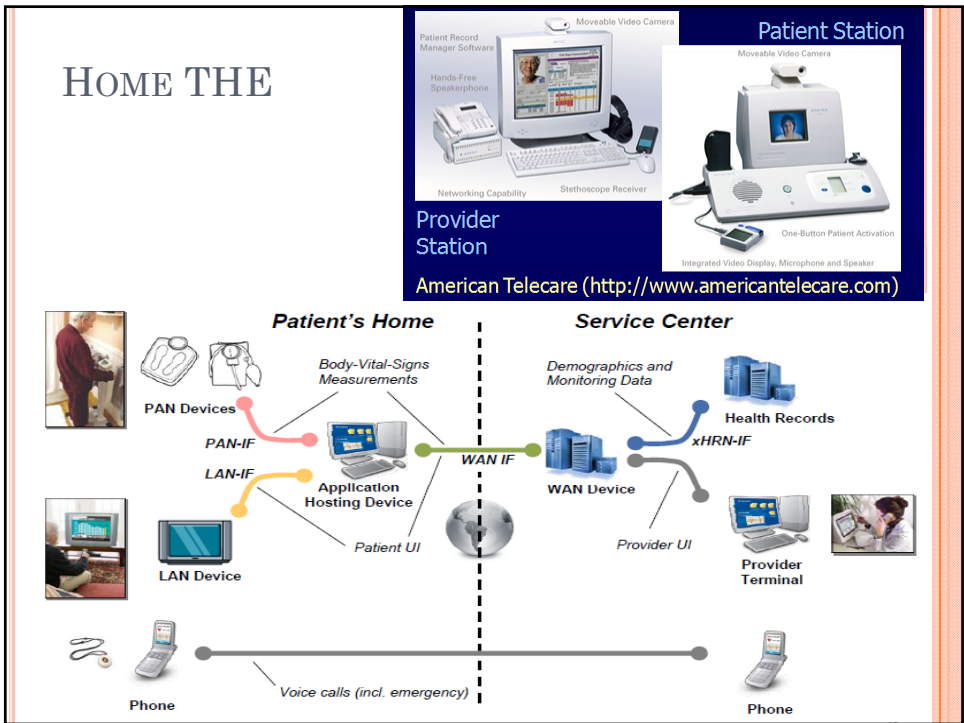
Fei Hu, Yang Xiao, and Qi Hao

TELECOMMUNICATIONS FOR HEALTHCARE

REMOTE ICU

- *Definition:* The remote intensive care unit is a system that combines audio, video, patient records and image access with customized decision support. The remote ICU is an application that enables remote critical care specialists (intensivists and nurses) to sit in a central command center, from where they can monitor and direct the care of critically and acutely ill patients in multiple ICUs.
- **Solution**: audio/video communication system, centralized patient record, image access, decision support system.
- **Bandwidth requirements:** > 1MBbps (5Mbps for TP version)
- **Networking components**:
  - VPN (on public nw)
  - WAN router
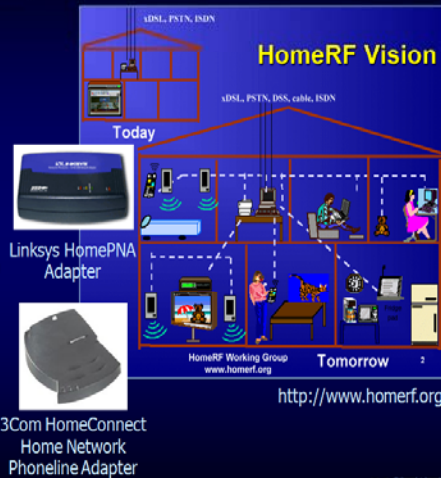 - UC with Vide Conference unit (TV quality) or TP (high end)

REMOTE SURGERY

HOME THE

Patient Station

Provider Station

American Telecare (http://www.americantelecare.com)

5/16/2012

TeleHealth Applications and devices

Applications
- **Medical, surgical, diagnostic**
- **Emergency care**
- **Disaster management**
- **Homecare**
- **Rehabilitation**
- **Tele-Education**
- **EMR**
- **E-prescribing**
- **Health 2.0 social media function**

Devices
- Digital ECG
- Electronic Stethoscope
- [High Resolution] Camera
- Retina Scanner
- Tele-pathology Microscope
- X-Ray Digitizer
- Fetal Heart Rate Monitor
- Pulmonary Function Test Machine
- Glucose meter
- Blood pressure cuff
- Pulse oximeter
- Cholesterol meter
- Weight scales

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Home THE:
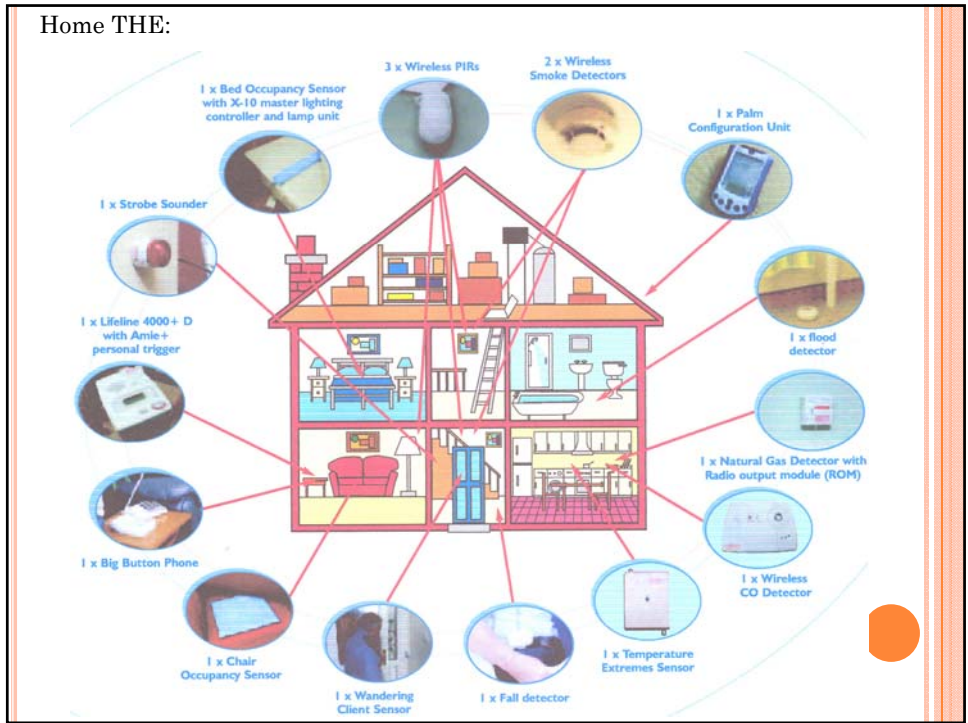
INFRASTRUCTURE VALUE IN THE

- Endpoints and medical devices play an important role in Telemedicine solution, as they are the ones sending the requested information (data, voice, video).

- But most of the value is provided by intelligent call control to video collaboration. Voice and video endpoints, presence, contact center must be integrated and supported by call control (using SIP). The integration of video endpoints, directory services and presence, plus required QoS and Security provides telemedicine solutions that effect business process and could not have been offered just few years ago, without the progress made towards this integration.

QoS - Security

Directory svcs
Presence svcs
Call control svcs

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THE TREND

From reactive to preventative…

Community alarms   **Tracking**   **Wearable monitors**

| 1990 | 2010 | 2030? |

Biometric monitoring   **Lifestyle monitoring**   **Intelligent therapies?**

and from static to a smart, distributed environment

CASE 1: NEW USAGE MODEL FOR THE-MEXICO

- Remote Health Consultation
  - Bridge the Healthcare Divide
  - Access for all @ Healthcare (Telemedicine)
  - Tele-Pharmacy
- Doctor & Nurse Training
  - Continuous education
  - Enhance quality of Healthcare Professional
- Community Healthcare Survey
  - Proactive & preventive Healthcare Services
  - Rural reach

CASE 2: DENMARK - MEDCOM

MedCom is a non-profit co-operation between authorities, healthcare professionals and IT vendors, working to create a market for electronic communication in the Danish Health Care sector.

In a three year project, an number of telemedicine development and implementations projects have been carried out within:

– Cardiology (included in a Intentional project Health Optimum)
– Diabetes: both home-monitoring and treatment over video conference
– Alcohol treatment over video conference
– Physiotherapy
– Tele radiology
– Preparation of surgery over video conference
– Home-hospital for children
– Home-hospital for COPD patients

CASE 3: UNIVERSITY OF MIAMI - CENTER ON AGING

Business Challenge:
- Help family members serve as an extension of the medical system

Network Solution:
- Provided video-based counseling and skills training, support groups, and educational seminars on Cisco Unified IP Phone 7985G
- Created text-based tips and resource lists displayed on IP phone screen

Business Results:
- Enabled caregivers to access formal and informal support and resources without leaving family member
- Provided cost-effective training and information
- Helped reduce self-reports of isolation, loneliness, burden, and distress

CASE 4: ONTARIO TELEMEDICINE NETWORK

- Government-funded Healthcare Delivery
- 110 employees, 1500 Participating Health Care Professionals

BUSINESS CHALLENGE

- Support delivery of complex medical care that is exacerbated by sparsely populated large area lacking access to modern facilities/specialists
- Facilitate cost-effective, time-sensitive delivery of expert healthcare to citizens in remote locations

SOLUTION

- Employ Cisco's MPLS Network, Unified Communications, Collaborative Care, and Unified Contact Center Express to bring remote specialist care without travel
- Reliable high-bandwidth videoconferencing stations transfer audio, video, and data to allow for remote evaluations and diagnoses
- Backbone is Cisco Medical-Grade Network

BUSINESS RESULTS

- Provincial medical-related travel costs reduced Canadian $8 million annually
- Network hosts more than 32,000 clinical consultations each year safety and patient flow

Utilization by Event Type

Event Type	Encounters
Psychiatry Mental Health	7,894
Internal Medicine	6,363
Oncology	4,415
Surgery	3,802
Paediatrics	1,139
Anesthesia	1,002
Community Medicine Public Health	598
Dietary Encounter	367
Speech Therapy Encounter	323
Geriatrics	285
Community Support Worker Encounter	264
Physical Medicine Rehabilitation	241
Psychology Encounter	183

Clinical Videoconferencing Cart

- Medical grade, CSA approved
- Customized interfaces
- High-resolution exam cameras
- Otolaryngoscope
- Digital Stethoscopes
- Digital x-ray workstations

ONTARIO THE NETWORK

Emergency Telemedicine: 'Telestroke'

- Ischemic strokes require clot-busting agents such. But drugs have to be administered within <u>three hours</u> of onset.
- Neurologists need to see the patient and a CT scan of the brain. No neurologist – no treatment.
- OTN connects remote hospitals to stroke specialists in Toronto hospitals and to the homes of 7 doctors using dedicated T1 lines.
- Teleradiology stations and video conferencing systems supported 24/7.
- FY06/07: 224 consults, 62 received tPA (28%).

QUESTIONS?