THE EVOLUTION OF MEDICAL IMPLANT TELEMETRY AND BODY AREA NETWORK

HARDWARE TECHNOLOGY: HAKAN OHLGREN
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Presentation overview

- Overview
  - St. Jude Medical at a glance
  - IMD telemetry of today
  - Future IMD telemetry
  - Why BAN?
  - Standards, standards, standards...
# St. Jude Medical at a Glance

<table>
<thead>
<tr>
<th>Founded:</th>
<th>1976</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global Headquarters:</td>
<td>St. Paul, Minnesota, USA</td>
</tr>
<tr>
<td>First Product:</td>
<td>Mechanical Heart Valve</td>
</tr>
<tr>
<td>Global Reach:</td>
<td>Products sold in 100+ countries</td>
</tr>
<tr>
<td></td>
<td>More than 20 principal operations and manufacturing facilities worldwide</td>
</tr>
<tr>
<td>Employees:</td>
<td>16,000+</td>
</tr>
<tr>
<td>2010 Net Sales:</td>
<td>$5.165 billion</td>
</tr>
<tr>
<td>Technology Platforms:</td>
<td>Atrial Fibrillation</td>
</tr>
<tr>
<td></td>
<td>Cardiac Rhythm Management</td>
</tr>
<tr>
<td></td>
<td>Cardiovascular</td>
</tr>
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<td></td>
<td>Neuromodulation</td>
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![St. Jude Medical Logo]
IMD telemetry of today: In clinics

**Used during follow up:**
- Read out stored data (IEGM, events, alarms etc)
- Re-programming parameters (if required)
- Configuring functionality (if required)

**Used during implantation:**
- Programming parameters
- Configuring functionality
- In case of ICD: Trigger tachycardia in order to find and program proper shock energy.

Radio standard: MedRadio
- MICS band: 402-405MHz
- 10 channels @ 300KHz bw.
- Data rates: ≈ 400kbps
IMD telemetry of today: Remote Monitoring

**Heart failure Monitoring**
- Send events, status and alarms etc on scheduled and manual basis.
- Physicians will analyze data and call in the patient only when needed.
- The data base holds statistics that can be used for trends etc.

**Follow-up**

**Alarm**

**Used at home – bed side:**
- Ethernet, Cellular etc
- Radio standard: MedRadio
  - MICS band: 402-405MHz
  - 10 channels @ 300kHz bw.
  - Data rates: ≈ 400kbps

[St. Jude Medical logo]

MORE CONTROL. LESS RISK.
BAN topology using multiple RF standards

Useful in different use cases:
- Legacy support during implantation and follow up in hospitals – backwards compatibility!
- Legacy support and new technology used in Remote Monitoring.
- Use of adequate RF technology for different purposes.
Radio communication with Implanted devices:

Body attenuation is a significant parameter in the RF-link budget.

- Implantation depth differs between physicians.
- Attenuation differs significantly (5-6dB) between patients.
- Higher frequency => Higher attenuation.

Free space path loss is even more significant parameter:

<table>
<thead>
<tr>
<th>Distance [m]:</th>
<th>Path loss @ 400MHz [dB]</th>
<th>Path loss @ 2.4GHz [dB]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Near field (low loss)</td>
<td>40</td>
</tr>
<tr>
<td>2</td>
<td>30.5</td>
<td>46.1</td>
</tr>
<tr>
<td>4</td>
<td>36.5</td>
<td>52.1</td>
</tr>
<tr>
<td>8</td>
<td>42.5</td>
<td>58.1</td>
</tr>
<tr>
<td>10</td>
<td>44.5</td>
<td>60</td>
</tr>
</tbody>
</table>

Pathloss=20log(4πd/λ)

Battery longevity in IMD:

- Power consumption from IMD battery need to be kept as low as possible.
- Higher frequency => need for higher RF output power => lower battery longevity.
If these numbers are decimals (e.g., 30.5) for US audience I would suggest changing the ",," to "."
Why BAN?

Problems to address:

● Health care costs are rapidly growing due to multiple factors.
● Increased demands from patients
● Lifestyle related issues – traveling, use of high tech equipment…

What can BAN do to help:

● Remote care with more data from multiple sensors, will improve trend analysis
  ● Less frequent hospital visits
  ● High quality & reliable ”automatic” indications.
  ● Early warnings of negative health trends.
● Integrating remote care into every day life – Cellular phone applications etc
Standards, standards, standards...:

It is essential to standardize BAN with frequency bands that works worldwide!

Situation today is very fragmented:
Thank you!
Global Presence

Geographic Divisions
Regional Headquarters

Asia Pacific
Hong Kong

Europe, Middle East, Africa, Canada
Brussels, Belgium

Japan
Tokyo, Japan

Latin America
Sao Paolo, Brazil

United States
Austin, Texas

Corporate Headquarters
St. Paul, MN

Technology Platforms

Cardiovascular
St. Paul, MN

Atrial Fibrillation
St. Paul, MN

Cardiac Rhythm Management
Sylmar, CA

Neuromodulation
Plano, TX

United States Manufacturing
- Arizona
- California
- Minnesota
- New Jersey
- Oregon
- Puerto Rico
- South Carolina
- Texas

International Manufacturing
- Brazil
- Israel
- Sweden
- Thailand

United States Manufacturing

- Arizona
- California
- Minnesota
- New Jersey
- Oregon
- Puerto Rico
- South Carolina
- Texas

International Manufacturing

- Brazil
- Israel
- Sweden
- Thailand