Getting to the Poynt

Specialised antennas for IoT

www.poynting.tech
Presenter:

Dr. André Fourie
CEO of Poynting Group

- Ph.D Electrical Engineering 1991
- Professor at Wits until 2001
- Founded Poynting Antennas 2001
- Listed as inventor in over 30 patents
- Published over 50 academic papers and 4 books
Agenda

• IoT, and the big picture?
• IoT omni antenna performance?
• Why are expensive antennas often cheaper?
• Application examples & case studies
• How are we positioning our antennas for IoT
IoT, and the big picture?
Which M2M / IoT Technologies?

- **Low Power Wide Area Network (LPWAN)**: Sigfox, LoRa
- **Cellular Network**: NB-IoT, LTE-M
- **Local Area Network (LAN)**
- **Personal Area Network (PAN)**: Z-Wave, ZigBee, Wi-Fi, Bluetooth, RFID
Frequency Bands are Region Dependant

<table>
<thead>
<tr>
<th>Wi-Fi</th>
<th>IEEE 802.11 standard for Ethernet replacement</th>
<th>WiFi HaLow</th>
<th>HaLow is Wi-Fi at a lower frequency ISM band</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2M &amp; IoT Technologies</td>
<td>Access and tracking of identifying RFID tags</td>
<td>Bluetooth BLE</td>
<td>Bluetooth Low Energy (e.g. BT 4.0), BT 5.0 for IoT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Zigbee</td>
<td>IEEE 802.15.4 Low-power, RF mesh network</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Z-Wave</td>
<td>Primarily home automation RF technology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LoRa</td>
<td>Low-Power Wide-Area Network (LPWAN)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sigfox</td>
<td>Proprietary technology using ISM bands</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LTE-M/NB-IoT</td>
<td>IoT standards using existing LTE networks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CDMA450</td>
<td>CDMA at the lower frequency bands for M2M/IoT</td>
</tr>
</tbody>
</table>

Antennas don’t care about technology, but only frequency

ISM Frequency Bands

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Band</th>
</tr>
</thead>
<tbody>
<tr>
<td>433MHz</td>
<td>✓</td>
</tr>
<tr>
<td>868MHz</td>
<td>✓</td>
</tr>
<tr>
<td>EMEA</td>
<td>✓</td>
</tr>
<tr>
<td>915MHz</td>
<td>✓</td>
</tr>
<tr>
<td>US &amp; APAC</td>
<td>✓</td>
</tr>
<tr>
<td>2.4GHz</td>
<td>✓</td>
</tr>
<tr>
<td>ISM &amp; Wi-Fi</td>
<td>✓</td>
</tr>
<tr>
<td>5GHz</td>
<td>✓</td>
</tr>
<tr>
<td>ISM &amp; Wi-Fi</td>
<td>✓</td>
</tr>
</tbody>
</table>

GSM/UMTS/LTE Frequency Bands (Country Specific)

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Band</th>
</tr>
</thead>
<tbody>
<tr>
<td>450MHz</td>
<td>✓</td>
</tr>
<tr>
<td>700MHz</td>
<td>✓</td>
</tr>
<tr>
<td>800MHz</td>
<td>✓</td>
</tr>
<tr>
<td>850MHz</td>
<td>✓</td>
</tr>
<tr>
<td>900MHz</td>
<td>✓</td>
</tr>
<tr>
<td>1800MHz</td>
<td>✓</td>
</tr>
<tr>
<td>1900MHz</td>
<td>✓</td>
</tr>
<tr>
<td>2100MHz</td>
<td>✓</td>
</tr>
<tr>
<td>2300MHz</td>
<td>✓</td>
</tr>
<tr>
<td>2500MHz</td>
<td>✓</td>
</tr>
<tr>
<td>2700MHz</td>
<td>✓</td>
</tr>
<tr>
<td>3400MHz</td>
<td>✓</td>
</tr>
<tr>
<td>3800MHz</td>
<td>✓</td>
</tr>
</tbody>
</table>

aka CBRS Bands
# IoT Specific Technologies

<table>
<thead>
<tr>
<th></th>
<th>LoRa</th>
<th>SIGFOX</th>
<th>LTE-M</th>
<th>WiFi</th>
<th>MESH</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequencies</strong></td>
<td>868/915MHz, (also 433MHz)</td>
<td>868/915MHz</td>
<td>Various GSM/LTE bands</td>
<td>2.4GHz, 5.8GHz (also 868/915 MHz)</td>
<td>2.4GHz, 5.8GHz (also 868/915 MHz) ++</td>
</tr>
<tr>
<td><strong>Data Rates</strong></td>
<td>bits/s – kb/s</td>
<td>bits/s</td>
<td>Kb/s ~ Mb/s</td>
<td>Mb/s</td>
<td>Mb/s</td>
</tr>
<tr>
<td><strong>Mobility</strong></td>
<td>Yes</td>
<td>Limited</td>
<td>Yes/Limited</td>
<td>Limited</td>
<td>High</td>
</tr>
<tr>
<td><strong>Coverage</strong></td>
<td>Limited Area</td>
<td>International</td>
<td>National</td>
<td>Small/Large</td>
<td>Large</td>
</tr>
<tr>
<td><strong>Network Ownership</strong></td>
<td>Own</td>
<td>Sigfox</td>
<td>Telco</td>
<td>Own</td>
<td>Own</td>
</tr>
<tr>
<td><strong>Client Device Costs</strong></td>
<td>Low</td>
<td>Low</td>
<td>Med</td>
<td>Med</td>
<td>High</td>
</tr>
<tr>
<td><strong>Data/Subscription Costs</strong></td>
<td>None</td>
<td>Low</td>
<td>Med/High</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td><strong>User Network Deployment Costs</strong></td>
<td>Medium</td>
<td>None</td>
<td>None</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td><strong>Device Battery Life</strong></td>
<td>Long</td>
<td>Very Long</td>
<td>Medium</td>
<td>Short</td>
<td>Short</td>
</tr>
<tr>
<td><strong>Typical Base Station Range</strong></td>
<td>~ 10 Kilometers</td>
<td>~ 50 Kilometers</td>
<td>~ 50 Kilometers</td>
<td>~ 200 meters</td>
<td>N/A</td>
</tr>
</tbody>
</table>
IoT omni antenna performance?
PUCK-5 vs. Competitor Comparison (700MHz)

COMPETITOR ANTENNA (TOP VIEW):
698 – 960 MHZ

POYNTING ANTENNA (TOP VIEW):
698 – 960 MHZ

2dBi Max Gain @ 698-960 MHz
According to competitor specification sheet
Gain @ 700 MHz - Unknown

-1dBi Max Gain @ 698-960 MHz
According to Poynting specification sheet
Omni-280 vs. Competitor Comparison (2600MHz)

COMPETITOR ANTENNA (TOP VIEW):
2600 MHZ

5dBi Max Gain @ 2600 MHz
According to competitor specification sheet

POYNTING ANTENNA (TOP VIEW):
2300-2700 MHZ

3dBi Max Gain @ 2300-2700 MHz
According to Poynting specification sheet

14dB variation
2dB variation

VS
Why are expensive antennas often cheaper?
**Smart Meter – example:**

**The cost of not doing it right**

<table>
<thead>
<tr>
<th>Scenario 1</th>
<th>Scenario 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Install Modem</strong></td>
<td><strong>Install DASH-1 antenna as standard</strong></td>
</tr>
<tr>
<td>Number of Smart Meters</td>
<td>1000</td>
</tr>
<tr>
<td>Percentage of meters - performing well</td>
<td>46%</td>
</tr>
<tr>
<td>Percentage of meters - performing average</td>
<td>35%</td>
</tr>
<tr>
<td>Percentage of meters - performing poorly</td>
<td>18%</td>
</tr>
<tr>
<td>Number of Meters - performing well</td>
<td>462</td>
</tr>
<tr>
<td>Number of Meters - performing average</td>
<td>355</td>
</tr>
<tr>
<td>Number of Meters - performing poorly</td>
<td>183</td>
</tr>
<tr>
<td>Cost for Technician/Contractor per hour</td>
<td>€35</td>
</tr>
<tr>
<td>Price for a DASH-1 antenna</td>
<td>€18</td>
</tr>
<tr>
<td>Total Number of sites installed with DASH-1 from the outset:</td>
<td>0</td>
</tr>
<tr>
<td>Number of rework sites (return to repair):</td>
<td>538</td>
</tr>
<tr>
<td>Initial installation costs (DASH-1 installed with Smart Meter):</td>
<td>€-</td>
</tr>
<tr>
<td>Rework costs (price of antenna):</td>
<td>€9,684</td>
</tr>
<tr>
<td>Rework costs (send technician/contractor back to site):</td>
<td>€18,830</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>€28,514</td>
</tr>
</tbody>
</table>

- Cost of initial ‘correct’ deployment more efficient than ad-hoc implementation
- Many costs not obvious:
  - Cost of second, third rework
  - Cost of transport, tolls
  - Cost of overtime
  - Cost of distant towns/cities
  - Loss of productivity
- Cost of labour in Europe much higher than South African salaries assumed
- Cost of damage to reputation => loss of business potential
- **Strategy:** implement all smart meters with DASH-1 antenna
Application Examples & Case Studies

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Mining & Tunnels: Why use Circular polarised?

**Linear Polarisation**
- Rotates unpredictably down a tunnel
- Propagation affected by tunnel dimensions & surfaces

**Circular Polarisation**
- Contains all polarisations, therefore significantly more reliable radio links
- Propagation ‘adapts’ better within tunnel dimensions
- Circular polarisation propagates past obstacles & obstructions more reliably
Mining & Tunnels: Technologies & Frequencies

- **HELI-6** (700-960 MHz)
- **HELI-5** (1800-2100 MHz)
- **HELI-3**
- **HELI-4** | **HELI-8** (2.4-2.5 GHz)
- **HELI-22** (2.4-2.5 & 5.0-6.0 MHz)
- **HELI-31** (1.7 - 7.2 GHz)

For WiFi 6, Wideband LTE/5G
To be released soon

~99% of Poynting HELI antennas used in mines @ 2.4 GHz frequency

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Mining Tunnels: Example Tests in South Africa using Rajant Mesh nodes with Poynting HELI antennas

Platinum Mine

- HELI to Rugged Phone/Tablet (155m)
- HELI to Rugged Phone/Tablet (200m)
- HELI to HELI (275m)
- HELI to HELI (275m) while train passing

Coal Mine (mesh node to mesh node)

- 100m
- 200m
- 300m
- 400m
- 500m
- 670m
- 1000m
- LOS
- NLOS

Ping (ms) & TCP Throughput (Mbps)

RSSI (dBm)

- Platinum Mine
- Coal Mine

Ping (ms) & TCP Throughput (Mbps)

RSSI (dBm)

- Platinum Mine
- Coal Mine

Ping (ms) & TCP Throughput (Mbps)

RSSI (dBm)

- Platinum Mine
- Coal Mine
Active Mining Stopes Example (~1.5m high ceiling)- Rajant Mesh nodes with Poynting HELI antennas

Platinum Mine (Active Stopes)

RSSI (dBm)

Test # 1 Test # 2 Test # 3 Test # 4 Test # 5 Test # 6 Test # 7
-100 -95 -90 -85 -80 -75 -70 -65 -60 -55 -50
Point of Sale (POS) / Vending Company

From these antennas...

To our antennas

OMNI-39 / OMNI-280

OMNI-39 (indoors)
OMNI-600 (outdoors)

PUCK-5
John Laidler (author) relies on MIMO-1 in his motorhome.
First electric powered boat uses OMNI-291 & OMNI-296

✓ On the roof of the Fjords there are eight 4G antennas
✓ Ensuring a stable and reliable reception and transmission of cellular (3G and 4G signal)
✓ Two antennas for each of the four 4G routers
Vehicle Tracking: Where is the antenna?

- 10s of thousands of DIPL-1 antennas sold for stealth vehicle tracking
- New OMNI-510 for easy IoT/Smart Meter mount
- PCB antennas can be designed at MOQ

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How are we positioning our antennas for IoT?
**Urban LTE Omni-directional Antennas (2)**

- **OMNI-280**
  - Multipurpose M2M / POS / IoT Antenna
  - **690MHz to 3800MHz**, with 4dBi max Gain
  - Multiple mount (included): Wall and pole bracket, desk mount (with Velcro double sided tape), magnetic base
  - 154mm (h) x 51mm (w)

- **XPOL-1**
  - 2x2 MIMO (Cross Polarised +45/-45 degrees)
  - **790MHz to 2700MHz**, with 4dBi max Gain
  - 5m twin HDF195 with SMA Connectors
  - Pole, wall and window suckers
**DASH-1 Stealth IoT/M2M/Smart Meter Antenna**

- Low visibility LTE / Smart Meter / IoT Antenna
  - 690MHz to 2700MHz, with 4dBi max Gain
  - Meter Box mount – with spigot & double sided tape
  - 258mm (l) x 13mm (w) x 17mm (h)
  - High volume item, MOQ 1000

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**LTE/4G/3G/2G**

- Zigbee
- Z-Wave
- LoRaWAN
- Sigfox
- LTE-M/NB-IoT
- Bluetooth
- Wi-Fi
- Wi-Fi HaLow
Planned OMNI-510 IoT/M2M/Smart Meter Antenna

- Ultra low profile LTE / Smart Meter / IoT Antenna
  - Wideband 690MHz to 2700MHz, with 2dBi max Gain
  - Window & Box mount – with double sided tape
  - 138mm (l) x 26mm (w) x 10mm (h) - TBC

<table>
<thead>
<tr>
<th>Technology</th>
<th>Compatibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTE/4G/3G/2G</td>
<td>✓</td>
</tr>
<tr>
<td>Zigbee</td>
<td>✓</td>
</tr>
<tr>
<td>Z-Wave</td>
<td>✓</td>
</tr>
<tr>
<td>LoRaWAN</td>
<td>✓</td>
</tr>
<tr>
<td>Sigfox</td>
<td>✓</td>
</tr>
<tr>
<td>LTE-M/NB-IoT</td>
<td>✓</td>
</tr>
<tr>
<td>Bluetooth</td>
<td>✓</td>
</tr>
<tr>
<td>Wi-Fi</td>
<td>✓</td>
</tr>
<tr>
<td>Wi-Fi HaLow</td>
<td>✓</td>
</tr>
</tbody>
</table>
MIMO-3 ‘New Improved Base’ (V2)

- Variations of the following:
  - 2x2 MIMO LTE: 410MHz – 3800MHz
  - 2x2 MIMO Dualband WiFi: 2.4GHz & 5GHz
  - GPS/GLONASS

- Mounting Options:
  - Removable Spigot (30mm & 80mm lengths)
  - 6x M4 direct/flush mountable
  - Removable Magnet Mounts (Optional)
  - Thicker Foam base (5mm)

- Foam filled (IP68 rating)
- New ‘Bright’ White ASA Radome
PECJ Range of Antennas

- Easy installation; Multi-Mounting options: Magnetic, spigot, screw, double sided tape & wall/pole bracket (included)
- Small & Low-Profile (Ø 102mm x h 38mm)
- Waterproof & Dustproof
- Highly Ruggedized (complies with IK08)
- Fire Resistant (complies with ECE-R 118.02)

<table>
<thead>
<tr>
<th>Description</th>
<th>Puck Antenna: LTE (SISO)</th>
<th>2x2 MIMO</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUCK-0001</td>
<td>Puck Antenna: 2-in-1</td>
<td>LTE (MIMO)</td>
</tr>
<tr>
<td>PUCK-0002</td>
<td>Puck Antenna: 3-in-1</td>
<td>LTE (MIMO) &amp; GPS</td>
</tr>
<tr>
<td>PUCK-0004</td>
<td>Puck Antenna: 5-in-1</td>
<td>LTE (MIMO), WiFi (MIMO) &amp; GPS</td>
</tr>
<tr>
<td>PUCK-0005</td>
<td>Puck Antenna: WiFi (2x2 MIMO)</td>
<td>2x2 MIMO</td>
</tr>
<tr>
<td>PUCK-0012</td>
<td>GPS Only, in the same housing as the PUCK</td>
<td>2x2 MIMO</td>
</tr>
</tbody>
</table>

Includes:
- 3.2GHz to 3.8GHz CBRS Band
HELI Range of Antennas

• Ideal for mining / tunnels where normal antennas do not perform sufficiently
• Perfect for IoT, Telemetry
• Circular Polarized Antennas; works in tunnels without line of sight
High Level Product Roadmap 2019 (DRAFT)

• **OMNI-510**
  • Flat surface/window mount LTE IoT antenna)
  • To be released June 2019

• **HELI-5**
  • LTE 1800/2100MHz HELI Antenna for mining and other tunnels
  • Limited Availability, to be officially released June/July 2019

• **Mini-HELI series**
  • Various smaller HELI antennas, for Dualband 2.4GHz & 5GHz
  • Flexible configurations for MIMO, different frequency bands, etc.
  • Availability Q3 2019

• **New XPOL Models – Availability Q3/Q4 2019**
  • New model based on the XPOL-2, with additional bands for 5G (includes 3.4 – 3.8GHz)
  • New model based on the XPOL-1, with additional bands for 5G (details TBA)
LoRa / Sigfox Roadmap (DRAFT)

- LoRa / Sigfox (ISM 868/915MHz) Q4 2019 / Q1 2020 in the following enclosures & types:
  - PUCK sized LoRa / Sigfox antenna
  - OMNI-280 sized LoRa / Sigfox antenna
  - OMNI-121 or OMNI-292 sized LoRa / Sigfox antenna
  - OMNI-510 sized LoRa / Sigfox antenna
Thank you!

Any questions?

info@poynting.tech

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