PLC Technology

PLC Standardization Tutorial
Orlando, March 2004
Contents

• INTRODUCTION

• ARCHITECTURES

• CHANNEL

• EMC CONTROL

• ROADMAP
• Powerline improves consumer experience:
  - Easy to use: just plug it in and it’s connected
  - No coverage problems due to walls
  - No need for new wires
  - No antennas (psychological fear)
  - Ubiquitous: works in every plug
  - Low cost
  - High speed: up to 200 Mbps
  - Has synergies with other technologies (WLAN, BlueTooth, DSL, Cable)
ACCESS PLC

Underground or aerial
**INHOME PLC**

<table>
<thead>
<tr>
<th>Total: 34.6 Mbps</th>
<th>PowerLine Communications (PLC) is the only technology that satisfies all these requirements:</th>
</tr>
</thead>
<tbody>
<tr>
<td>And, in addition to this, you need:</td>
<td>- Up to 200 Mbps</td>
</tr>
<tr>
<td>- full-house coverage</td>
<td>- Not attenuated by walls</td>
</tr>
<tr>
<td>- QoS</td>
<td>- Fully supports QoS</td>
</tr>
<tr>
<td>- low cost</td>
<td>- no RF components needed</td>
</tr>
<tr>
<td>- easy installation</td>
<td>- no wiring needed</td>
</tr>
</tbody>
</table>
INHOME PLC

- The PowerLine backbone improves the coverage of the WLAN
Channel

- 1.7 to 30 MHz
- Few hundred meters
- Multi-path (strong fadings)
- Noisy: background, ingress, impulsive
EMC Control

- **Wide-band modulations:**
  - The signal is spread over a wide bandwidth, instead of being concentrated at a single strong carrier.
  - This means that power spectral density is lower than with single-carrier modulation, reducing the possibility of interfering other users of the spectrum.

- **Adaptive transmission power**
  - PLC technology can have an *adaptive transmission power*, so that the system *only* injects the *minimum signal level required* to achieve the desired performance level.
  - Equipment is typically transmitting with *much less power* than nominal level, thus reducing any potential emissions to a minimum.

- **Differential-mode signals** (no ground reference)
Spectrum Friendly Notches

Programmable PSD notches

Bit loading automatically reduced on notches
Leading manufacturers ensure the availability and development of PLC equipment. 2nd generation chipset will increase performance and competitiveness.

NOTE: DS2 has already tested a 2nd Generation chip (200 Mbps), that will be available in the market in 2004.
• PLC Access technology roadmap:

- **1st gen**
  - GMSK/DSSS: 1-4 Mbps

- **2nd gen**
  - OFDM: 10-45 Mbps

- **3rd gen**
  - Dense OFDM: >100 Mbps
Example 2nd gen

- 1280 OFDM carriers
- Data rate:
  - Up to 27 Mbps in downstream channel
  - Up to 18 Mbps in upstream channel
- Data rate per subcarrier adaptable according to SNR detected
  - Nº bits per carrier: up to 8
  - Different carriers transmit at different data rates
- Modulation efficiency up to 7.25 bps/Hz
- Overlapped subchannels: efficient use of the spectrum saving bandwidth
Example 2nd gen

- **MAC**
  - FDD or TDD
  - MASTER-BASED or PEER-to-PEER

- **QoS**
  - THROUGHPUT, LATENCY and JITTER CONTROL

- **Security**
  - CODING
  - ENCRYPTION

- **Bridging**
  - ETHERNET, USB, VoIP, WLAN, etc
3rd generation PLC products

- Speeds higher than 100 Mbps...
- ...achieved thanks to high-density, high-efficiency multi-carrier modulations
- Advanced features (multicast, QoS, integrated VoIP) and built-in high-speed interfaces
- Cost equal or lower than DSL/Cable
- Easier installation, higher coverage and better diagnostic mechanisms that will reduce operational costs for running a large-scale network