

Gearing up to meet Africa's
rising power and water demand



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**AFRICAN
UTILITY
WEEK**

**CLEAN POWER
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**Power Line
Telecommunications:
Standards, spectrum
and broadband issues**

Power Line Telecommunications: Standards, spectrum and broadband issues

- Background
- Narrowband
- Smart Grid
- Spectrum
- Standards
- Broadband needs and solutions
- Progress to date

Background

- Power Line Communications (PLC) or Telecommunications (PLT) refers to sending and receiving data signals across electrical power wiring
- Use cases:
 - Domestic – e.g. Baby Alarm
 - Utility – e.g. Smart Metering, HT monitoring & control, ripple control, etc.
 - Broadband:
 - Household
 - Local
 - Neighbourhood

Spectrum Used

- Different applications use different frequencies
- Narrow band
 - Lower frequencies, longer range: 3 to 500 kHz
 - Used to monitor and control HT switchgear, Smart meters, Advanced Metering Infrastructure-AMI, etc.
- Broadband – “BPL”
 - Higher frequencies: 1.7 to 250 MHz
 - Short range
- Surface Wave – single conductor
 - GHz frequencies
 - Fairly long range
 - Since 1899!

Narrow Band

- Advanced Metering Infrastructure - AMI
 - AKA the Smart Grid
- Studies show that Narrowband PLT is best suited for AMI with over a 100 million NB-PLT devices installed to date.
- It is estimated that by 2020, Europe will have 80% coverage of smart meters and the rest of the world is expected soon to follow suit. (EETimes)

Narrow Band Standards

| Standard | Technology | Frequency Band | Bit Rate (kbps) |
|-----------------------|------------|----------------|-----------------|
| G3-PLC | OFDM | 36-90.6 kHz | 5.6-45 |
| PRIME | OFDM | 42-89 kHz | 21.4 128.6 |
| IEEE P1901.2* | OFDM | 9-500 kHz | < 500 kbps |
| ANSI / EIA 709.1,2 | BPSK | 86, 131 kHz | 3.6-5.4 |
| KNX | S-FSK | 125-140 kHz | 1.2 |
| IEC61334 | S-FSK | CENELEC-A | 2.4 |

*HomePlug Alliance

The Smart Grid

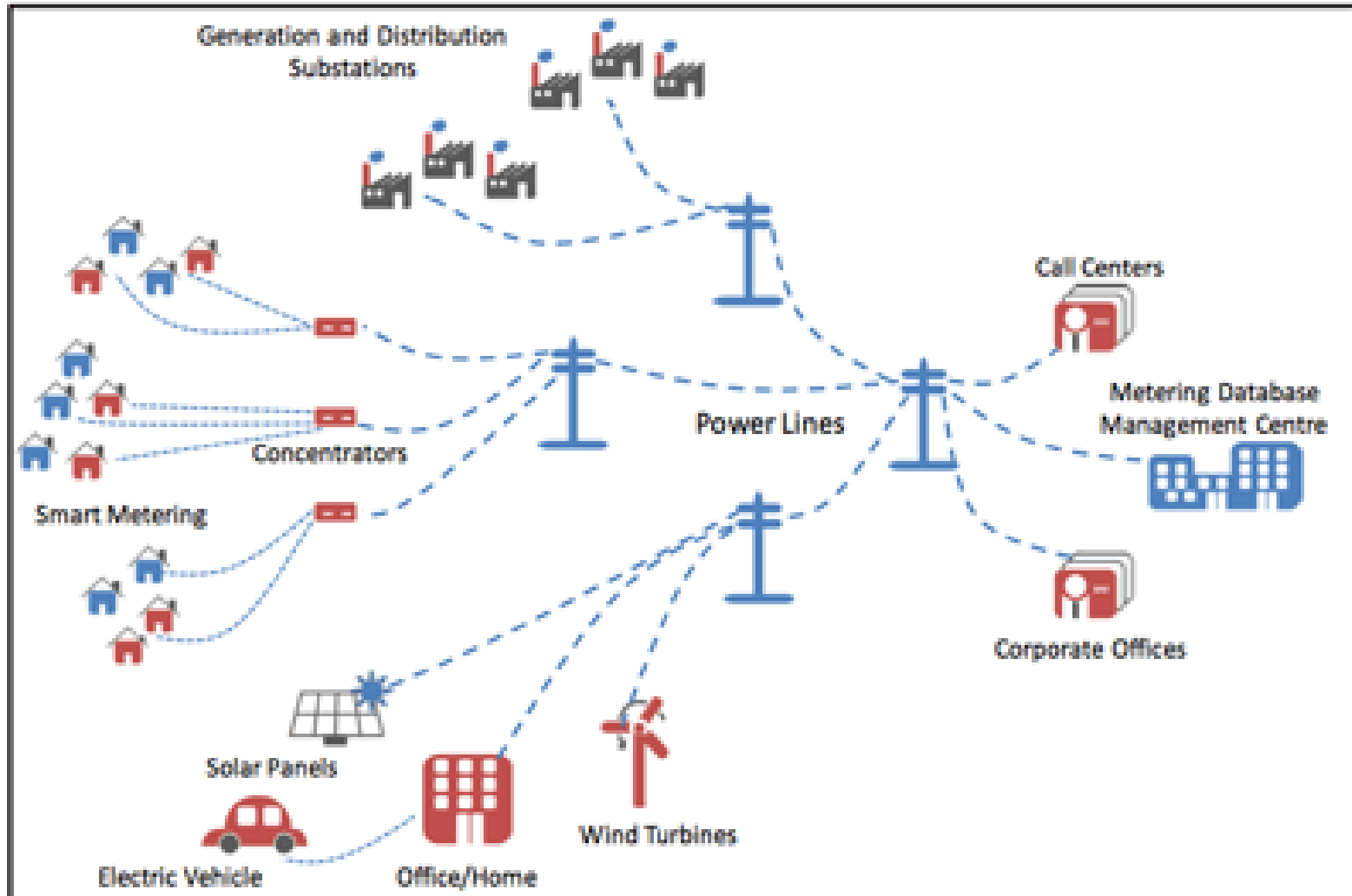


Figure 3: The Smart Grid

Distributed Generation

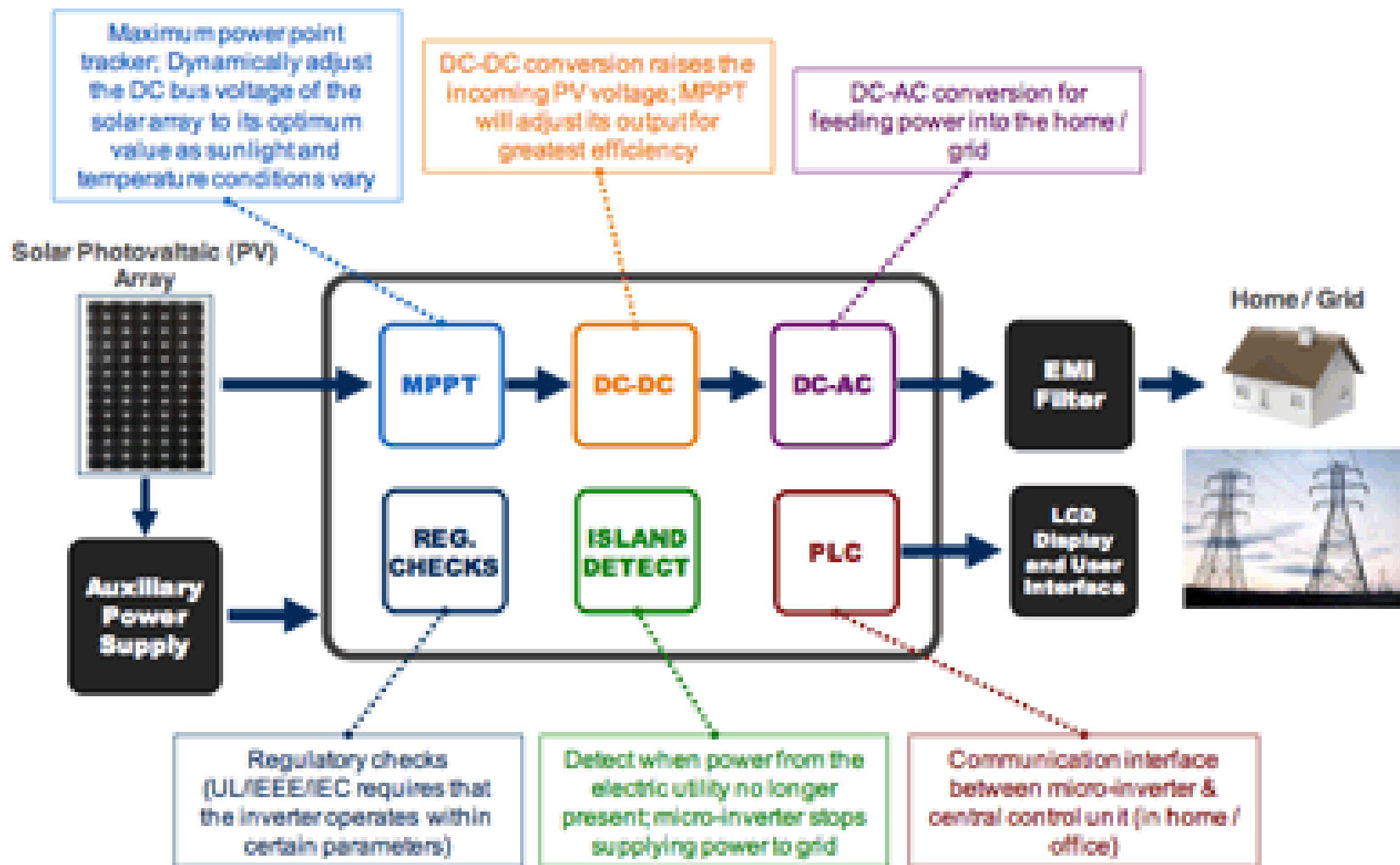


Figure 2. Block Diagram of a Micro-inverter

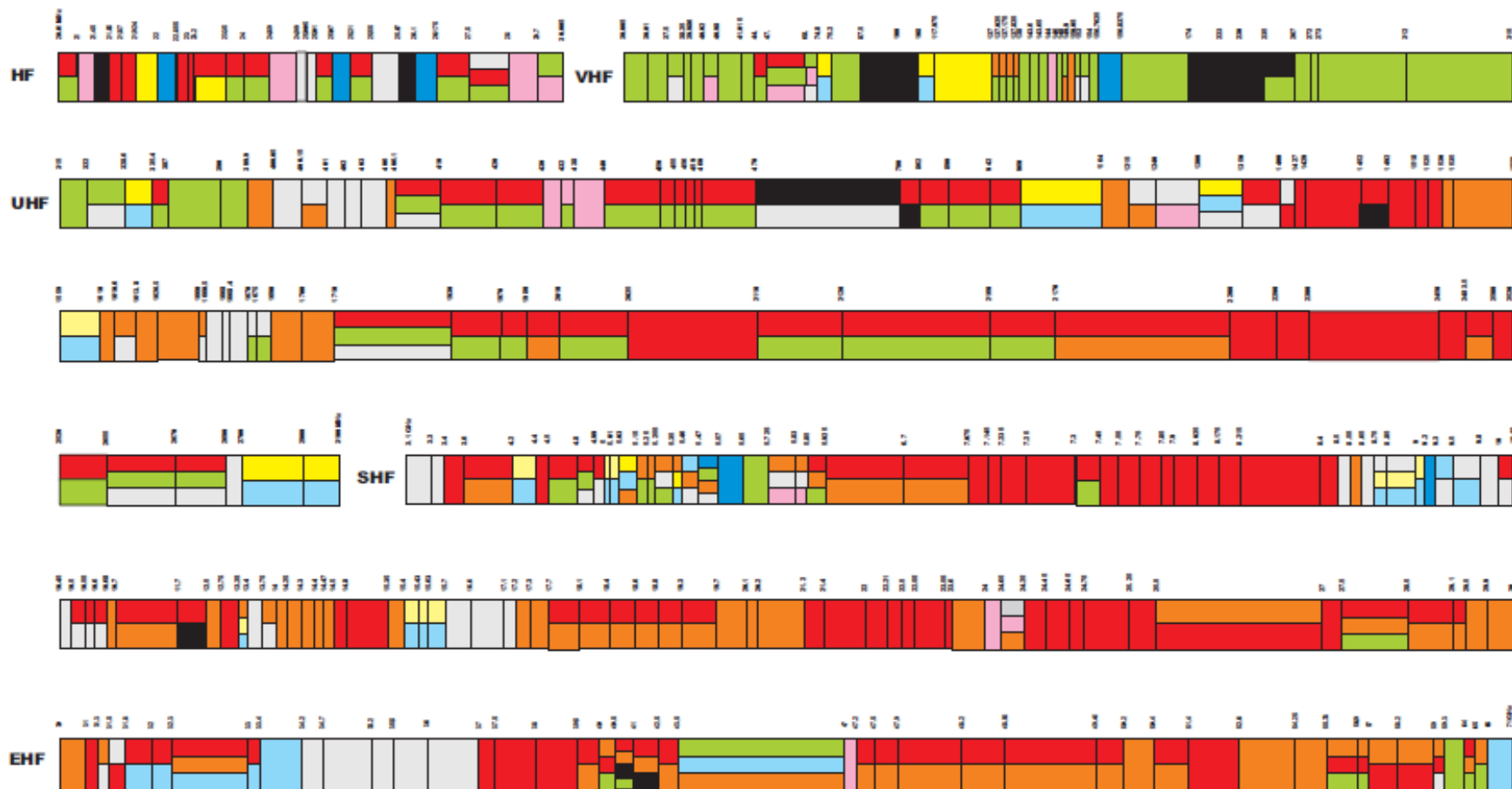
Lower Frequency Usage

| Band | Frequency | Usage |
|------|--------------|---|
| VLF | 3–30 kHz | Maritime, navigation, time signals, submarine communication, wireless heart rate monitors, geophysics |
| LF | 30–300 kHz | Radio navigation, maritime, clock time signals, AM long wave broadcasting (Europe and parts of Asia), RFID, amateur radio |
| MF | 300–3000 kHz | AM (medium-wave) broadcasts, amateur radio, avalanche beacons |

SA Spectrum Management Plans

- SABRE-1 (1997)
 - 20 MHz to 3 GHz
- SABRE-2 (2001)
 - 3 GHz to 70 GHz
- SATFA (2004)
 - 20 MHz – 70 GHz
- NRFP 2010
 - 9 kHz – 3000 GHz
- NRFP 2013

SOUTH AFRICAN FREQUENCY ALLOCATIONS



LEGEND



NOTE: This chart represents the main frequency allocations only. Refer to the South African Table of Frequency Allocations (SATFA) Government gazette No. 20884 of July 2004, for sub-allocations and more information.

VISION
To be strong, service-oriented and responsive communications regulator in South Africa

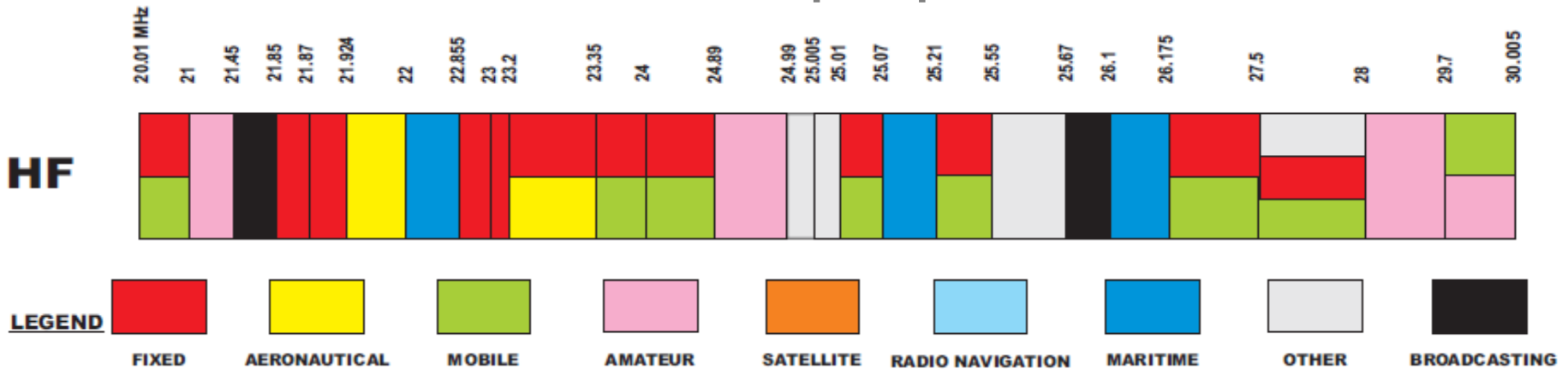
MISSION
To increase access to communication services through the promotion of a competitive and socially responsive communications industry

VALUES
The promotion of choice and diversity, both in carriage and content, as an expression of the creativity of the South African people



SA Spectrum Allocation

This expansion of the portion from 20 MHz to 30 MHz shows all spectrum is allocated for some purpose



Which makes it hard to find space for BPL

Broadband Uses

- PLT mooted as the solution to last mile connectivity.
- The Last Mile is the connection from a concentration / access point on a network to the consumers' premises.
- Problems will be solved “Real Soon Now”
- This has been said for at least 10 years!

BPL Spectrum

- SA Regulations deal with 3 ranges of frequencies:
 - 1.705 MHz – 30 MHz
 - 30 MHz – 230 MHz
 - 230 MHz – 1000 MHz

Why is BPL a problem?

- Carrying a radio frequency signal over unshielded (and often untwisted) pairs of wires acts as an enormous antenna.
- In the case of long separated parallel wires, these act as a Plane Antenna – attenuation with distance is linear, not inverse square!

Why is BPL a problem - 2?

- This not only means that other licensed and unlicensed uses of spectrum will interfere with BPL, but that BPL will interfere with other legitimate uses.
- Attempts to reduce this by “notching” – filtering out specific frequencies. OFDM facilitates this.
- Since ALL spectrum below 30 MHz, for example, is already allocated and usually assigned, there is very little scope for avoiding interference.

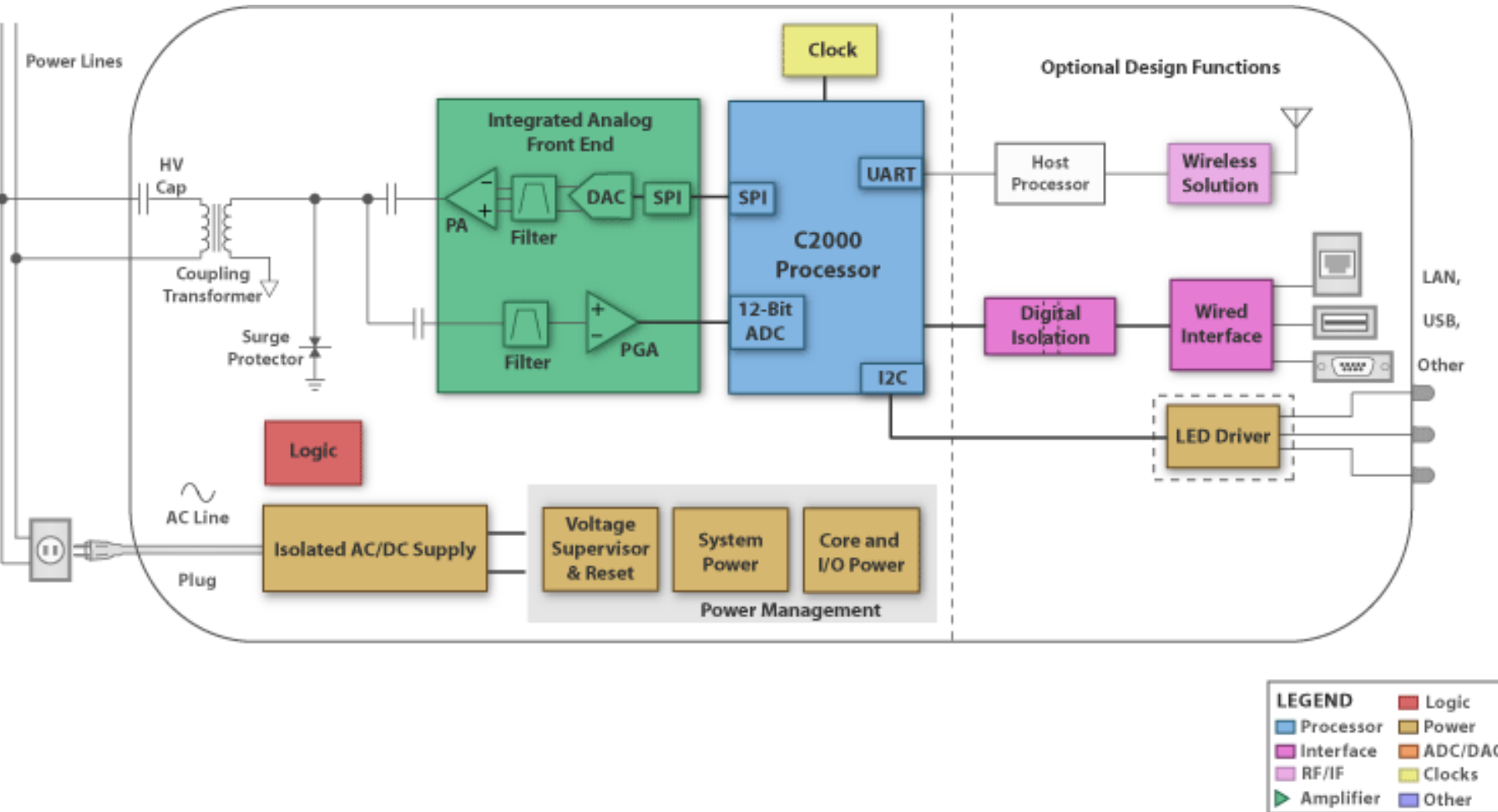
Why is BPL a problem - 3?

- In essence, use of BPL must be treated in terms of spectrum licensing
 - Facilitates interference mitigation
- This approach has not been taken elsewhere
- Most large-scale trials elsewhere have been abandoned

Is it important?

- Last Mile connectivity still an unsolved problem in SA.
 - Copper (ADSL) usage dropping every year
 - Fibre being rolled out, but will take many years
- Plenty of commercial interest. Some manufacturers include: -
 - Atheros
 - Sigma
 - Marvell
 - Broadcom
 - Lantiq
 - Maxim
 - Plugtek

Typical Implementation (TI)



Progress to date

- Draft Regulations published in 2008
- An attempt made to resurrect these in 2012
- Unfinished – ICASA has limited resources and too many fish to fry
- 2013 – draft standard in TC73 @ SABS: based on EN 50065-1

Where to next?

- SABS Standard would help significantly
- Recognition by manufacturers and BPL evangelists that a power line is an antenna
- Reasonable methods of dealing with spectrum licensing for BPL
- Workable regulations

Thank you

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