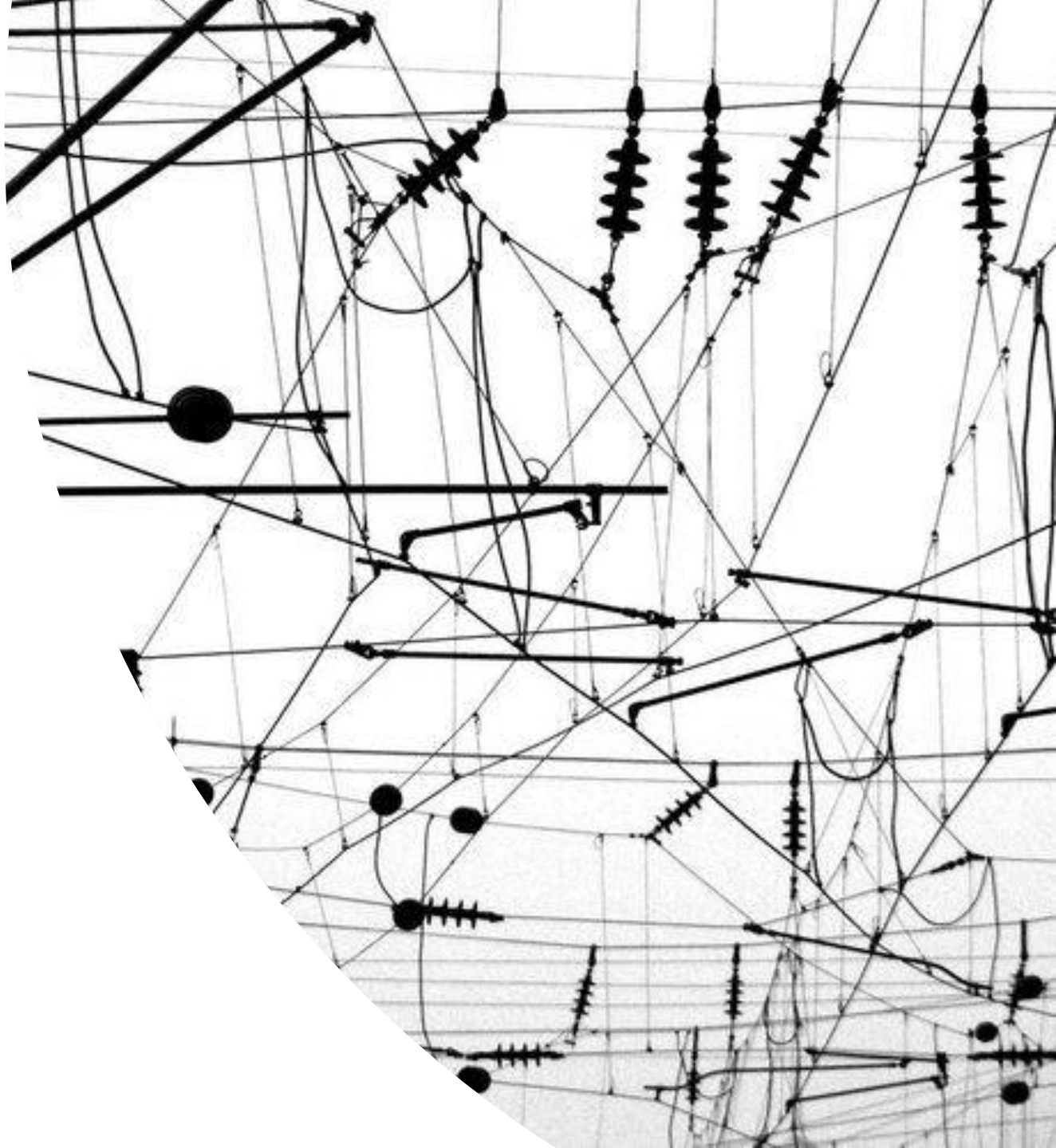
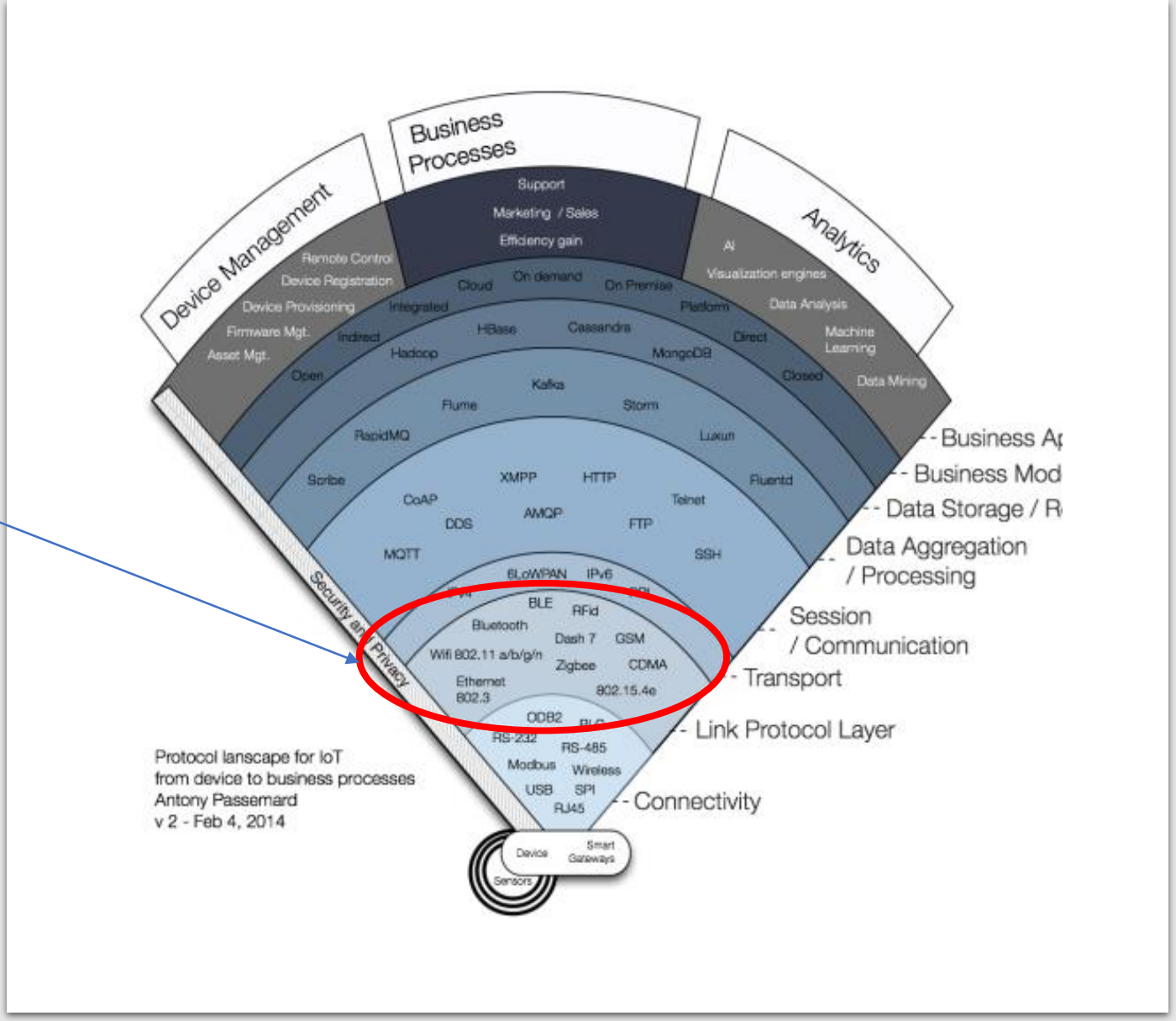
Frank Walsh

IoT Link Layer Protocols



Link Protocols

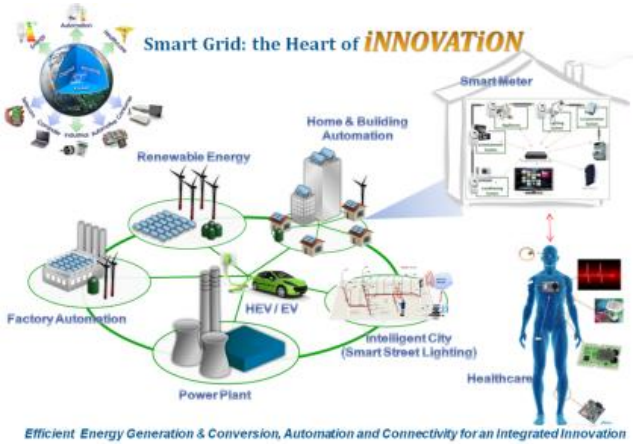
- Focusing down here.
- Summerise IoT applicable protocols.



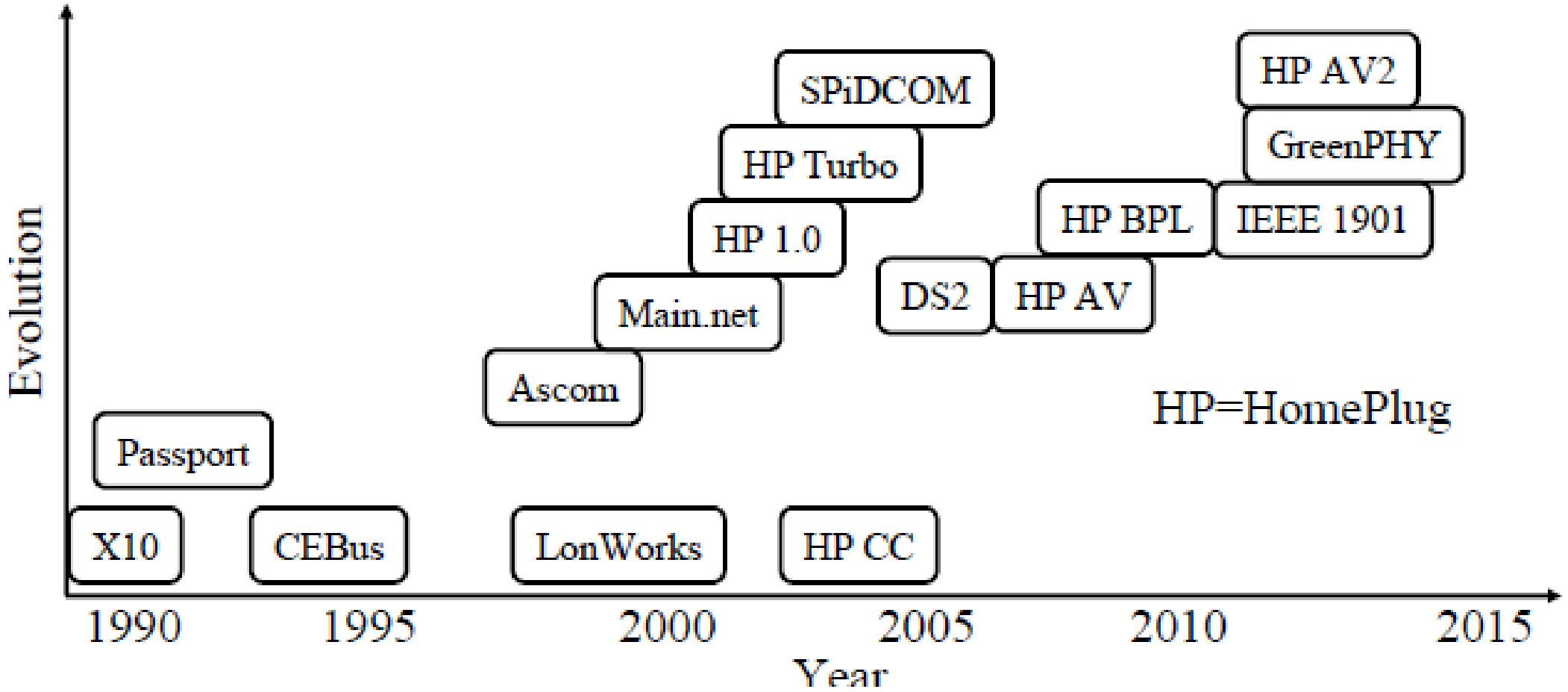
Protocols of note for IoT at link Layer

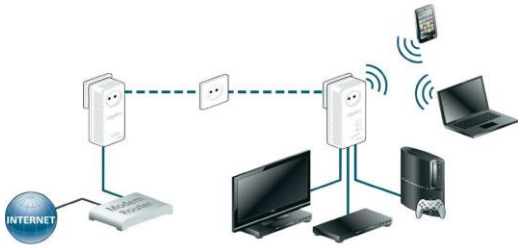
Power Line Communication (PLC)

- Origins in 1950s
  - remote lighting of street lights. 100 Hz and 1 kHz signals over electrical wires.
- Uses existing electrical wiring to carry both data and electric power
- Applicable to
  - Internet access
  - Utility management
  - Home automation
  - IoT



Evolution


Evolution
Passport
X10
CEBus
Ascom
Main.net
HP 1.0
HP Turbo
SPiDCOM
DS2
HP AV
HP BPL
IEEE 1901
GreenPHY
HP AV2
LonWorks
HP CC
HP=HomePlug
1990
1995
2000
2005
2010
2015
Year



HomePlug

- HomePlug 1.0
  - provides a peak PHY-rate of 14 Mbit/s. Replaced by HomePlug AV
- HomePlug AV/AV2
  - AV has sufficient bandwidth for applications such as HDTV and VoIP. Peak data rate of 200 Mbit/s at the physical layer. AV2 achieves gigabit-class PHY-rate
- HomePlug GP
  - HomePlug Green PHY specification is a subset of HomePlug AV. Intended for smart grid. Peak data rates of 10 Mbit/s
  - Designed for home appliances and plug-in electric vehicles

HomePlug

- 1.8 – 30 MHz spectrum.
- Uses Orthogonal Frequency Division Multiplexing (OFDM)
- Robust:
  - Same information transmitted on 2-5 subcarriers
  - Uses low-bit rate modulation (more resilient to High Freq. noise)
- Devices form an AV logic Network (AVLN)
  - Share a 128 bit AES key
  - Each AVLN has central coordinator
- Transmission over 2 lines (live and neutral)

Security

- AVLN Netork Membership Key
  - All devices have default NMK
  - Users/developers can configure devices to specific NMK
- Using NMK, device can request an encryption key

HomePlug AV2

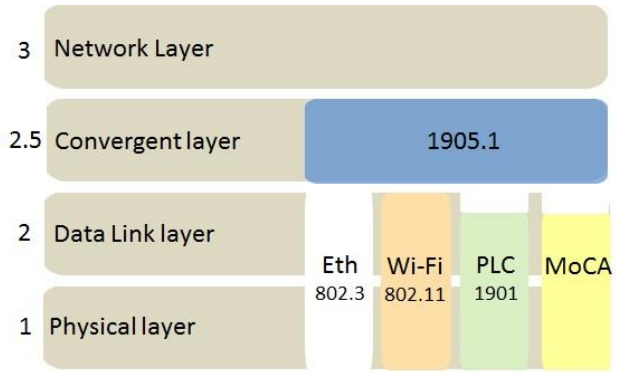
- Compatible with AV and GP
- In addition
  - Additional spectrum
  - MIMO(Multiple Input Multiple Output): two wires with three wire combinations(line-neutral, line-ground, neutral-ground)
  - Lower overhead: shorter packet
  - Repeating: intermediate devices can demodulate-remodulate
  - Better encoding
  - Power efficient: Stations can declare sleep periods

HomePlug GreenPHY

- Deigned for home area networks
- Monitoring and control apps
  - Hence lower power, lower data rates, lower cost
- Embedded in Smart Home devices:
  - smart appliances
  - programmable communicating thermostats (PCTs)
  - electric meters
  - plug-in electric vehicles (PEVs)
- Audi, BMW, Daimler, Ford Motor Company, General Motors, Porsche and Volkswagen use HomePlug Green PHY specification for PEVs.
  - a common, recognized standard to reduce the build complexity for suppliers and infrastructure providers.

HomePlug GreenPHY

- Complies with IEEE 1901-2010 (powerline networks)
- Compatible with AV and AV2
- Up to 10Mbps
- Uses 75% less power than HomePlug AV
- Version 1.1 has specific features for Evs
  - Secure billing at public chargers



Convergent Digital Home - IEEE 1905

- defines a network enabler for home networking
- Combines WiFi, HomePlug, Ethernet, Multimedia over coax(MoCA) at home
- Makes home look like single network
- Devices can aggregate data through multiple interfaces
  - Also allows fallback on link failure
- Convergent layer used to exchange Control Message Data Units(CMDU)
- No changes to underlying tech.

IEEE 1905.1 Management

- Compliant devices use Abstraction Layer Management Entity (ALME) (protocol)
  - Neighbour discovery
  - Topology exchange/change notifications
  - Flow forwarding rules
  - Security associations
- Common Topology
  - Homeplug as backbone for WiFi

IEEE 1905.1 Security

Push button

- Press button on new and existing device

Passphrase/key in new device

NFC: User touches new device with NFC device which is existing member

Auto Config:

- New access points can request configuration from existing APs.