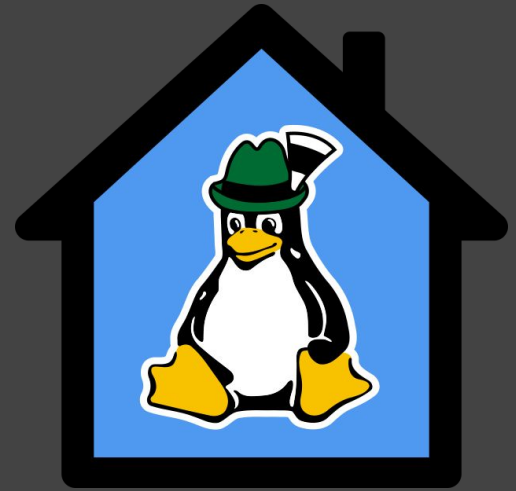


Build your own Smart Home

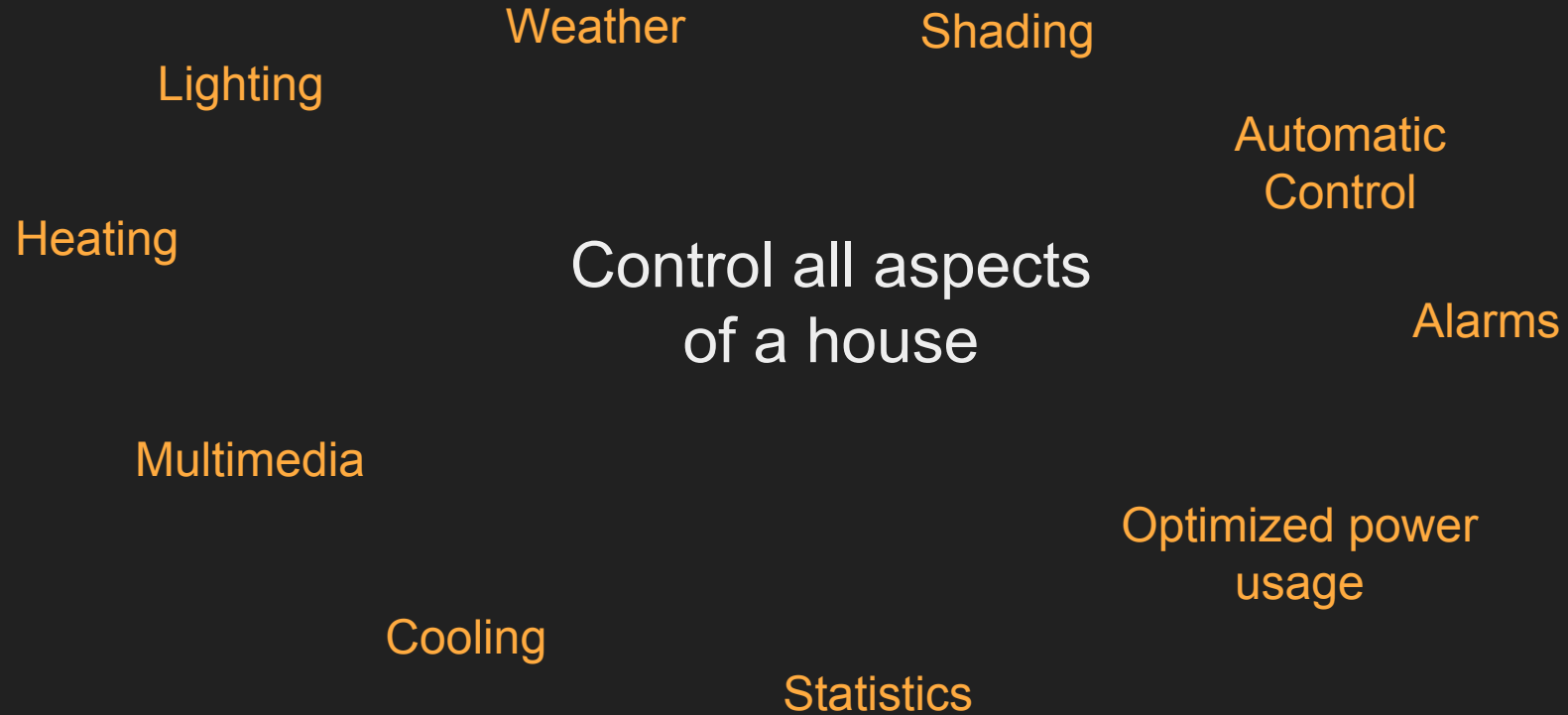


Matthias Straka
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Praktische Erfahrungen vom SmartHome-Bau
mit KNX und Linux

What can a smart home do?

What can a smart home do?

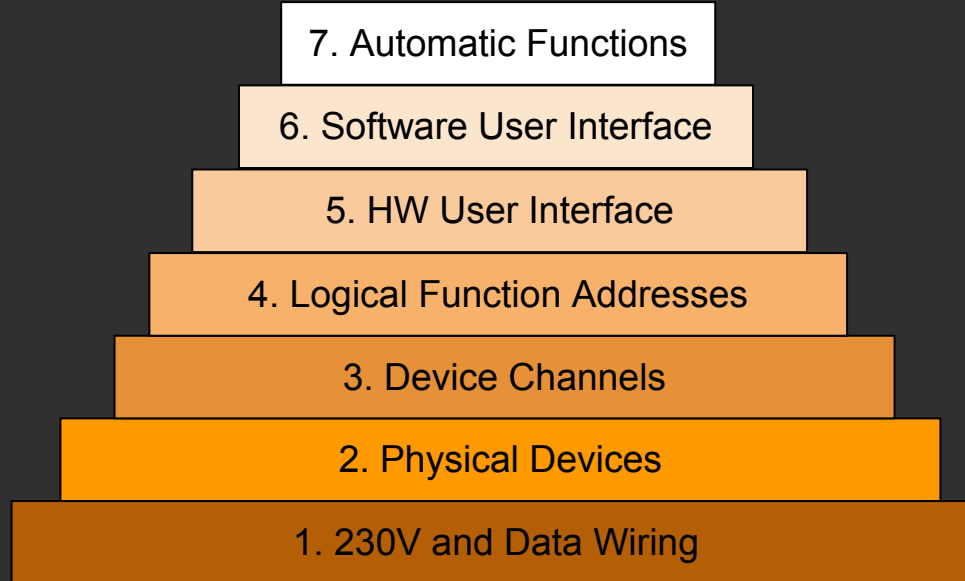


Build up your Smart Home in Layers

- Roughly plan all layers of your smart home in the **planning phase**
- No need to plan every detail in the beginning, **things will change!**
- **Focus** only **on current layer** during the installation
- Plan and reserve **space for future extensions**
- **Adapt** your **layers** as needed

Build up your Smart Home in 7 Layers

Planning



Planning your Smart Home

- **General considerations**
 - What do I want to do?
- **Choosing your hardware**
 - Technology
 - Installation
- **Software Control and Visualization**
 - Display-Panel
 - Smartphone
 - Web-based

What hardware system should I choose?

- **Where** do I install the system?
 - Building a new house
 - Replacing / Extending existing installation
- **Long-term support** of the manufacturer
 - Can I replace parts after >5 years?
 - Compatible with future technologies?
- **Maintenance** / Operation by other people
- Estimating **costs**
 - Costs for devices
 - Wiring costs
 - Cost for work

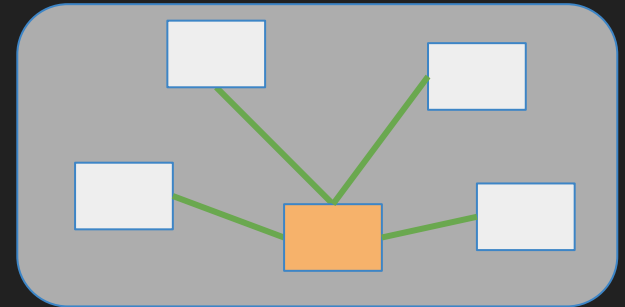
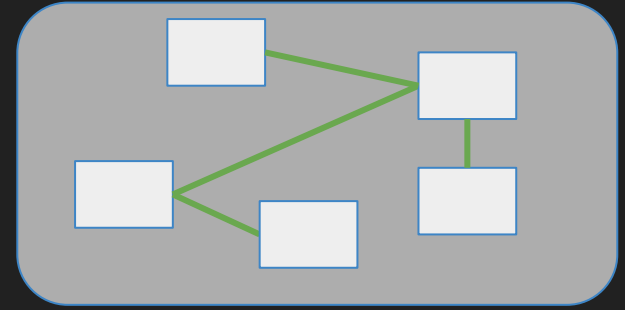
Why we have chosen KNX

- Open industry **standard**
- 100s of independent **manufacturers**
- **Decentralized** system
 - Single-Device failure does not break the system
- Easy to install
- Dedicated **actors** for switches, blinds, etc.
- Many **sensors** / UI choices
- Reasonable price



Layer 1: Wiring / Communication

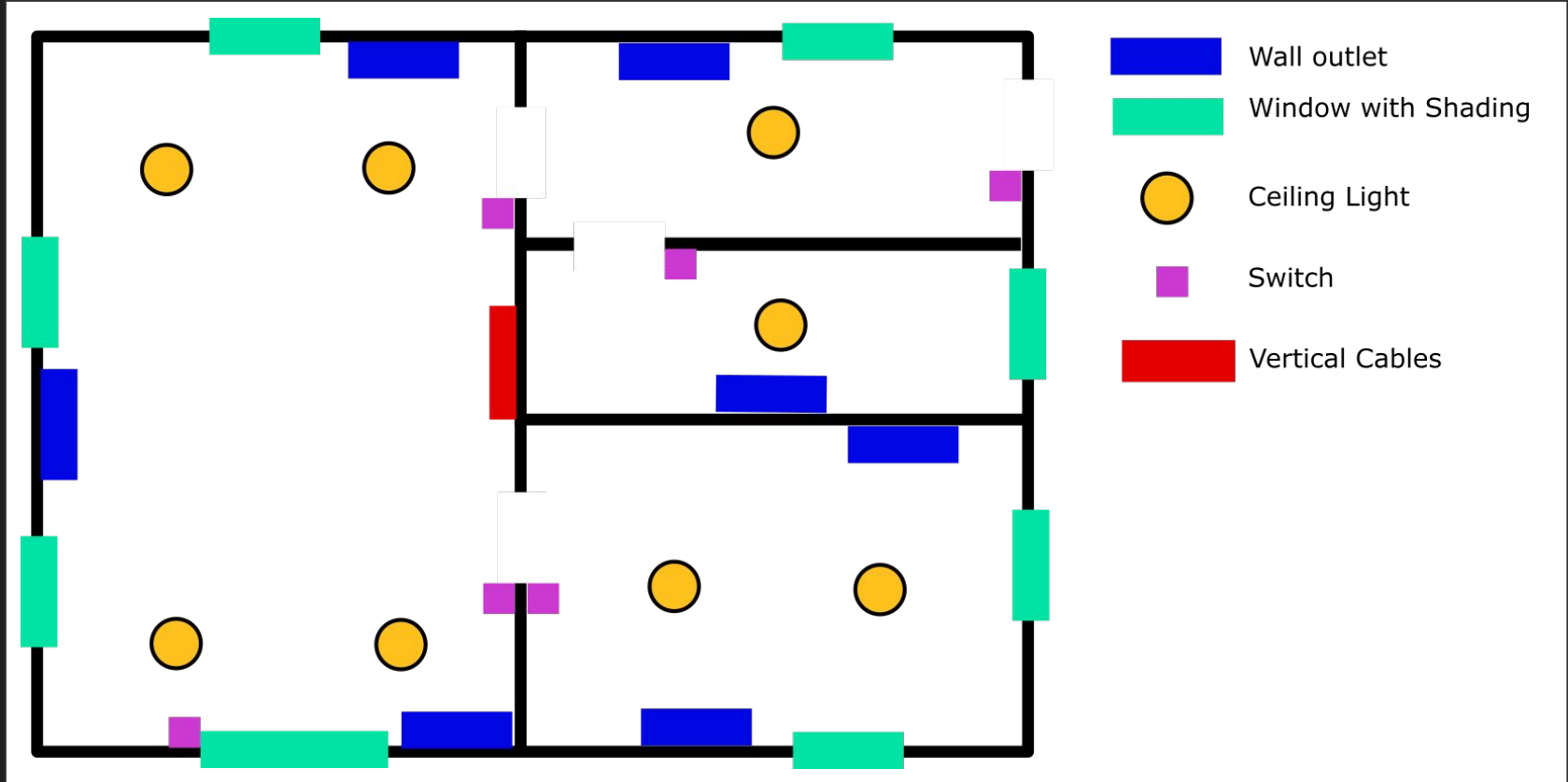
- **Tree-Topology**
 - 2/4-Wire line between all bus nodes (Power + Data)
 - KNX: Bus cable parallel to 230V cables possible
- **Star-Topology** with binary inputs
 - All active devices can be placed in one location
 - Use cheap standard switches
- **Wireless-Technology**
 - Ideal for replacing existing installations
 - Batteries !?
- **Hybrids**



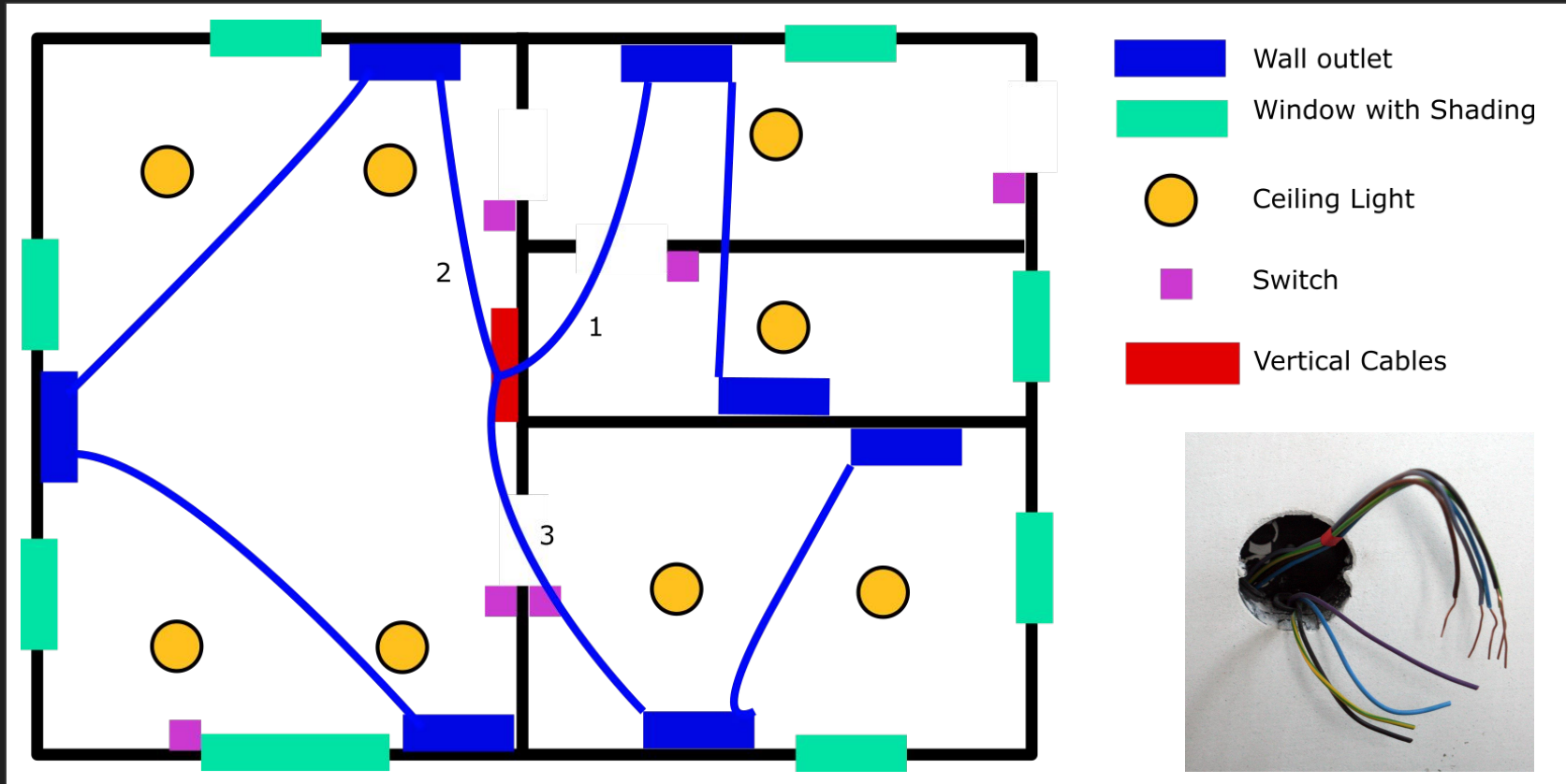
Layer 1: Wiring / 230V Power

- Wall outlets
 - Switchable outlets → Install extra wires!
 - One circuit per room → To main distribution
 - Make all outdoor outlets switchable
- Lights / Shading
 - To junction point on each floor
 - One multi-wire cable to main distribution

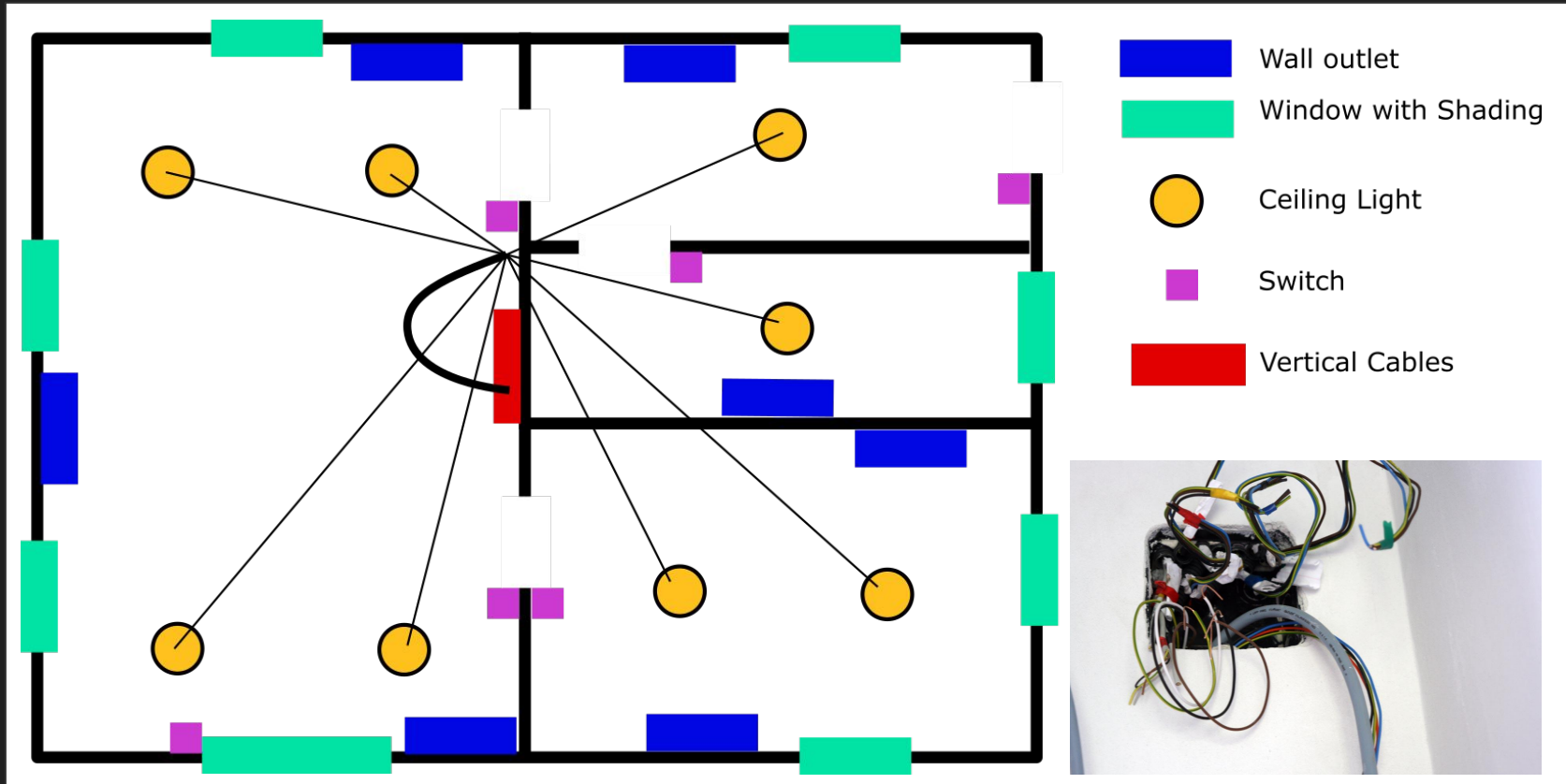
Layer 1: Wiring Schema



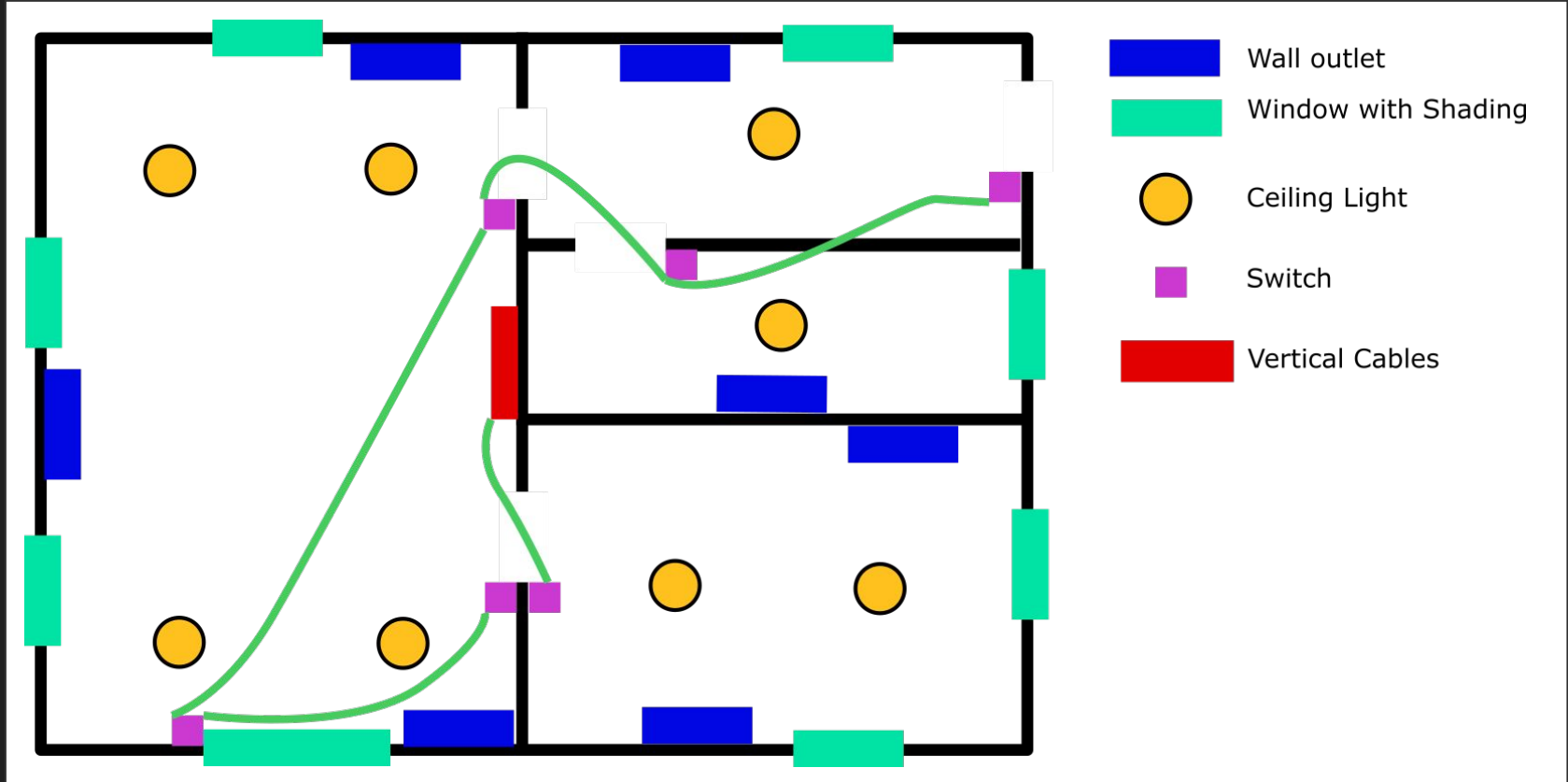
Layer 1: Wiring Schema - Wall outlets



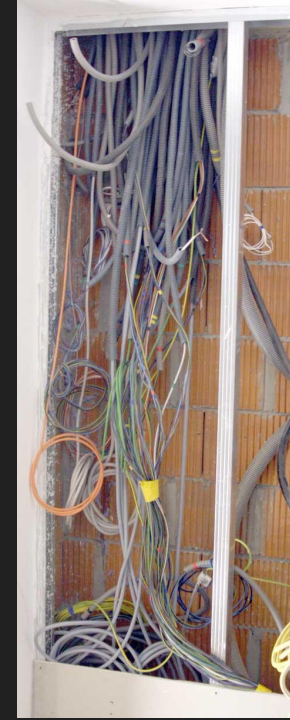
Layer 1: Wiring Schema - Lights



Layer 1: Wiring Schema - Bus Switches

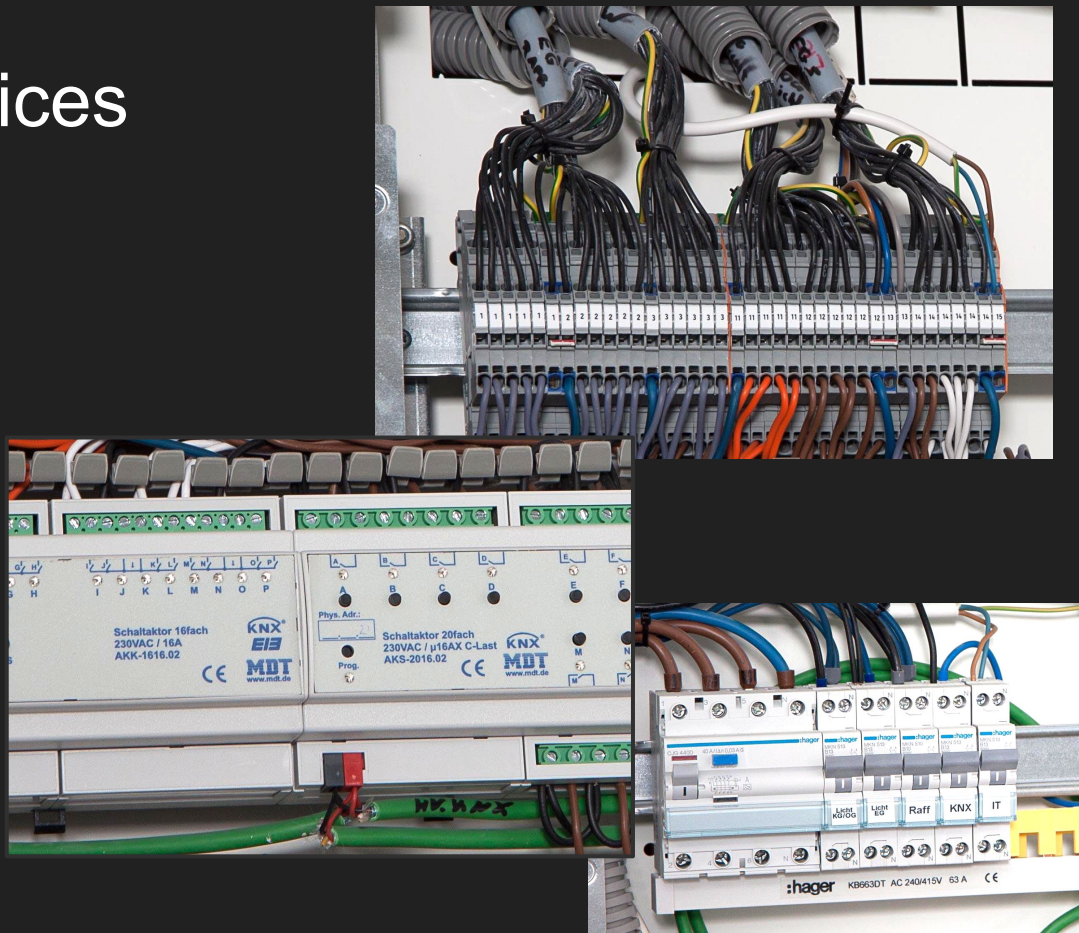


Layer 1: Wiring / Impressions



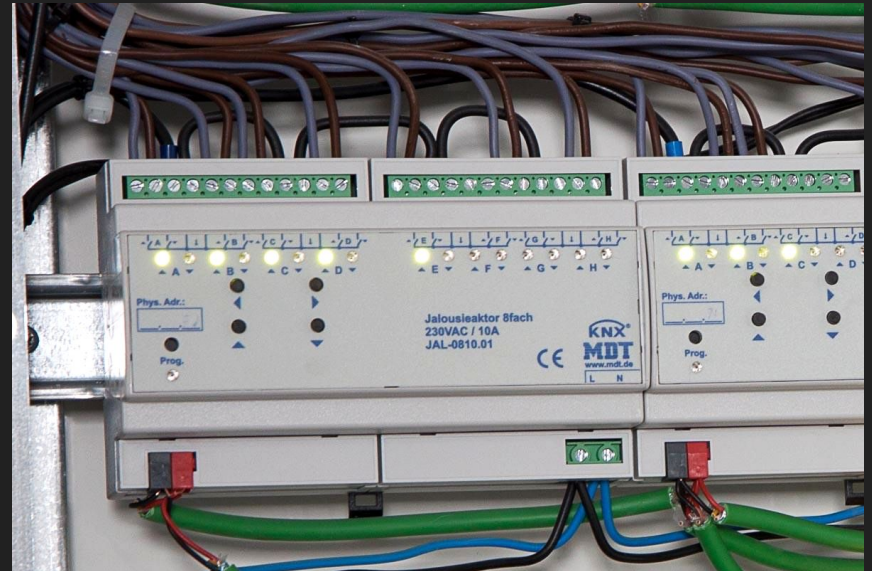
Layer 2: Physical Devices

- Collect incoming cables
- Actors
 - Isolation SELV / 230V
 - Type of relais (caution LEDs)
- Sensors
- System Devices
 - Power supply
 - Bus interfaces



Layer 3: Channels

- Assign a channel to each cable
- Channel settings
 - Timeouts (Staircase)
 - Locks
- Special channels
 - Up/Down for automatic blinds
 - Heating control
 - Binary Input



Layer 4: Group addresses

- “Virtual Wires”
- Event based communication
- Data packets: Group address + Data
 - One sender → 1 or many receivers
- Data types
 - On/Off
 - Percentage
 - Temperature
- Define hierarchical address schema:
 - 1/1/20 could mean lights / 1st floor / main light in room 2

Example:

- Button sends 1/1/20:1
- Actor reacts on 1/1/20
turns on relay CH C
- Actor sends status 1/1/21:1
- Button receives 1/1/21,
turns on status LED

Layer 4: Programming KNX Devices

- **Requires proprietary software** (ETS) + IP interface
- Professional version is expensive (> 1000 EUR)
- Cheaper versions with devices per project limit:
 - Split your house into several projects
 - **Free ETS Demo** for max. 3 devices/project
 - **ETS Lite** for max. 20 devices/project (~ 200 EUR)
 - Online-Course to earn a **voucher**: <http://wbt5.knx.org/>
 - ETS Lite price with voucher ~ **100 EUR** all incl.

Layer 5: HW user interface / Buttons

- Text / Graphic **labels**
- One button, **multiple functions**
 - Single-Action
 - Toggle
 - Multi-Action
- Feedback / **Status** lights
- **Sensors**
 - Temperature
 - Movement



Layer 6: Software UI

- **Dedicated server** in local LAN
- **Access** to core system via **TCP/IP** connection
- Home-Control via Browser
- Home-Control via Smartphone/Tablet
- Remote access



© flickr/Scott Lewis

Layer 6: Choosing a home server

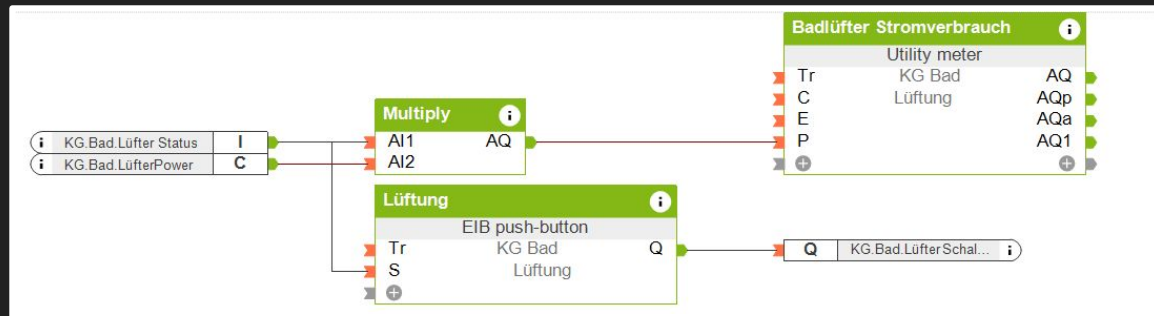
- **Basic home control** should be **independent of any server**
 - Fail-safe, decentralized operation
- **Open source home automation hubs**
 - Run on Linux - e.g. Raspberry PI
 - Integrate sensors / actors from different systems
- **Dedicated commercial servers**
 - Mid to high price
 - Easy to install and maintain
 - Possibly with built-in interfaces (Relays, 1-10V, Binary inputs)

Layer 6: Bus access with KNXD/eibd (Linux)

- **Linux Service** for KNX bus access via TCP
- <https://github.com/knxd/knxd>
- Runs on Raspberry PI / Banana PI
- Test-Tool `knxtool`:
 - Turn on 1-Bit command: `knxtool on ip:localhost 1/1/20`
 - Send Command: `knxtool groupwrite ip:localhost 1/1/20 1`
 - Read Value: `knxtool grouplisten ip:localhost 1/1/20`
- **C-API**:
 - Connect to KNXD service
 - read/write data via simple C interface
- Similar KNX interfaces for **Python** available

Layer 7: Automatic Control

- React on **user presence**
- Use **weather data** (sunlight, wind, temperature)
- **Optimize** dynamic power **costs** (e.g. solar)
- Gather **statistics** data



Unexpected Challenges

- **Ordering** electrical supplies **online**
- **Lots of wires**
- Difficulties to operate smart buttons for **house guests**
- **Status lights** are nice - except when sleeping
- Buttons will be **reprogrammed** often in the beginning
- There is usually **little time** to program your smart home in the beginning

What can I do myself?

- Planning electrical installations [**hard**]
- Installing wall outlets / switches [**medium**]
- Installing wiring [**easy**] (but takes lots of time!)
- Installing devices in main distribution frame [**hard**]
- Wire switches, power outlets [**easy**]
- Programming devices [**easy***]
- Working with software interfaces [**easy***]

* considering the audience in this room

Summary

- It is relatively **easy to build your own smart home**
 - Ideal when building a new house
- Break down your **project into layers**
- There is a **growing community** of smart home owners
- Build with **standard hardware**, **extend with custom software**
- **Pay** more on hardware, **save** money by installing it yourself
- More information in following talks



Is there anything else you'd like to know?

Planning

