newBaC Device & Infrastructure Software Architecture (DISA)
Version 1.0 Proposal

1. Purpose

The newBaC Device & Infrastructure Software Architecture (DISA) defines the common software architecture for all newBaC products.
Its purpose is to provide:

- vendor-independent building infrastructure
- Matter interoperability
- Thread networking
- local commissioning
- local maintenance
- local recovery
- browser-based management
- long-term device lifecycle management

without dependency on:

- cloud services
- proprietary mobile apps
- specific ecosystems
- single gateway devices

All newBaC devices shall implement a common software foundation and may assume one or more logical roles.

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2. Core Design Principles

2.1 Building-Centric

Configuration belongs to the building.
It shall not belong to:

- a resident
- a smartphone
- a cloud account
- a vendor platform

The building remains operational despite tenant or ecosystem changes.

```
Building
└─ Home-ID
    ├─ Rooms
    ├─ Devices
    ├─ Scenes
    ├─ Automations
    └─ Gateways
```

2.2 Matter-First
Every newBaC device shall operate as a standards-compliant Matter device whenever applicable.
newBaC extensions shall never prevent standard Matter interoperability.
Supported ecosystems may include:

- Apple Home
- Google Home
- Samsung SmartThings
- Home Assistant
- Future Matter ecosystems

2.3 No Cloud Dependency
All essential functionality shall work locally.
Including:

- commissioning
- diagnostics
- maintenance
- firmware update
- backup
- recovery

Internet access shall not be required.

2.4 Browser-First
No dedicated mobile application shall be required.
Every device shall expose a local web interface.
Example:

http://192.168.26.1
http://newBaC-device.local

2.5 Distributed Infrastructure
No single device shall be a mandatory point of failure.
Any suitable device may assume infrastructure responsibilities.

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3. Device Roles
A single physical device may implement multiple roles simultaneously.
3.1 Matter Device
Standard Matter endpoint.
Examples:

- Light
- Switch
- Sensor
- Thermostat
- Window Covering

3.2 Infrastructure Device

Provides:

- provisioning
- maintenance
- diagnostics
- firmware management

independent of Matter ecosystems.

3.3 Gateway

Additional responsibilities:

- Device Registry
- house.json management
- Backup & Restore
- Tenant Management
- Infrastructure Diagnostics
- Matter Bridge

3.4 Matter Bridge

Exposes bridged devices into Matter fabrics.

3.5 OTA Provider

Distributes firmware images to other devices.
Any newBaC device may temporarily assume this role.

3.6 Infrastructure Commissioner

Creates provisioning packages and commissions devices into the newBaC infrastructure.
Possible implementations:

- Gateway
- Switch
- Browser Tool
- Installer Tool

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4. Commissioning Models

Every device shall support three commissioning models.

4.1 Direct Infrastructure Provisioning

The device enters provisioning mode.
Activation:

- button press
- reset sequence
- installer command

The device provides:

Temporary Wi-Fi Hotspot
+
Web Interface

The installer uploads:
device.json
containing:

- Home-ID
- Gateway-ID
- Thread Credentials
- Security Information

The device automatically joins the building infrastructure.

4.2 Standard Matter Commissioning

The device behaves as a standard Matter device.
Provisioning through:

- BLE
- QR Code
- Manual Pairing Code

The device may join any Matter fabric.

4.3 Gateway Commissioning

When configured as Gateway:
Additional functionality becomes active:

- Device Registry
- Building Configuration
- Matter Bridge
- Backup & Recovery
- OTA Coordination

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5. Matter and Thread Architecture

5.1 Matter over Thread

The preferred transport for newBaC devices shall be:

Matter over Thread

5.2 Temporary Commissioning Hotspot

A commissioning hotspot shall not interrupt:

- Thread operation
- Matter operation
- Device functionality

Hotspot operation is intended for:

- commissioning
- diagnostics
- maintenance
- firmware updates

5.3 Multi-Fabric Support

Devices shall support Matter Multi-Fabric wherever feasible.
This allows simultaneous participation in:

- newBaC Infrastructure
- Apple Home
- Google Home
- Home Assistant
- other Matter ecosystems

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6. Matter Bridge Architecture

When operating as a Gateway, the device shall expose a Matter Bridge.
The bridge shall support certification for the following Matter Device Types:

Controls

- Generic Switch
- Dimmer Switch

Lighting

- On/Off Light
- Dimmable Light
- Color Temperature Light

Sensors

- Contact Sensor
- Occupancy Sensor
- Light Sensor (Illuminance)
- Temperature Sensor
- Humidity Sensor
- Air Quality Sensor

HVAC

- Thermostat

Entry Control

- Window Covering

Future Matter Device Types may be added without architectural changes.

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7. Thread Border Router

Thread Border Router functionality is optional.
A Gateway may operate in one of three modes:

Mode A

Gateway only

Mode B

Gateway + Matter Bridge

Mode C

Gateway + Matter Bridge + Thread Border Router

This allows interoperability with:

- Apple Border Routers
- Google Border Routers
- IKEA ecosystems
- third-party Thread infrastructures

without requiring a mandatory newBaC Border Router.

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8. Data Architecture

factory.json

Immutable manufacturing information.

```
{
  "device_id": "...",
  "hardware_type": "...",
  "serial_number": "...",
  "matter_dac": "...",
  "qr_code": "..."
}
```

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device.json

Infrastructure provisioning package.

```
{
  "home_id": "...",
  "gateway_id": "...",
  "thread_credentials": "...",
  "timestamp": "...",
  "signature": "..."
}
```

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runtime.json

Generated dynamically.

```
{
  "firmware_version": "...",
  "matter_status": "...",
  "thread_role": "...",
  "uptime": "...",
  "memory": "..."
}
```

house.json
Stored on Gateways.

```
{
  "home_id": "...",
  "rooms": [],
  "devices": [],
  "scenes": [],
  "automations": []
}
```

Weitere Zeilen anzeigen

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9. Matter Onboarding Information
Every device shall expose through its web interface:

- Vendor ID
- Product ID
- Device ID
- Discriminator
- Setup Passcode

as well as:
Manual Pairing Code
Example:
1462-573-3552
MT String
Example:
MT:Y.K9042C00KA0648G00
Matter QR Code
Generated dynamically from onboarding data.
This information shall remain available whenever the device hotspot is active.

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10. Firmware Architecture

OTA Requestor

Every device shall implement OTA Requestor functionality.

Distributed OTA Provider

Any newBaC device may temporarily become an OTA Provider.

Firmware distribution workflow:

Mobile Device
↓
Selected newBaC Device
↓
OTA Distribution
↓
Target Devices

Gateway Responsibility

The Gateway stores:

- firmware metadata
- approval status
- rollout policies

The Gateway is not required to permanently store all firmware images.

This minimizes storage requirements on gateway devices.

10A. Dual Runtime Architecture

Principle

Every newBaC device shall separate:

- infrastructure functionality
- application functionality

into independent software domains whenever supported by the target platform.

For ESP32-C6 based devices this separation shall utilize:

High Performance Processor (HP Core)
+
Low Power Processor (LP Core)

The infrastructure layer shall remain independent from application-specific logic.

HP Core Responsibilities

The High Performance Processor shall host the mandatory newBaC infrastructure functionality.

Examples:

- Matter Stack
- Thread Stack
- Matter Bridge
- Gateway Functions
- Device Provisioning
- Web Interface
- REST API
- OTA Management

- Security Services
- JSON Handling
- Diagnostics

The HP firmware shall not depend on ESPHome.
Implementation may use:

- ESP-IDF
- ESP-Matter
- OpenThread
- other approved software components

LP Core Responsibilities
The Low Power Processor shall host optional device-specific functionality.
Implementation shall be based on:
ESPHome
where practical.
This allows rapid implementation of reusable application modules.
Examples:

- Sensors
- Lighting diagnostics
- Energy monitoring
- Product-specific features
- Demonstration functions

The HP firmware shall continue to operate normally even if the LP firmware is unavailable, stopped, corrupted or not installed.

Mandatory ESPHome Compatibility Layer
All newBaC products shall provide a defined interface between:
HP Infrastructure Firmware and

- LP ESPHome Firmware
- Weitere Zeilen anzeige

This interface shall remain hardware-independent.
The objective is that:

- Matter functionality remains unchanged
- Gateway functionality remains unchanged
- Device-specific functionality can evolve independently

10B. Public Device Data Services
The LP firmware may expose public product information through the local web interface.
Examples:
EPREL Information
Storage and presentation of:

- EPREL registration information
- energy label information
- public product characteristics

Data may be stored in dedicated device memory components such as:

U1TMP1827NNGRR
or equivalent devices.

Temperature Curve
The device may expose:

Temperature
vs
Operating Time

or
through:

- Web Interface
- REST API
- downloadable JSON

Energy Data
ESPHome reference implementations shall support display of:

- Voltage
- Current
- Active Power
- Energy Consumption

when suitable hardware is available.

10C. Demonstration Platform Requirements
Reference platforms shall support the same LP architecture as production devices.
Example:

M5Stack NanoC6
+
newBaC Hanging Light

The LP firmware shall continue to provide:

- EPREL information
- Temperature monitoring
- Voltage monitoring
- Current monitoring
- Power monitoring

through the local hotspot and web interface.
This ensures that prototype, validation and production environments share the same software architecture.

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11. Storage Architecture
Internal flash shall primarily contain:
- firmware
- Matter data
- Thread data
- configuration data

Devices requiring larger data retention may use external non-volatile memory.
Examples:
- event logs
- diagnostics
- energy history
- commissioning history

Supported technologies include:
- SPI Flash
- FRAM
- EEPROM

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12. Diagnostics
Every device shall provide:
- Firmware Version
- Build Date
- Thread Status
- Matter Status
- Memory Usage
- Signal Quality
- Uptime
- Factory Data Integrity
- Configuration Integrity

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13. REST API
Minimum endpoints:
GET /api/device
GET /api/runtime
GET /api/factory
POST /api/device
POST /api/reset
POST /api/ota
Gateway devices may provide additional APIs.

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14. Security Model
Protected Storage
The protected partition shall contain:
- DAC Certificates
- Manufacturing Credentials
- Factory Data
- Thread Credentials

OTA updates shall never overwrite this partition.

Signed Provisioning
Before accepting a device.json package, the device shall verify:

- signature
- timestamp
- Home-ID consistency

Access Roles
Installer

- commissioning
- firmware updates
- diagnostics

Building Owner

- backup
- recovery
- tenant management

Resident

- ecosystem pairing
- normal operation

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15. Long-Term Vision
The DISA architecture shall support future building functions without fundamental redesign:

- Lighting
- Presence Detection
- HVAC
- Shading
- Metering
- Energy Management
- Load Control
- Battery Storage
- EV Charging
- Building Analytics

while always maintaining the principles:

1. Matter
2. Thread
3. Browser Tools
4. Local Commissioning
5. No App Required
6. No Cloud Required
7. Building Ownership of Configuration

This architecture becomes the normative software foundation for all future newBaC devices and should be referenced by individual SDAs rather than duplicated within them.