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Pushing Java EE outside of the Enterprise

Home Automation

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JavaOne ORACLE

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Program Agenda

1. Home Automation
2. Java EE
3. Demo
4. Wrap-up

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Home Automation

Features

- “Devices” control
  - Lights, windows, blinders, audio, doors, wall-plugs, heating, etc.
  - From different “terminal”
- Monitoring & dashboard
  - Power consumption, weather, motion/presence, intrusion, etc.
- Scenario, scene, scheduling & automation
- “Flexible” configuration

Home Automation

Benefits

- Better control
  - Improves day-to-day life, e.g.. disabled person
  - Improves security
  - More Eco friendly
- …

Home Automation

Market

- Crowded space
- Just the beginning!
- IoT

Home Automation

Technologies

- X10 / PCLBUS
- RF433
- EnOcean
- Z-Wave
- ZigBee
- Domologic
- Domintell
- NikoBus / HomeControl
- Chacon / DI-O
- Somfy RTS
- io-homecontrol
- VelBus
- Domologic
- KNX
- BLE
- HomeKit
- Thread
- …

Home Automation

Actors

- Sensors
  - Switches, motion, temperature, CO2, humidity, wind speed, etc.
- Actuators
  - Lights, blinders, windows, doors, audio, wall-plugs, etc.
- Network
  - Wired or/and wireless + TCP/IP
- Hub, box, gateway
  - Provides added values

Z-Wave

“Z-Wave, The Interoperable Standard”

- “Interoperable wireless RF-based communications technology designed for control, monitoring and status reading applications in residential and light commercial environments.”
- Proprietary
- Z-Wave Alliance
  - Consortium of 250 manufacturers and service providers worldwide

http://www.z-wavealliance.org

Z-Wave

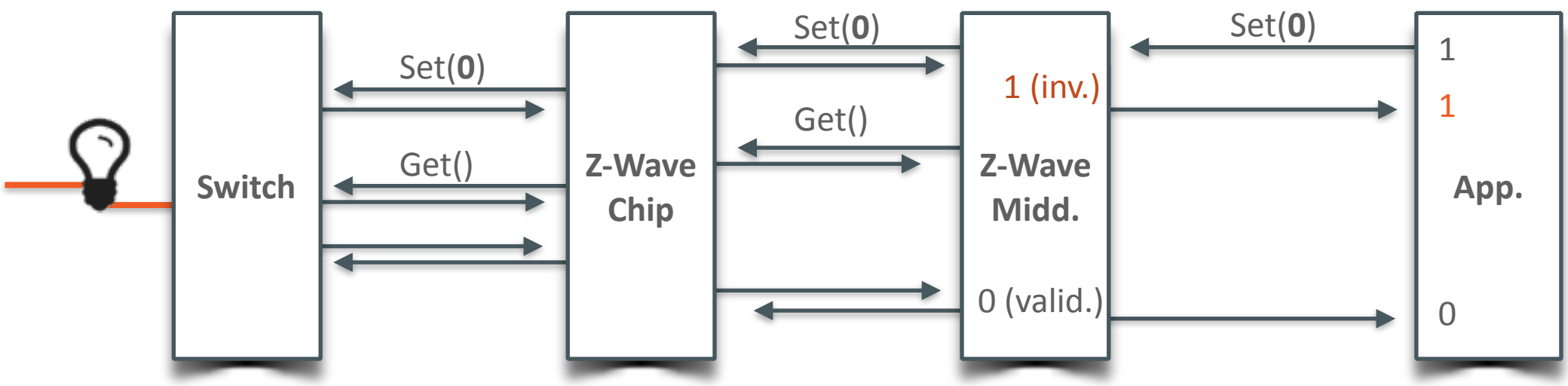
“Z-Wave, The Interoperable Standard”

- Meshed wireless network
- Range 100 ft (open-sight)
- 232 modules per controller
- Cheap and simple

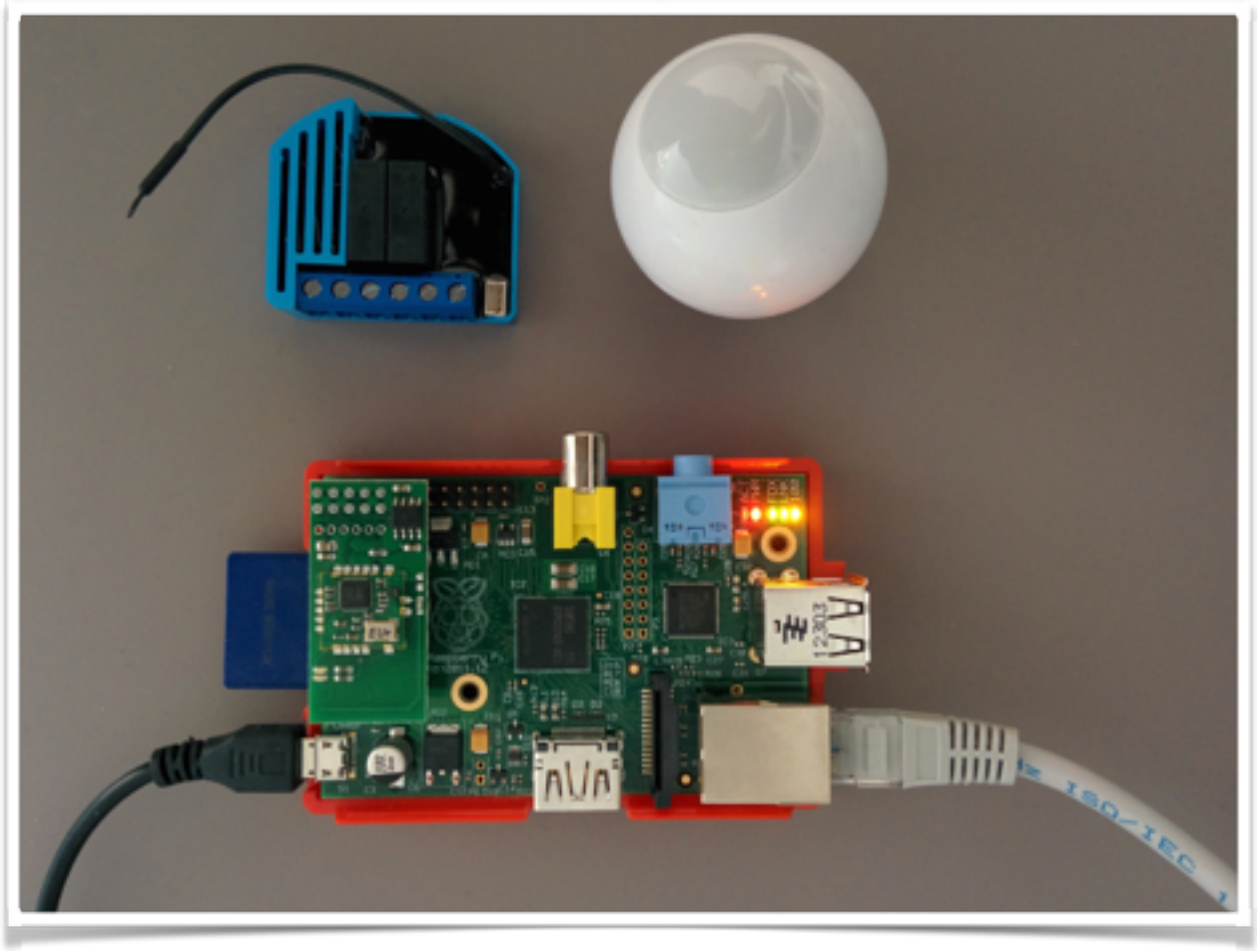
Connectivity

- Physical connectivity
  - Razberry-Pi Daughter Card
  - Aeon Labs Z-Stick, …
- Middleware
  - OpenZwave
  - RaZberry / Z-Wave-me / Z-Way
  - Domoticz, …

Principles



In real life



KNX

“The worldwide STANDARD for home and building control”

- ISO/IEC 14543-3
- KNX Association
  - 340 KNX Members in 37 countries
  - 40 KNX National Groups
  - 275 Training Centres in 51 countries
  - 40,189 KNX Partners in 125 countries
  - 100 Scientific Partners in 28 countries
  - 13 User clubs in 12 countries

http://www.knx.org

KNX

“The worldwide STANDARD for home and building control”

- Media
  - TP, PL, RF and IP
- Engineering Tool Software
  - Manufacturer independent configuration software tool
  - Design and configure intelligent home and building KNX installations

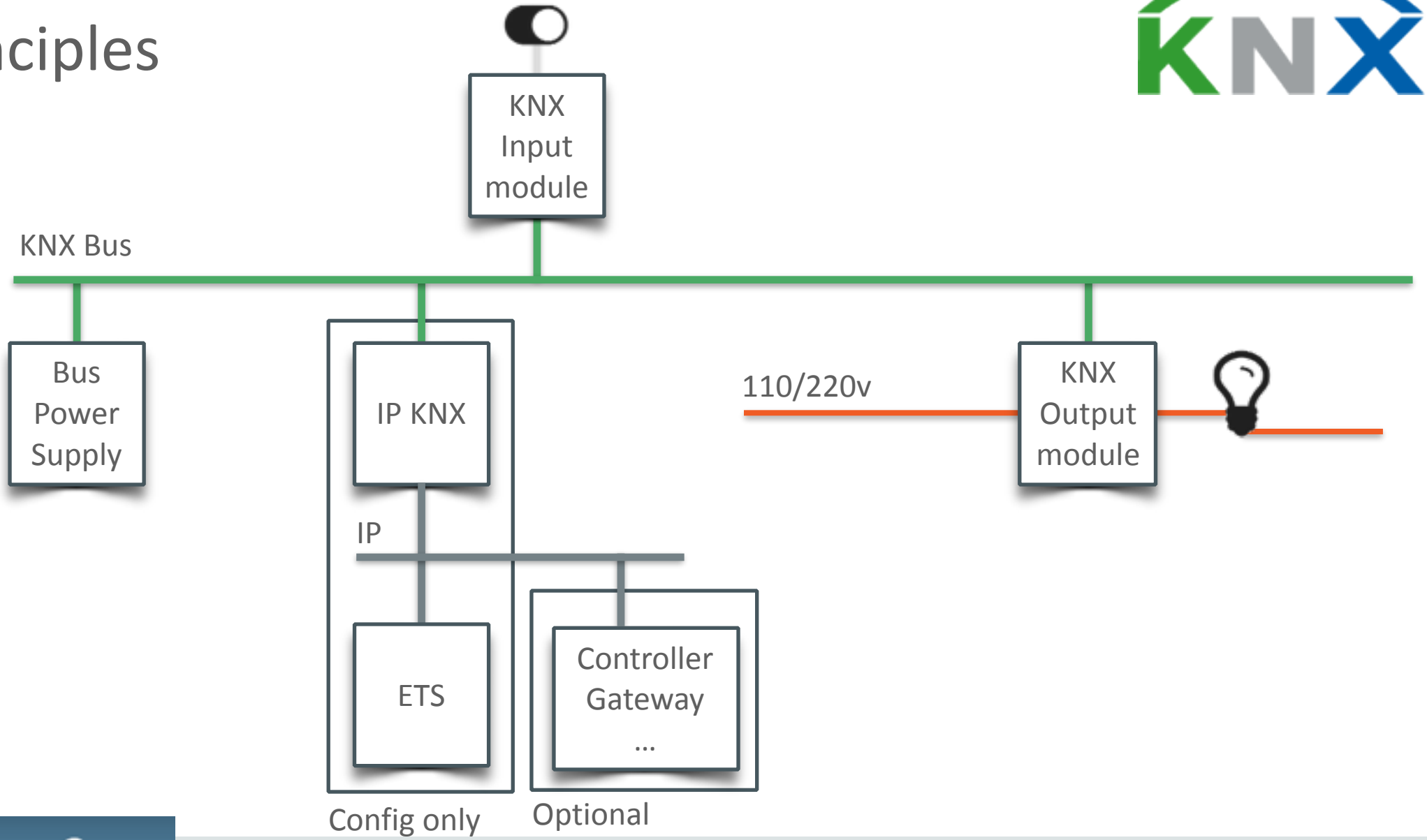
Connectivity

- Physical connectivity
  - KNX/USB Router
  - KNX/IP Router
  - Eelectron Raspberry Pi KNX interface

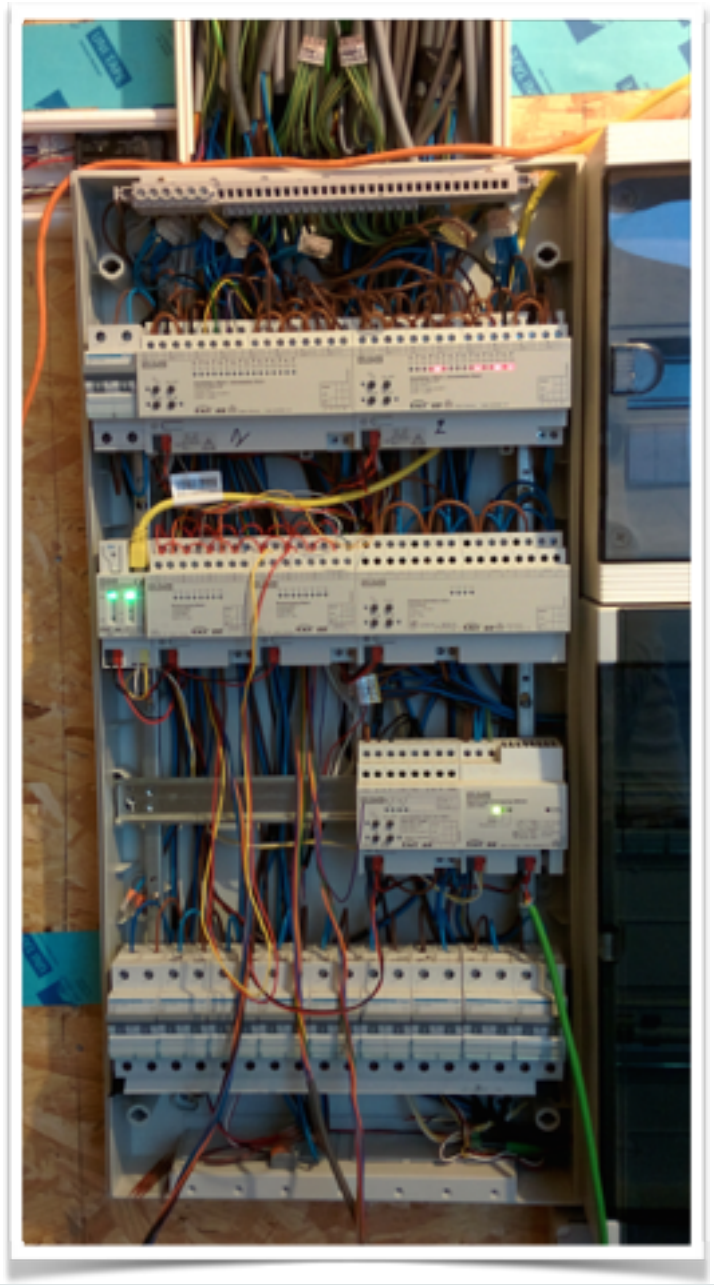
Calimero

- Java library for KNX/EIB applications
  - KNX Network services and data encodings
  - Routing
  - Local device management
  - Datapoint type and property type translation
  - ETS4 import, …
- Min Java 2 Micro-Edition CDC Foundation Profile
- http://calimero.sourceforge.net

Principles



In real life



Z-Wave Vs. KNX

- Proprietary
- 232 devices per controller
- Residential grade
- Wireless, more sensible
- Powered via batteries and PL
- Controller is the Single PoF
- Simple, non intrusive
- Cheap

- ISO Standard
- Up to 58.000 bus devices
- Industrial, professional grade
- Wired, more reliable
- Powered through the Bus
- No real PoF
- Complex, intrusive
- Expensive

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Java EE

- More annotated POJOs
- Less boilerplate code
- Cohesive integrated platform

- WebSockets
- JSON
- Servlet 3.1 NIO
- REST

- Batch
- Concurrency
- Simplified JMS

Java EE

- Connectivity
  - EE to clients
  - EE to HA
- Events

JSON-P

JSR 353

- API to parse and generate JSON
- Streaming API (`javax.json.stream`)
  - Low-level, efficient way to parse/generate JSON
  - Similar to StAX API in XML world
- Object model API (`javax.json`)
  - Simple, easy to use high-level API
  - Similar to DOM API in XML world

JSON-P

```
public class Notification {

    // bunch of Getters & Setters

    public String toJson() {
        JsonObject model = Json.createObjectBuilder()
                .add("source", getSource())
                .add("target", getTarget())
                .add("val", getValue())
                .add("type", getType())
                .add("medium", getMedium())
                .add("cyclic", isCyclic())
                .add("time", getTimestamp())
                .build();
        return model;
}
```

Java API for Web Socket

JSR 356

- Bidirectional full-duplex messaging
  - Initial HTTP handshake
  - Over a single TCP connection
- IETF defined protocol: RFC 6455
- HTML5 / W3C defined JavaScript API
- JSR 356
  - Client & Server API

WebSocket Server Endpoint (1/2)

```
@ServerEndpoint("/wsEndPt")
public class InboundWebsocket implements Serializable {

    static Queue<Session> queue = new ConcurrentLinkedQueue<>();

    @OnOpen
    public void openConnection(Session session) {
        queue.add(session);
    }

    public void onEvent(Notification notif) {
        sendAllEndpoints(notif.toJson());
    }

    …
```

WebSocket Server Endpoint (2/2)

```
…
public static synchronized void sendAllEndpoints(String payload) {
     try {
         for (Session session : queue) {
             if (session.isOpen()) {
                 session.getBasicRemote().sendText(payload);
             }
         }
     } catch (IOException e) {
         // Oooops
     }
 }
```

WebSocket Client Endpoint

```
function connect() {
    wsocket = new WebSocket('ws://' + window.location.host + '/dashboard/wsEndPt');
    wsocket.onmessage = onMessage;
}

function onMessage(evt) {
   jsonData = JSON.parse(evt.data);
   targetDiv = jsonData.target;
   var myDiv = document.getElementById(targetDiv);

   if (jsonData.type === "switch") {
          if (jsonData.val === "true") value = "ON";
          else value = "OFF";
   }
   else value = jsonData.val;
   $(myDiv).text(value);
}
```

Contexts and Dependency Injection for Java EE 1.1

JSR 346

- Core component model
  - Enabled by default in implicit bean archives
- Expanded use of CDI Interceptors
  - Transactional interceptors
  - Method-level validation interceptors
- New CDI scopes
  - @TransactionScoped
  - @FlowScoped

CDI Events

JSR 346

- Observer Design Pattern
- Defined by
  - A java object (the event object)
  - Event Qualifier(s)

CDI Events

JSR 346

```
@Inject
BeanManager beanManager;

public void doSomething() {
      beanManager.fireEvent(new Payload());
}



public void listenToPayload(@Observes Payload event) {
      //do something using the payload
}
```

CDI Events

MDB

```
@MessageDriven(
    …
)
public class KnxMdb implements KnxListener {

    @Inject
    @HomeEvent
    Event<Notification> homeEvent;

    @KnxMessage(type="sensor")
    public void handleKnxSensor(Notification notif) {
        …
        homeEvent.fire(notif);
    }


}
```

CDI Events

WebSocker Server Endpoint

```
@ServerEndpoint("/wsEndPt")
public class InboundWebsocket implements Serializable {


    @Inject
    @HomeEvent
    Event<Notification> homeEvent;

    @OnOpen
    public void openConnection(Session session) {
        …
    }

    public void onEvent(@Observes @HomeEvent Notification notif) {
        sendAllEndpoints(notif.toJson());
    }
    …
```

Java API for RESTful Web Services 2.0

JSR 339

- Filters and Interceptors
- Asynchronous Processing
- Hypermedia
- Validation
- Client API

JAX-RS Client

```
private void zwaveCommand(String url, String node, boolean val) {

    //http://host/ZWaveAPI/Run/devices[3].instances[0].commandClasses[0x25].Set(false)

    String zwaveUrl = url + node + ".Set(" + val + ")";

    private final Client jaxrsClient = ClientBuilder.newClient();

    String zwaveResp = jaxrsClient.target(zwaveUrl)
            .request(MediaType.TEXT_PLAIN_TYPE)
            .get(String.class);
}
```

REST Endpoint

```
@Path("/zwave")
public class ZwaveEndpoint {

    @Inject
    @HomeEvent
    Event<Notification> homeEvent;

    @PUT
    @Path("/{id}/{val}/")
    @Produces("text/plain")
    public String swithKnx(@PathParam("id") String id, @PathParam("val") String val) {
        Notification notif = new Notification(id, "sensor" , val, "ZWAVE");
        notif.setTarget(id); // target is required to identify the Zwave device
        notif.setValue(val);
        homeEvent.fire(notif);
    }

}
```

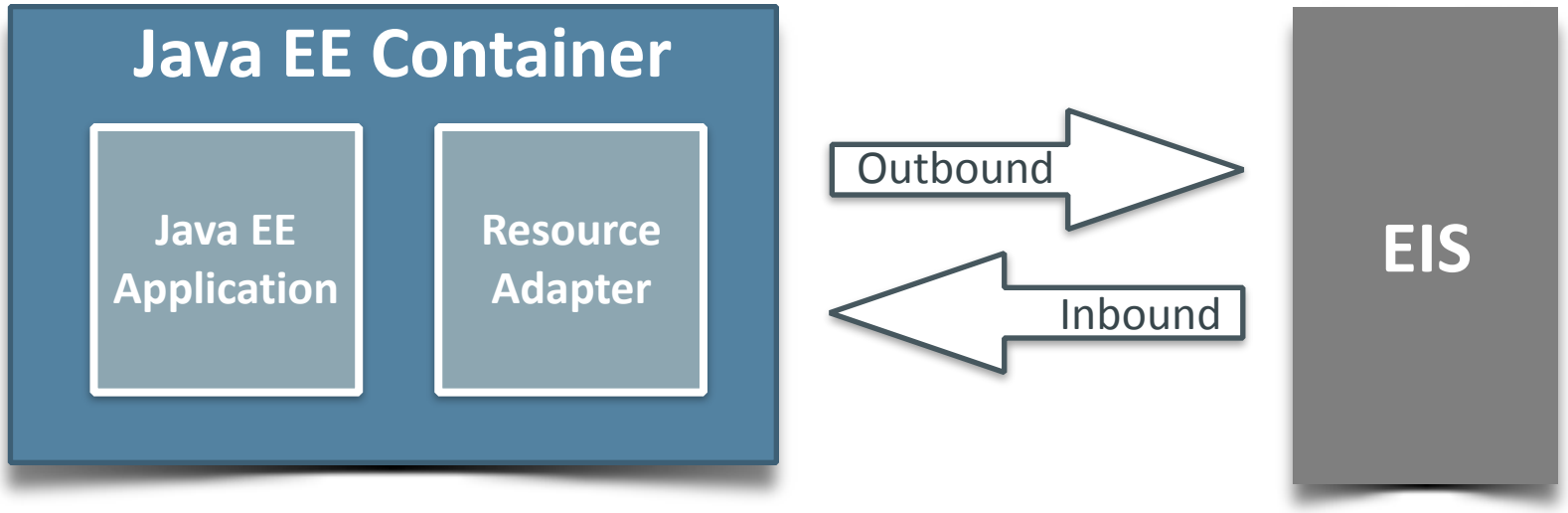
Java Connector Architecture 1.7

JSR 322

- Resource Adapter
  - JCA component for a specific EIS
  - Mediates communication between the container and the **EIS** by means of **contracts**
  - Packaged as a RAR
- EIS
  - Packaged Applications, ERP, CICS, mail server, MoM, etc.
- Contracts
  - Lifecycle, Connection (inc. pooling), TX, Work Management, CCI, …

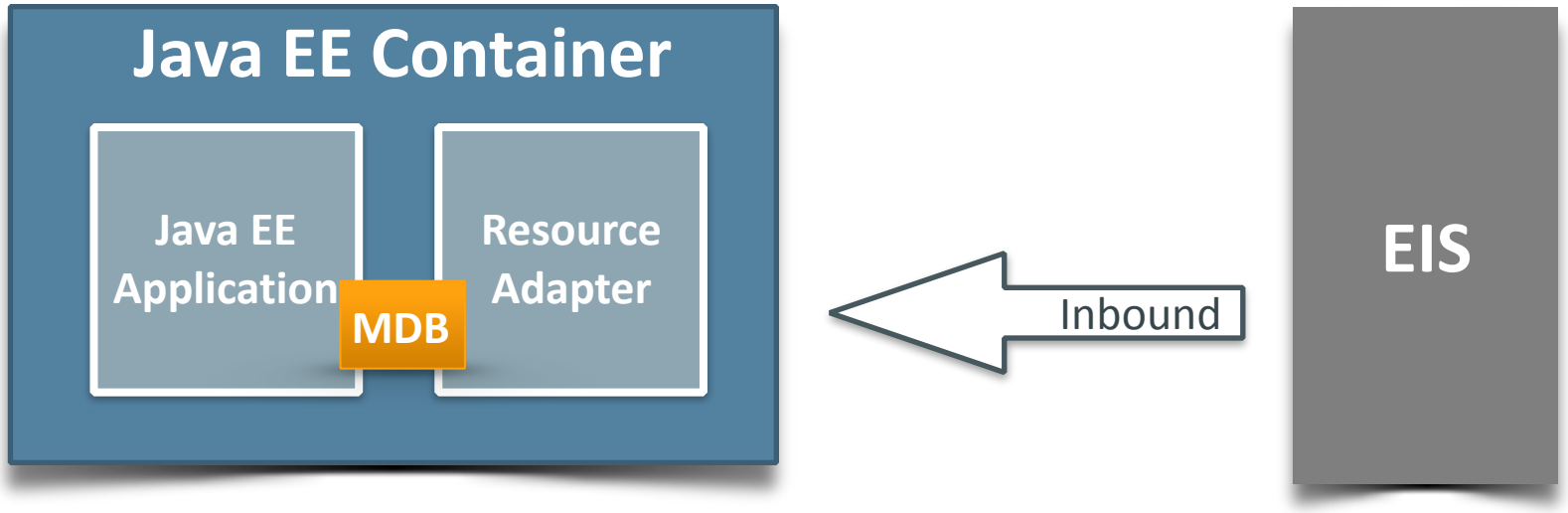
Java Connector Architecture 1.7

JSR 322



Java Connector Architecture 1.7

JSR 322



Message Driven Bean

JMS

```
@MessageDriven (
     activationConfig = {
          @ActivationConfigProperty(
               propertyName="destinationLookup", propertyValue="…"),
          @ActivationConfigProperty(
               propertyName="destinationType", propertyValue="javax.jms.Queue")
        }
)

public class MyJmsMdb implements MessageListener {

     @Override
     public void onMessage(Message message) {
     //do the work
     }

}
```

Message Driven Bean

- *“A MDB is an asynchronous message consumer…”*
- *“A MDB is invoked by the container as a result of the arrival of a message at the destination or endpoint that is serviced by the MDB…”*
- *“MDB listen to an Inbound Ressource Adapter”*
  - Eg. JMS

Message Driven Bean

KNX

```
@MessageDriven(
    activationConfig = {
        @ActivationConfigProperty(
              propertyName = “knx", propertyValue = "10.0.0.60")
    }
)
public class KnxMdb implements KnxListener {

     @Override
     public void onMessage(Message message) {
     //handle the KNX Message
     }

}
```

Message Driven Bean

KNX

```
@MessageDriven(
    activationConfig = {
        @ActivationConfigProperty(
                propertyName = “knx", propertyValue = "10.0.0.60")
    }
)

public class KnxMdb implements KnxListener {

    @KnxMessage(type="sensor")
    public void handleKnxSensor(Notification notif) {
        …
    }

    @KnxMessage(type=“switch")
    public void switchKnx(Notification notif) {
        …
    }

}
```

Inbound RA

- `public interface KnxListener { }`
  - Will be implemented by the MDB
- `public class KnxResourceAdapter implements ResourceAdapter {…}`
  - Do the actual work, without real constraints (e.g. threads)
  - Handle MDB activation
  - Will listen on the KNX bus via WorkManager
- `public class KnxActivationSpec implements ActivationSpec {…}`
  - Expose RA configuration to the application

Inbound RA

```
@Override
public void endpointActivation(MessageEndpointFactory endpointFactory,
                               ActivationSpec spec)
                               throws ResourceException {

    tSpec = (TrafficActivationSpec) spec;
    Class endpointClass = endpointFactory.getEndpointClass();
    tSpec.setBeanClass(endpointClass);
    tSpec.findCommandsInMDB();

    ObtainEndpointWork work = new ObtainEndpointWork(this, endpointFactory);
    workManager.scheduleWork(work);
}
```

Inbound RA

```
public void findCommandsInMDB() {

    for (Method method : beanClass.getMethods()) {
        if (method.isAnnotationPresent(KnxMessage.class)) {
            KnxMessage tCommand = method.getAnnotation(KnxMessage.class);
            commands.put(tCommand.type(), method);
        }
    }

   …
}
```

KNX (real) Listener

```
// KNX ProcessedEvent from the Calimero stack
switch (actor) {
            case "0/7/4":
                messageType = "sensor";
                notif.setType("humidity");
                processedEvent = Float.toString(knxSensorHumidity(pe));
                notif.setValue(processedEvent); // and so on…
                break;
}

if (spec.getCommands().containsKey(messageType)) { // Does the MDB support this message?
     Method mdbMethod = spec.getCommands().get(messageType);
     try {
          callMdb(mdb, mdbMethod, notif);
     } catch (ResourceException ex) { // Ooops! }
} else { // Unknown command ?! }
```

KnxMessage

```
/* Annotation to decorate methods in the MDB */
@Target({ElementType.METHOD})
@Retention(RetentionPolicy.RUNTIME)
public @interface KnxMessage {
          String type() default "";
          String info() default "";
}
```

Inbound connector

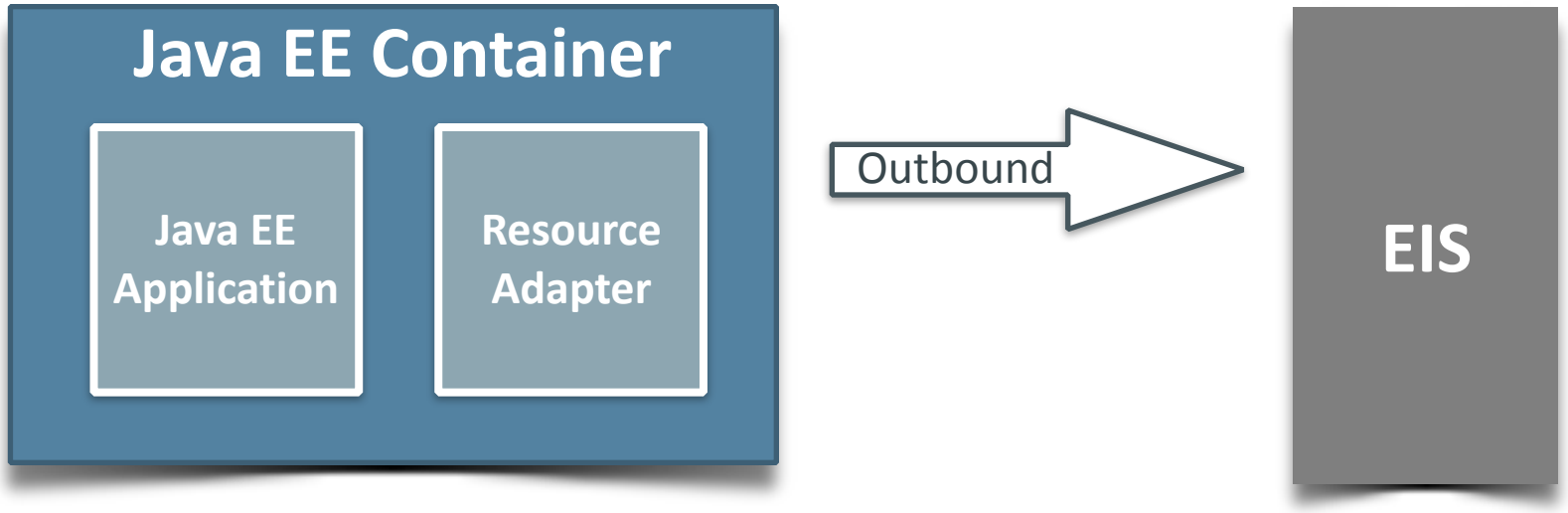
```
private Notif callMdb(MessageEndpoint mdb, Method command, Notification param)
            throws ResourceException {

     try {
           mdb.beforeDelivery(command);
           Object ret = command.invoke(mdb, param);
           notif = (Notif) ret;
     } catch (NoSuchMethodException | ResourceException | IllegalAccessException |
              IllegalArgumentException |InvocationTargetException ex) {
           // MDB invocation error :(
           …
     }
     mdb.afterDelivery();
     return notif;
}
```

KNX MDB

```
@MessageDriven(
    activationConfig = {
        @ActivationConfigProperty(
              propertyName = “knx", propertyValue = "10.0.0.60")
    }
)

public class KnxMdb implements KnxListener {

    @KnxMessage(type="sensor")
    public void handleKnxSensor(Notification notif) {
        …
    }

    @KnxMessage(type=“switch")
    public void switchKnx(Notification notif) {
        …
    }

}
```

Java Connector Architecture 1.7

JSR 322



And more…

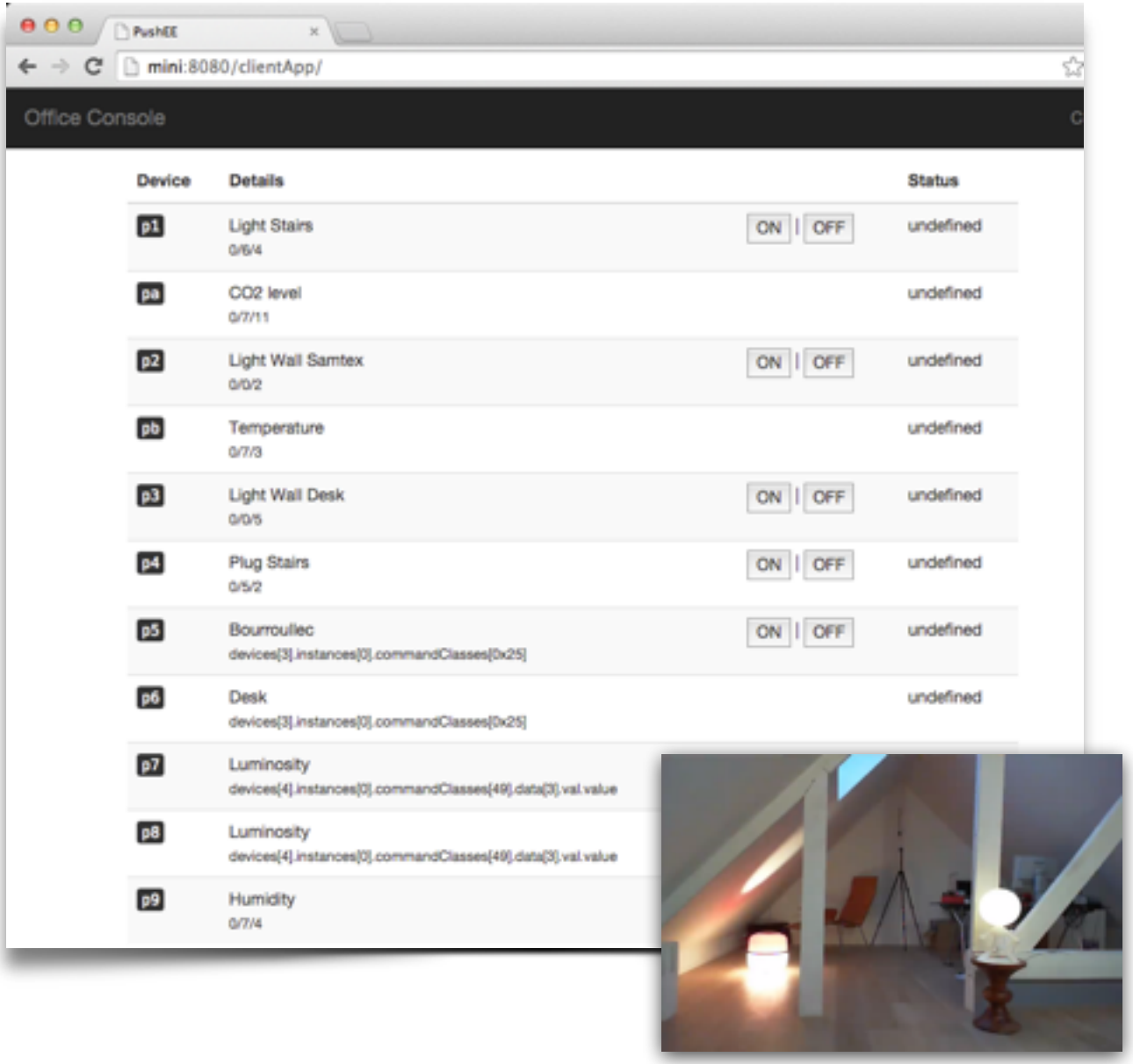
- EJB
- CDI Interceptors
- JAX-RS Interceptors
- Concurrency Utilities for Java EE
- Java Persistence API
- JavaServer Faces
- OpenMQ Stomp support
- Jersey SSE, MVC…

Program Agenda

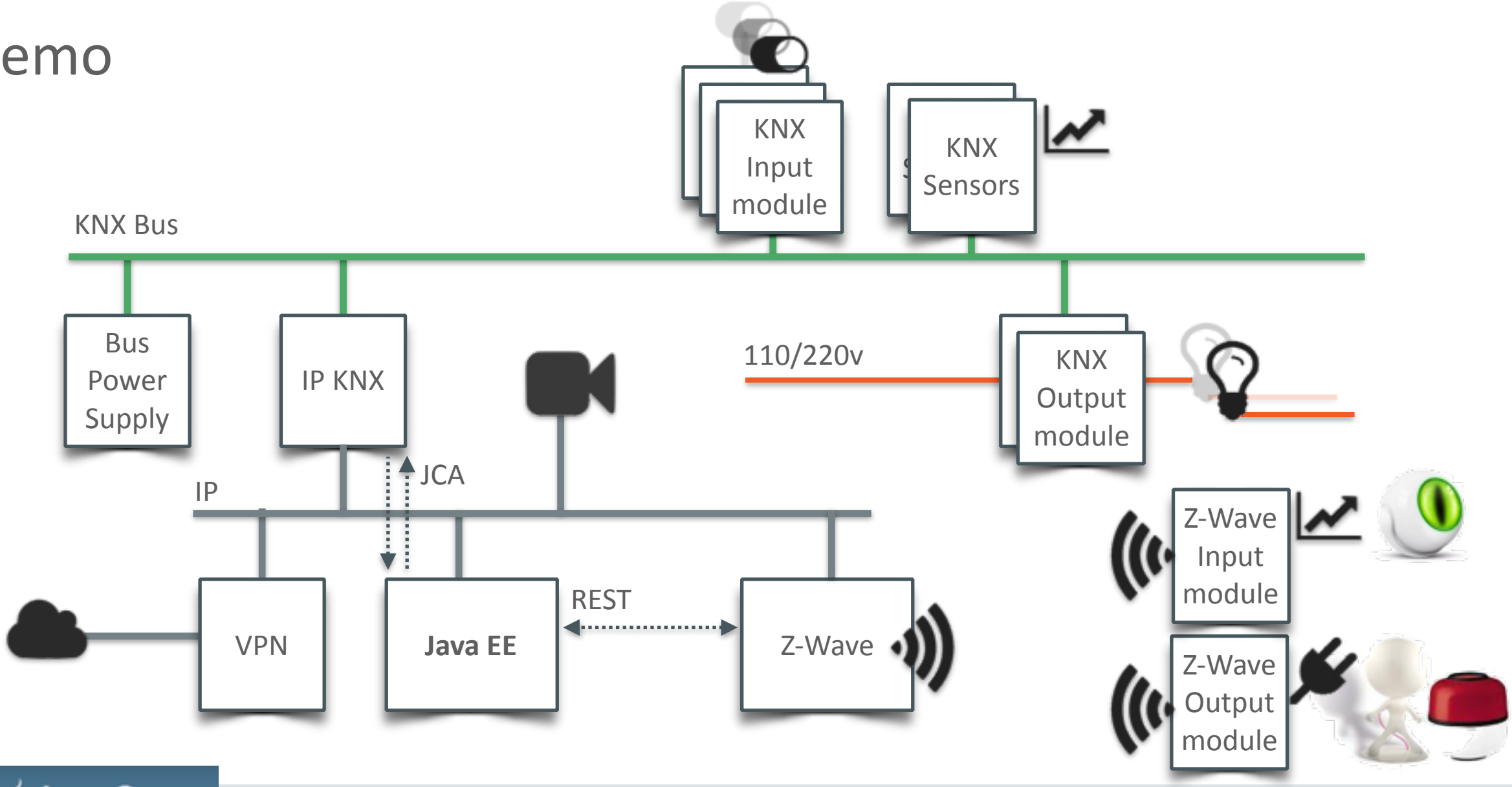
1. Home Automation
2. Java EE
3. **Demo**
4. Wrap-up

Dashboard

- HTML Client
  - “Pure” JS
  - Real-time notifications via WebSocket
  - Control devices via REST
- Java EE 7 backend
  - KNX (JCA) & Z-Wave (REST)
  - In & Outbound



Demo



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Java EE for Home Automation

- Connectivity
  - JAX-RS, JCA, WebSocket, JMS…
- ‘Event’ driven capabilities
  - MDB, CDI event
- Non blocking IO
- Asynchronous
- Scheduling
- Persistence

- Component models
- UI
  - JSF, JAX-RS
- Container
  - Lifecycle
  - Monitoring & Management
  - Ressources pooling
  - Logging
  - …

What's next

- PoC
  - KNX, Z-Wave & InfraRed
- Improvements
  - Additional 'connectors', e.g. RF433
  - More types, e.g. range for blinders
  - State Management
  - User interface
  - Add 'scenario's
  - Leverage Java EE more, e.g. CDI Interceptors

Java EE and IoT

- Connected devices
- Messages / data producer
- Data aggregation / processing
  - Deeper in the network
- Scaling
- Security

Java EE 8

TBC!

- CDI 2.0
- JMS 2.1
- MVC 1.0
- JAX-RS 2.1
- JSON-B + JSON-P

Resources

- The Java EE 7 Tutorial
  - http://docs.oracle.com/javaee/7/tutorial/doc/home.htm
- GlassFish 4.1
  - http://glassfish.org
- NetBeans 8.0.1
  - http://netbeans.org

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