m2m

eclipse.org

Open Source building blocks for the Internet of Things

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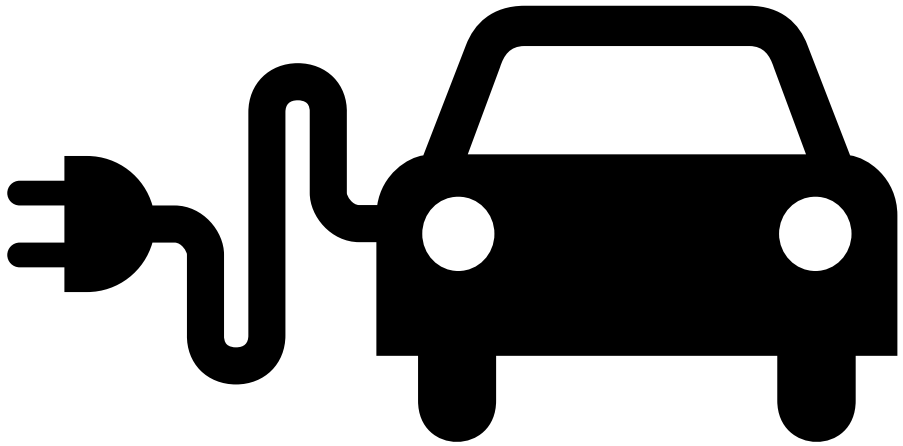
Who I am

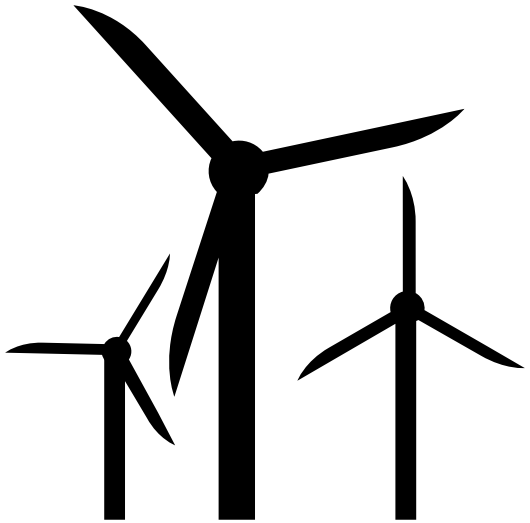
- **Benjamin Cabé**
- Open Source M2M Evangelist at Sierra Wireless
- Long-time Eclipse lover

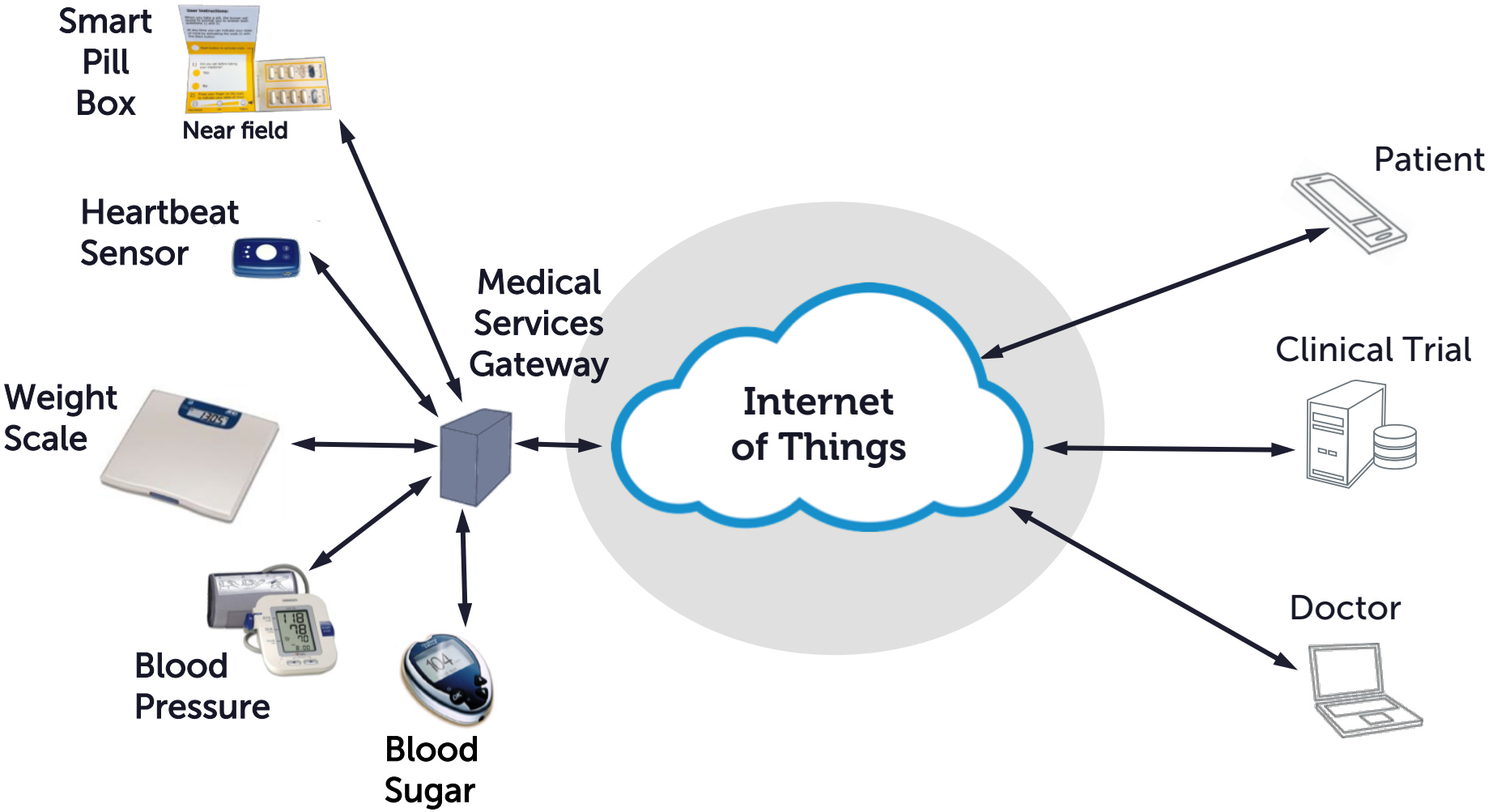
SIERRA WIRELESS

M2M? IoT?

Technology that supports wired or wireless communication between devices






Smart
Pill
Box
Near field
Heartbeat
Sensor
Medical
Services
Gateway
Weight
Scale
Internet
of Things
Patient
Clinical Trial
Doctor
Blood
Pressure
Blood
Sugar

However…

The market is fragmented

- Hardware, software, protocols…
  all different, independent
- Lack of integration…
  between devices, to enterprise systems

M2M development is complex

- Many different skills required…
  Hardware, Embedded, IT network, Telecom, web
- No common architectural guidelines

Current options are closed

- Monolithic solutions…
  device specific, app specific, market specific
- Proprietary SDKs, protocols, potential vendor lock-in

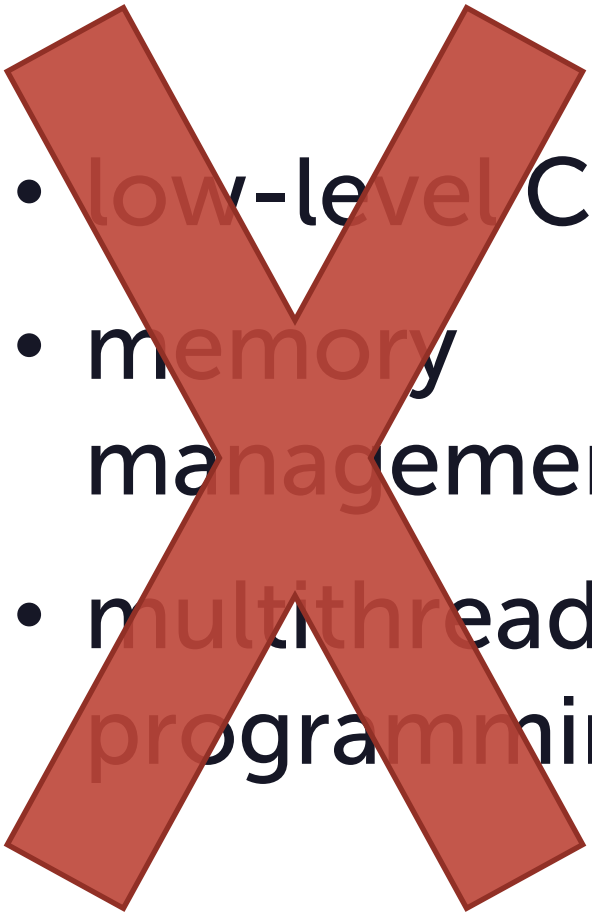
m2m

eclipse.org

3 projects

Framework	mihini
Protocols	paho
Tools	koneki

M2M embedded programming



- low-level C
- memory management
- multithreaded programming

- read sensor values
- control actuators
- consolidate data
- communicate

Example: Sending an SMS

```
int main()
{
    unsigned char char1[10];
    unsigned char char_buf[8]="AT+CSQ\n";
    // unsigned char sms_buf[20] = "AT+CMGS="xxxxxxxxx";

    int wc_fd;
    /********* Init of serial port ***********/
    wc_fd = init_wc(wc_fd);
    sleep(3);
    //writing to serial port
    write(wc_fd,char_buf,sizeof(char_buf));
    usleep(40000);
    //reading from serial port
    read(wc_fd,char1,sizeof(char1));

    sleep(2);
    close(wc_fd);

    return 0;
} // end of main

// initialization of serial port

struct termios options;

ttys5_fd = open("/dev/ttyS5", O_RDWR );
if (ttys5_fd &lt; 0)
```

```
sms.send(
    '+33612345678',
    'My SMS'
)
```

Simplify M2M programming

What is Lua?

- High-level programming language
- Scripting
- Simple
- Extensible
- Portable

Extensible by design

- Small
  - Trivial syntax and reduced keyword set
- Simple but not stupid
  - Simple enough for new users, powerful enough for advanced users (first-class functions, garbage collection, closures, tail calls, coercion, coroutines, metatables)
- Lua core is tiny
  - Compiled size is ~150kB
  - Lua uses libraries for its extensions

Lua vs. other high-level languages

- Same core features as Python, Ruby, Javascript
- Better concurrency management
  - Built-in – doesn't rely on the OS
- Cutting-edge execution technology & performances

Lua vs. other high-level languages

- Restricted set of libraries
  - Stay simple, the developer brings his own
- Designed for C integration
  - Performance
  - Legacy

Lua for embedded and M2M?

- High-level languages usually trade hardware resources for development & maintenance resources

Lua allows to reconcile high-level languages accomplishments with embedded constraints

You need an IDE!

- Project structure
- Syntax coloring
- Content assist
- Code navigation
- Code formatting
- Documentation
- Code templates
- Debugger
- Remote development
- Embedded interpreter

koneki

June 2012: first release (0.8)
Dec. 2012: 0.9 release
June 2013: graduate w/ Kepler
50,000+ installations already! (Feb. 2013)

Using Koneki LDT for remote Lua development

DEMO

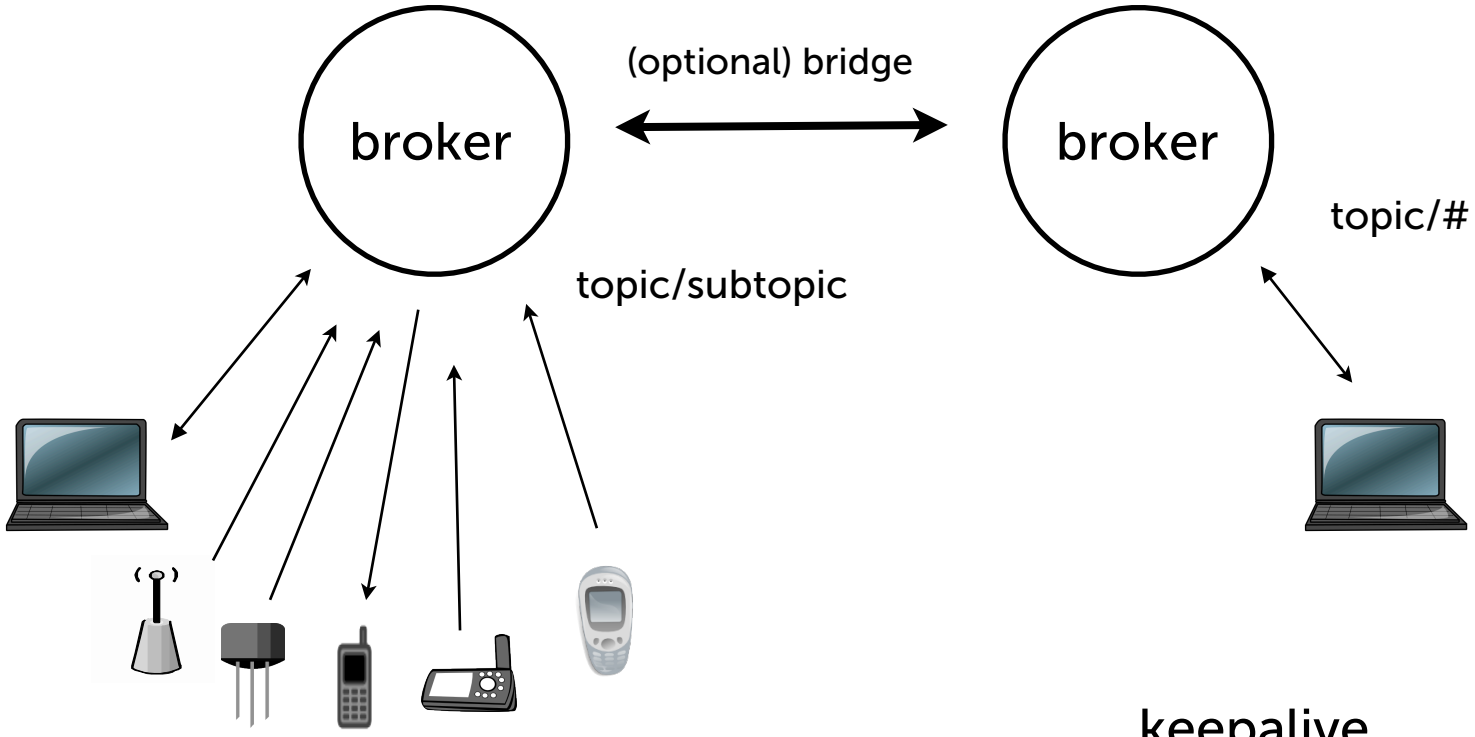
koneki 101

- http://www.eclipse.org/koneki/ldt
- Download standalone IDE
- Or install in existing Eclipse
  - from Juno repository (0.8.2)
  - from nightly/milestones repositories (0.9+)
- Execution environments on Koneki wiki
  - http://goo.gl/f6T80
- Contact the team
  - http://eclipse.org/forums/eclipse.koneki

http://www.sxc.hu/photo/1036004

- Messaging protocol
- Low-bandwidth / Low-power
- Payload agnostic
- Adjustable QoS
- Large ecosystem

MQTT



publish

subscribe

keepalive
last will & testament
username/password

- http://eclipse.org/paho/
- Eclipse Paho delivers clients for MQTT in C and Java
  - http://eclipse.org/paho/download.php
- Lua client available soon
  - https://github.com/geekscape/mqtt_lua
- MQTT view in Eclipse
  - http://git.eclipse.org/c/paho/org.eclipse.paho.esf.git/
- Free broker hosted at Eclipse: **m2m.eclipse.org**
- Contact the team
  - paho-dev mailing-list

Lua VM + MQTT client to go?

Application framework for M2M

- Set of libraries providing building blocks to develop M2M applications:
  - Serial and I/O management,
  - Networking (FTP, HTTP, e-mail, ...),
  - GPS,
  - Cryptography,
  - Modbus,
  - Local storage
  - etc.

mihini

http://www.eclipse.org/mihini

Smart agent for M2M

- M2M data queues
- Network bearers
- Device management
- Application container
- Application configuration

mihini

http://www.eclipse.org/mihini

Asset management

- User applications use an API to communicate with Mihini
  - Send data or events
  - Register listeners to handle data writing or commands
- The Mihini agent takes care of network connection, buffering and reliable storage of unsent data, etc.

Asset management

```
local gh_asset = asset_mgt.newAsset("greenhouse")

gh_asset:start()

gh_asset:pushdata("sensors.temperature", 22, "now")
gh_asset:pushdata("sensors.humidity", 89, "hourly")
```

Device management

- A Tree Manager presents device's data as
  - variables,
  - organized in a hierarchical tree,
  - that can be read, written, and monitored for changes by user applications.
- Standard paths for modem, network settings, ...

Device management

```
local devicetree = require 'devicetree'
local APN        = 'system.cellular.apn.apn'
local RSSI       = 'system.cellular.link.rssi'

local apn  = devicetree.get (APN)
log(LOG_NAME, "INFO", "Configure APN: %s", apn)

local function print_callback (values)
    for name, value in pairs(values) do
        log (LOG_NAME, "INFO",
                " - Variable %s changed: %s",name, value)
    end
end

devicetree.register(RSSI, print_callback)

devicetree.set(APN, 'foo')
```

Application Management

- Language-agnostic application container
  - install/uninstall
  - start/stop, auto-start on boot
  - restart on failure
- Agent handles over-the-air software download and update mechanism
- Remote script execution

mihini 101

- http://www.eclipse.org/proposals/technology.mihini
- http://eclipse.org/mihini
- Code will be available (very) soon
  - Initial contribution is pending IP review at Eclipse

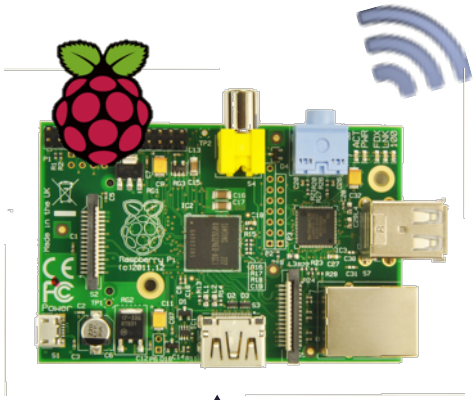

Let me
show you!

A very common use case

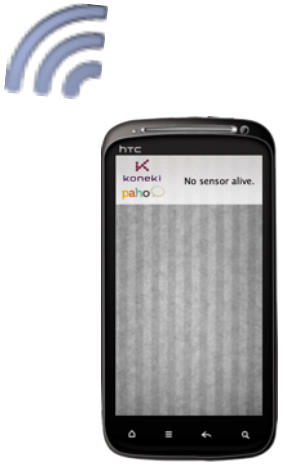
- Greenhouse business
  - Connect gardening equipment
  - Remote monitoring of sensors
  - Remote control

- M2M Gateway not selected yet, neither is the rest of the equipment (PLCs)

MQTT broker

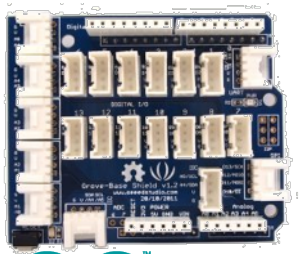


Raspberry Pi



Mobile phone

Modbus RTU



humidity
temperature
illuminance

light ON/OFF

Two Lua applications

Embedded

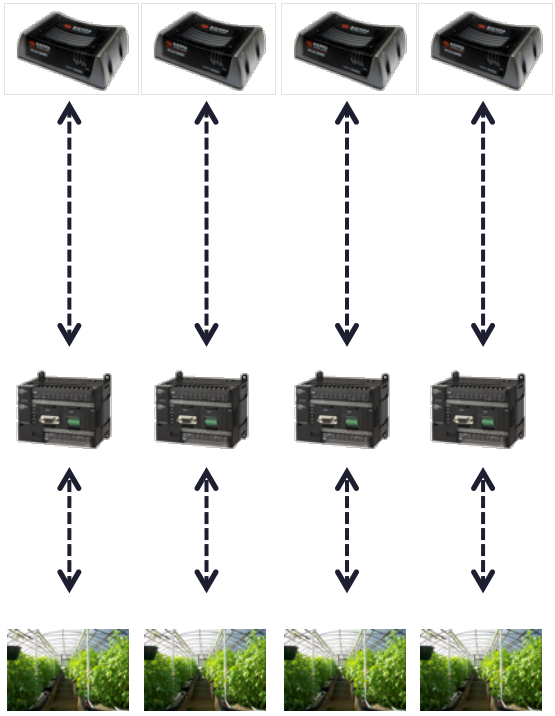
mihini

- Uses Modbus library to communicate w/ Arduino
- Collects sensor data/ controls actuators
- Publishes MQTT messages
- Subscribe to commands

Mobile

Corona SDK 

- Subscribes to MQTT messages
- Displays sensor data with a fancy UI
- Publish command to switch on/off the light

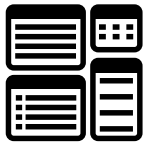


Rugged wireless gateways

Modbus

control sensors & actuators

Mobile phones



Web applications

IT applications

...

M2M server

Telco

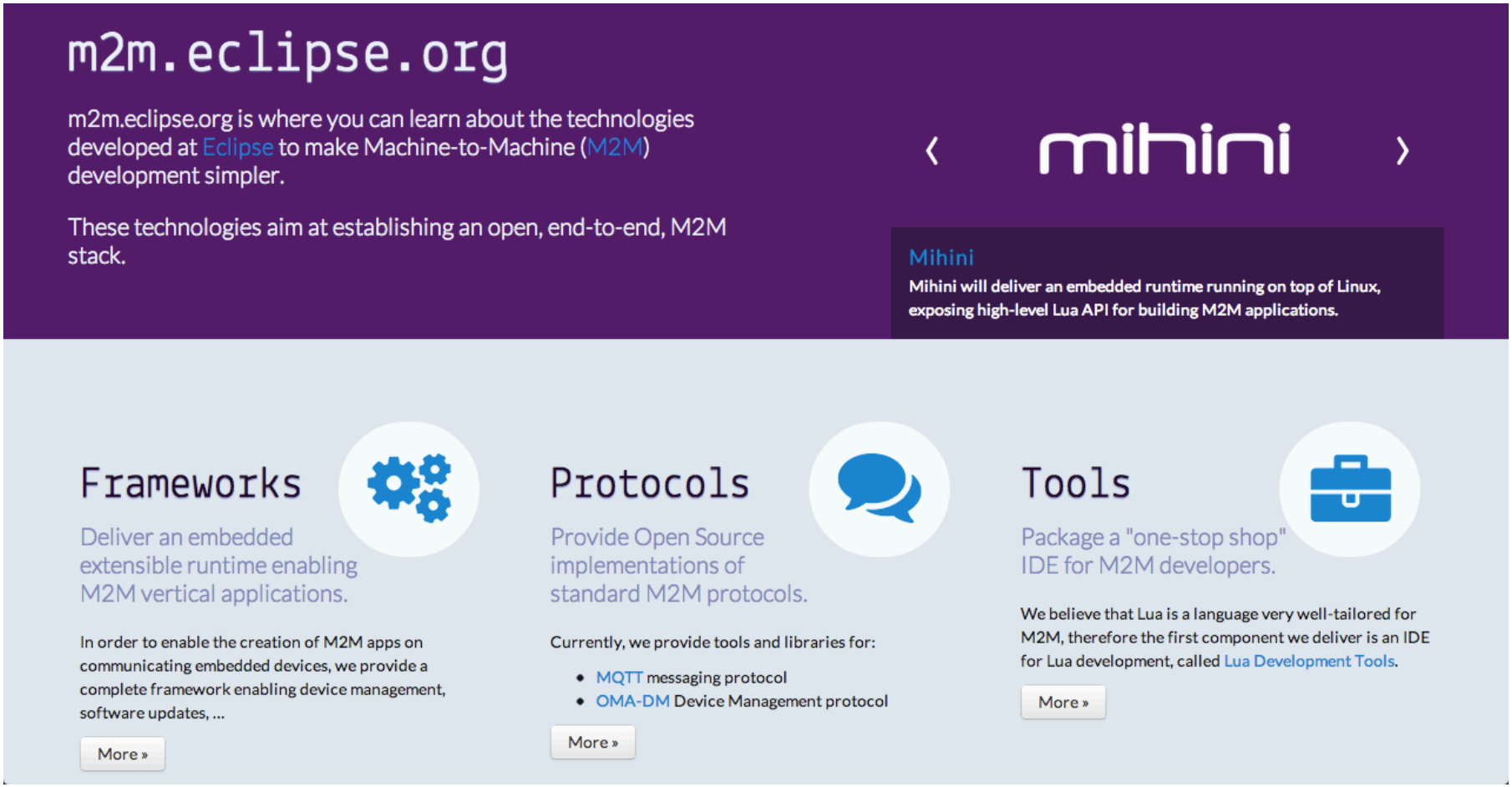
Billing

etc...

Roadmap

- **Protocols**
  - M3DA (Micro M2M Data Access) – see the spec. at http://wiki.eclipse.org/Mihini/M3DA_Specification
- **REST API**
  - Ease the communication of 3rd party apps with the Agent
  - Provide better tooling
- **Polyglot framework**
  - C and Java on their way

Join the party!



Thank you!