IOX

ROUTING MESSAGES THROUGH THE FOG

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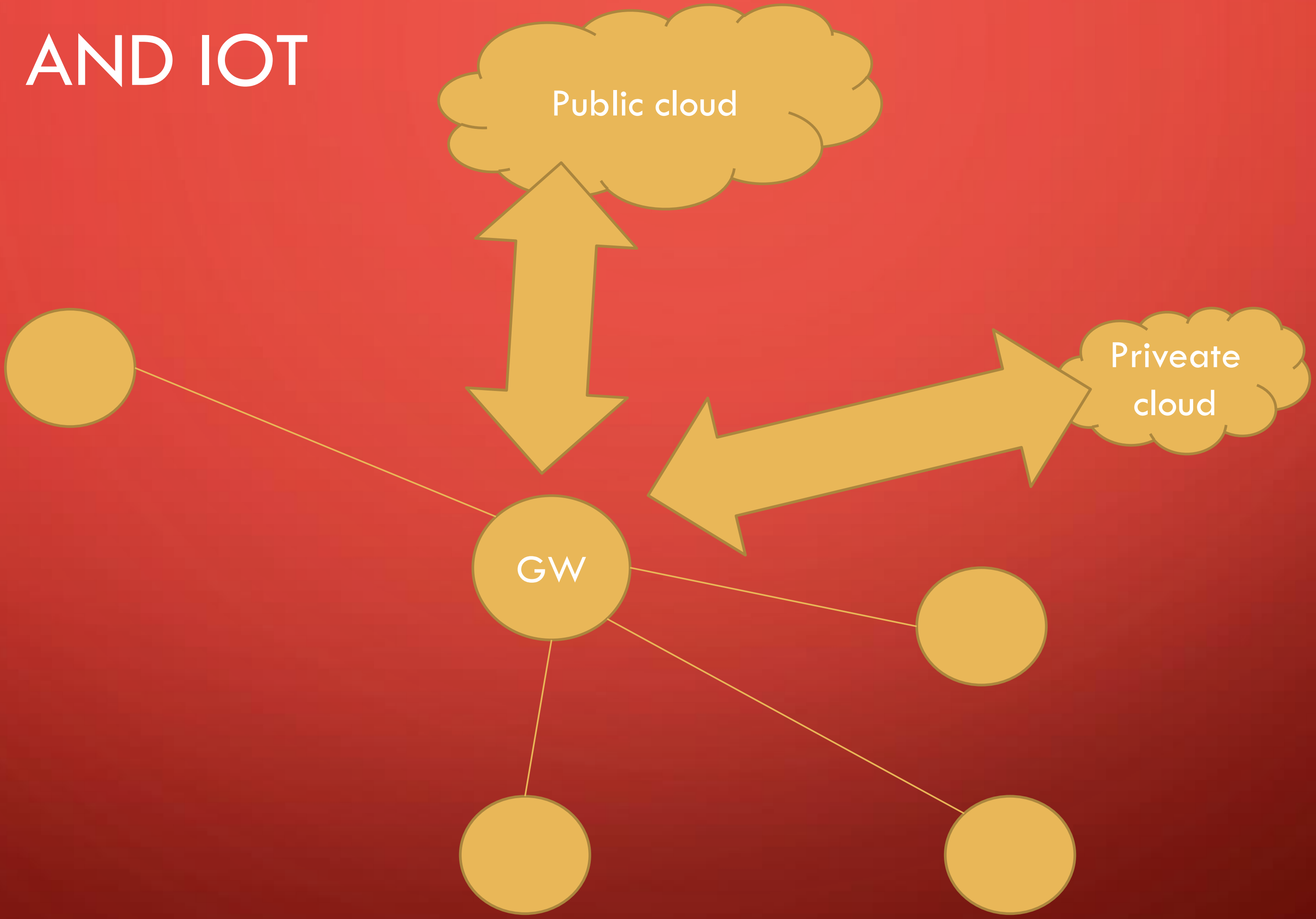
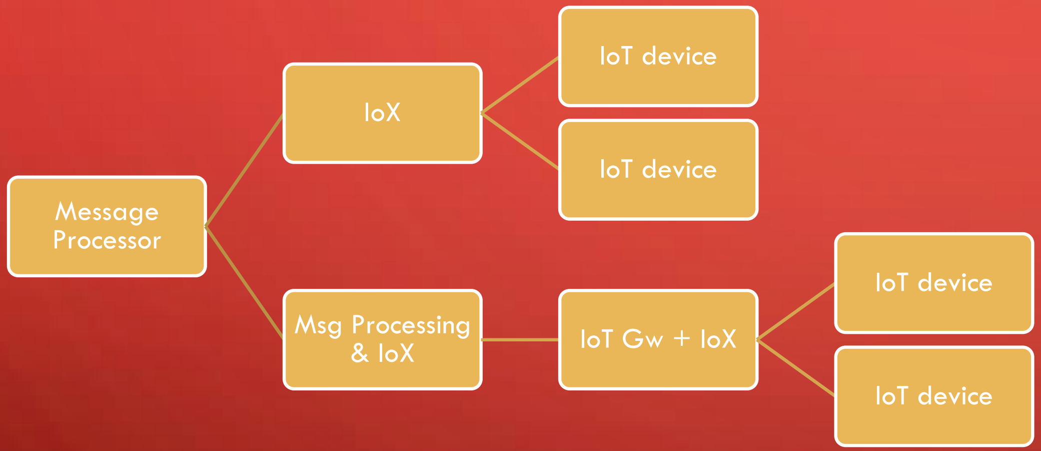
FOG AND IOT



MOTIVATION AND GOALS

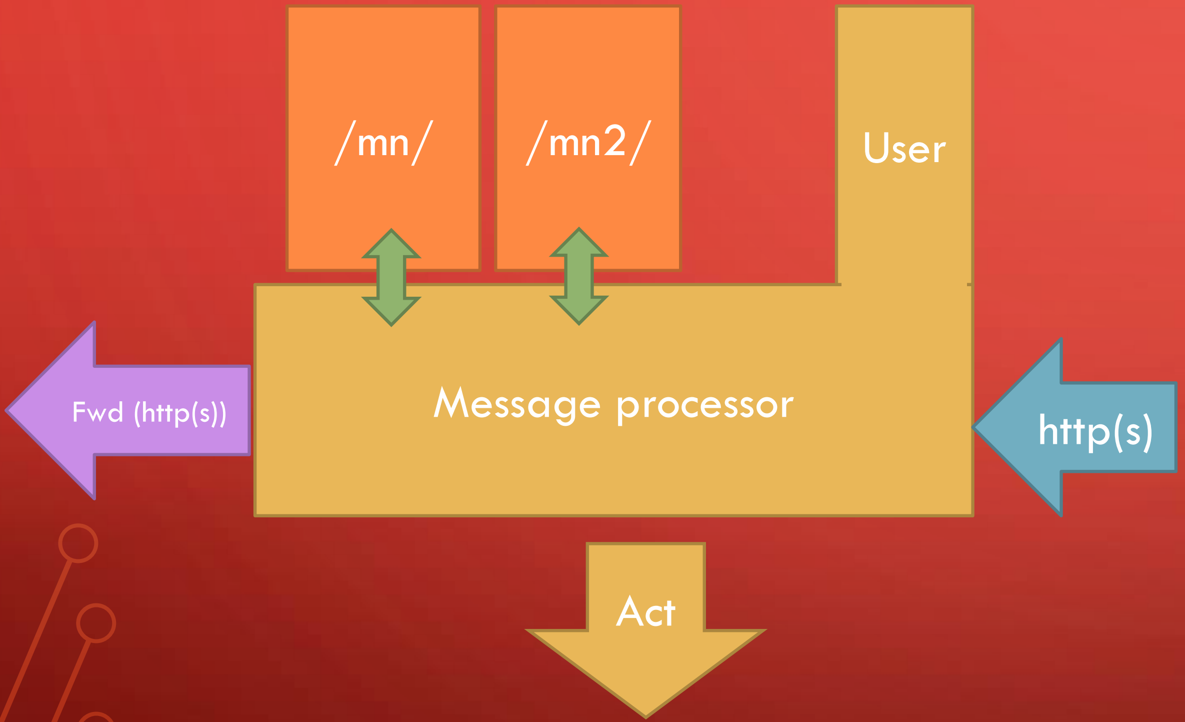
IoT	• interconnecting small devices and sensors with Internet technologies
ASSUMPTION	• http(s) + REST + JSON will drive most of the message passing for IoT
NEED	• Control routing of JSON messages
GOAL	• Define a (IoT) vendor independent runtime for processing JSON messages on whitebox IoT gateways and network switches

ARCHITECTURE



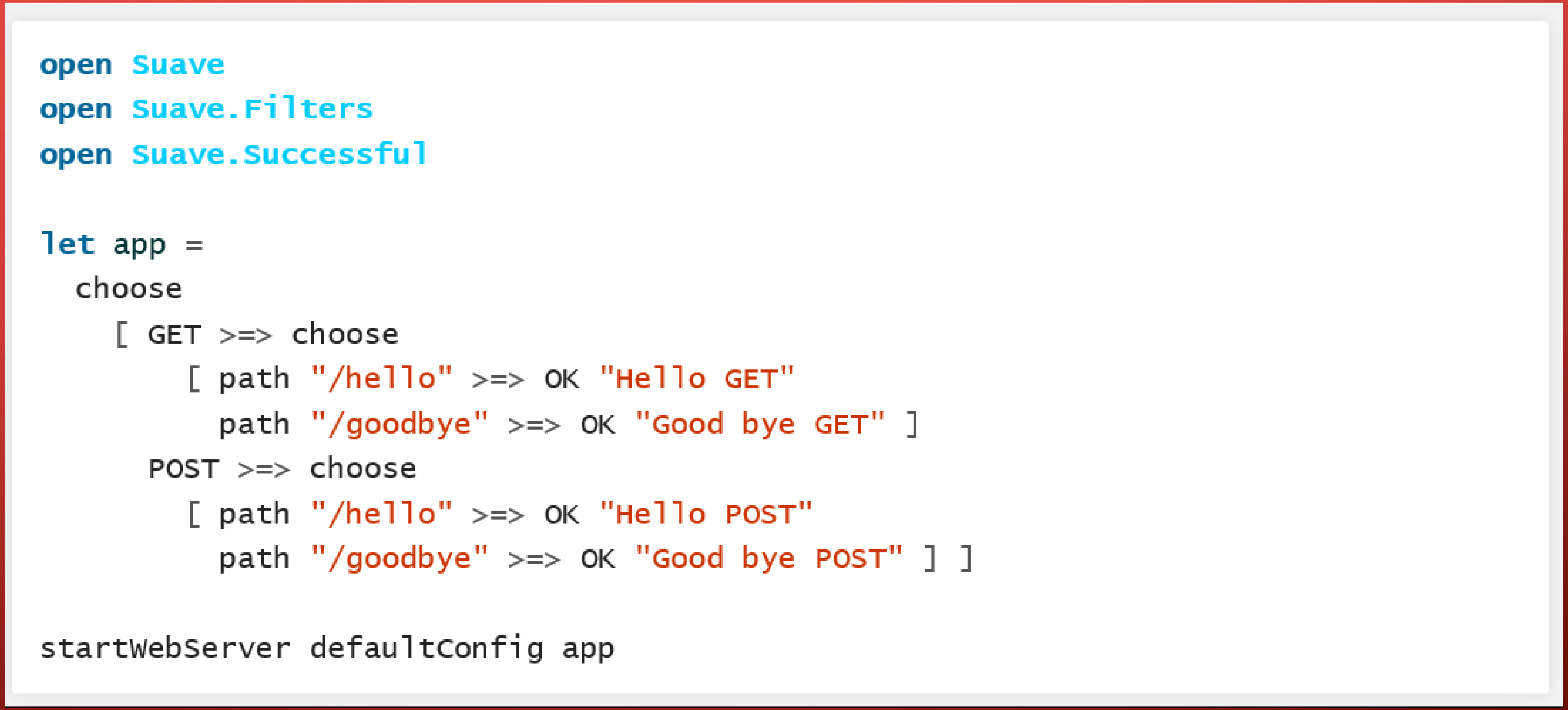
- IoX is responsible for:
  - Receiving JSON msgs
  - Vendor modules take action:
    - Fwd message
    - Send message to IoT devices
- Nodes can offer light or heavy computing capabilities (IoT gateways and network switches vs. PCs and servers)

IOX ARCHITECTURE



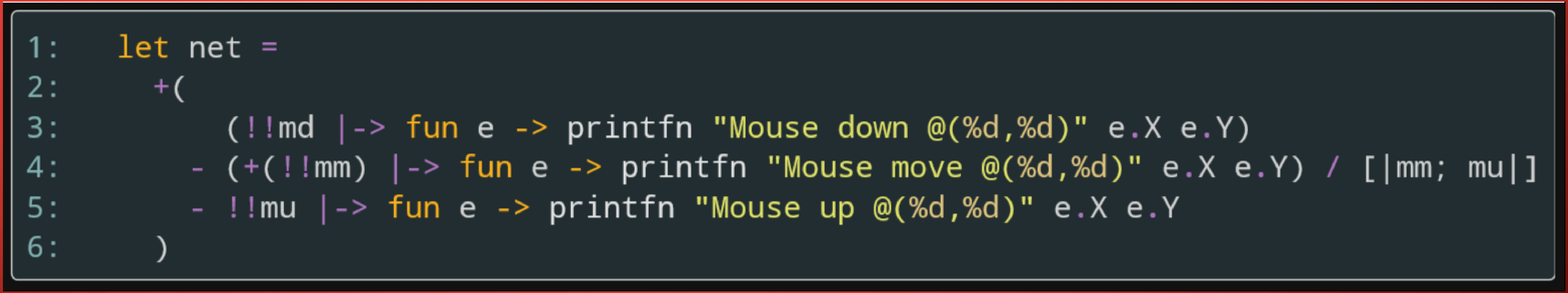
- Runtime
  - .NET + F# + Suave
  - CLI with F# interactive
  - Event based processing with evReact
- Vendor modules register for http prefixes
- Module isolated in process using .NET core capabilities
- inject message processors in the processing runtime
- User can express global rules for inspecting JSON messages
- Modules can offer HTML5 UIs
- Action may include Interop with host enviroment (i.e. network switch)

SUAVE: A FUNCTIONAL WEB SERVER



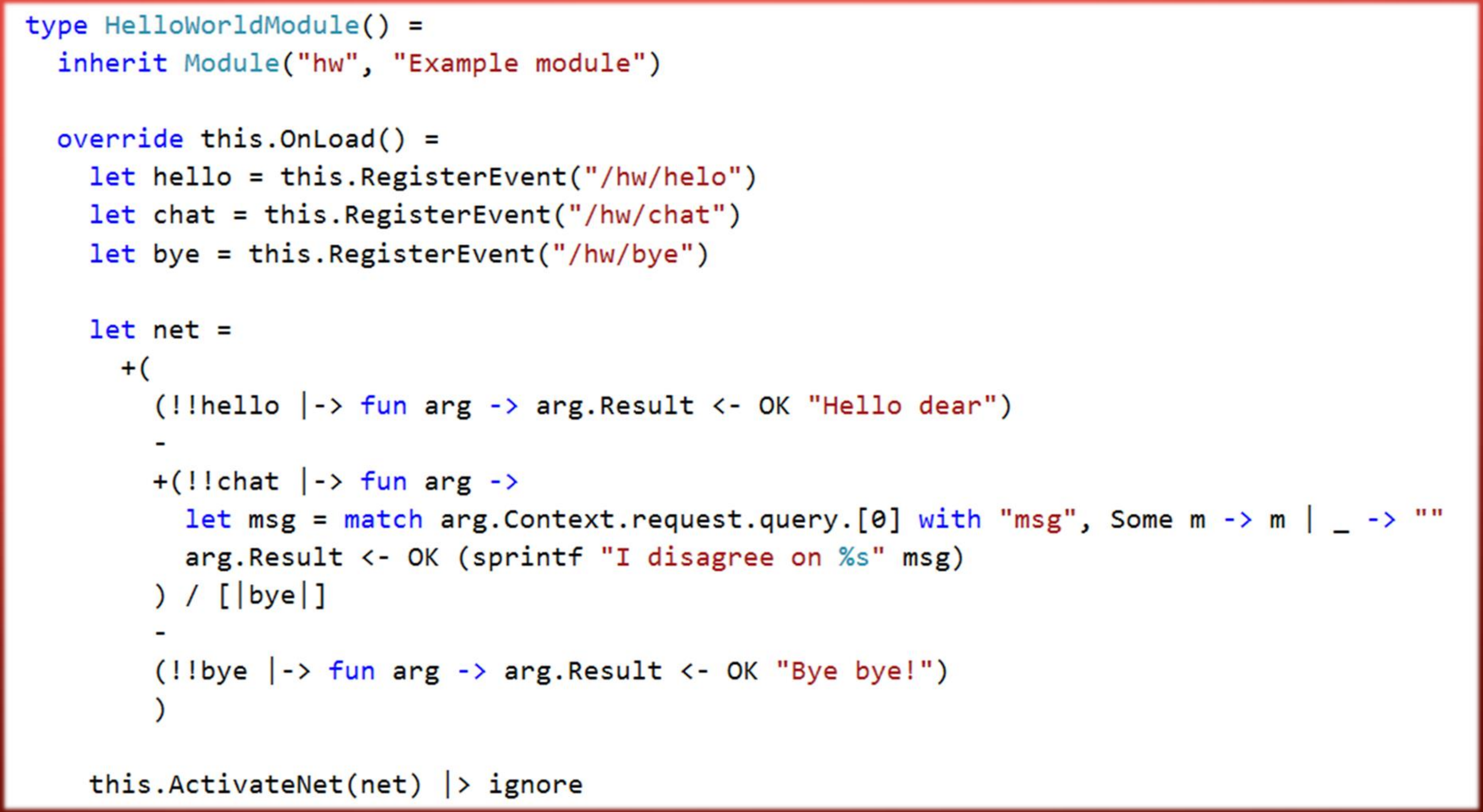
```
open Suave
open Suave.Filters
open Suave.Successful

let app =
  choose
    [ GET >=> choose
        [ path "/hello" >=> OK "Hello GET"
          path "/goodbye" >=> OK "Good bye GET" ]
      POST >=> choose
        [ path "/hello" >=> OK "Hello POST"
          path "/goodbye" >=> OK "Good bye POST" ] ]

startWebServer defaultConfig app
```

REACTIVE PROGRAMMING WITH EVREACT



```
let net =
  +(
      (!!md |-> fun e -> printfn "Mouse down @(%d,%d)" e.X e.Y)
    - (+(!!mm) |-> fun e -> printfn "Mouse move @(%d,%d)" e.X e.Y) / [|mm; mu|]
    - !!mu |-> fun e -> printfn "Mouse up @(%d,%d)" e.X e.Y
  )
```

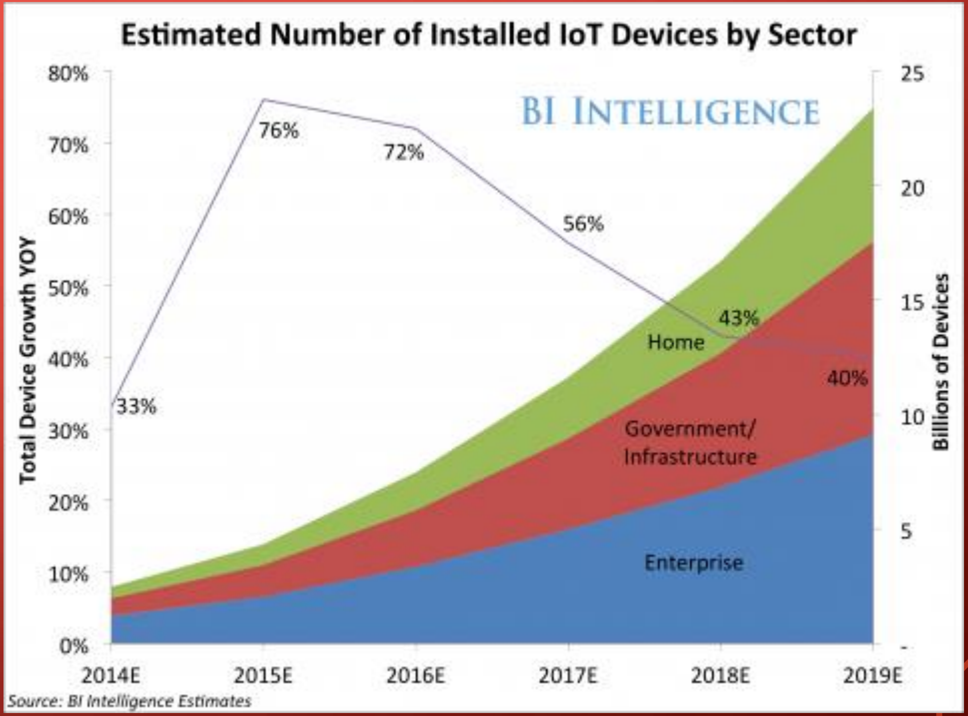
MODULE EXAMPLE



```
type HelloWorldModule() =
  inherit Module("hw", "Example module")

  override this.OnLoad() =
    let hello = this.RegisterEvent("/hw/helo")
    let chat = this.RegisterEvent("/hw/chat")
    let bye = this.RegisterEvent("/hw/bye")

    let net =
      +(
        (!!hello |-> fun arg -> arg.Result <- OK "Hello dear")
        -
        +(!!chat |-> fun arg ->
          let msg = match arg.Context.request.query.[0] with "msg", Some m -> m | _ -> ""
          arg.Result <- OK (sprintf "I disagree on %s" msg)
        ) / [|bye|]
        -
        (!!bye |-> fun arg -> arg.Result <- OK "Bye bye!")
        )

    this.ActivateNet(net) |> ignore
```

EARLY CONSIDERATIONS

- Using names and metadata seems impractical to control flow of information
- Overlaying of different network topology is becoming mainstream (SDN)
- Security should be enforced not only in communication, but also on route processing and message content
- Identity based filtering does not scale to the size
- Content and annotations should be added all along the way

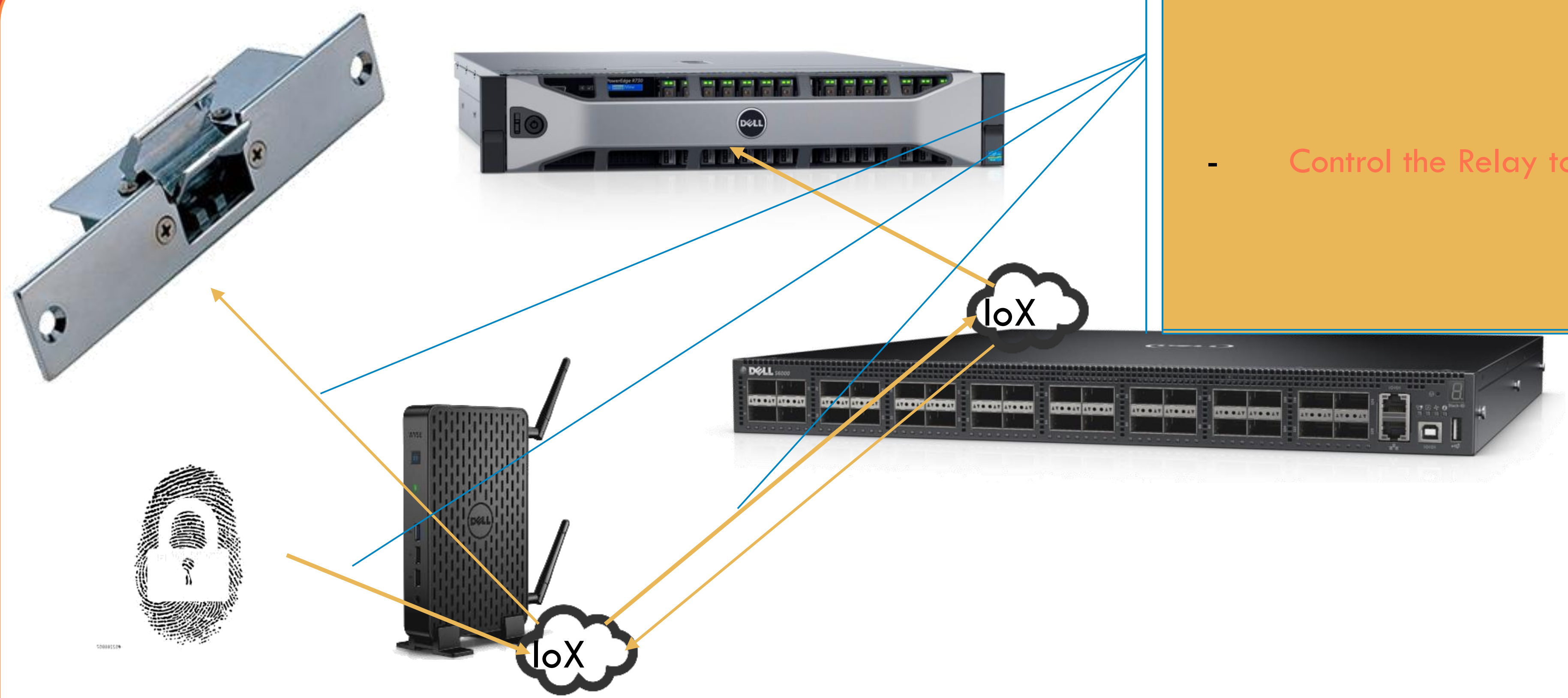


Source: BI Intelligence Estimates

A MOTIVATING EXAMPLE: TEMPERATURE SENSOR

- A temperature sensor on a window: public info
- The same sensor on a patient body: confidential
- Identity based control seems not to scale to the IoT size, we need semantic rules
- A distributed logic for controlling messages with user defined policies
- Keep automation (msg -> reaction -> message) as close as the device

A (ALMOST) WORKING DEMO



- Control the Relay to open the door

CONCLUSIONS

- We believe that HTTP/REST/JSON message routing will be central to IoT
- Security is central and should be first class in the message processing
- *IoX goal is to become an Open Source, cross platform runtime reference for routing and processing IoT messages based on standard protocols contributing to make the IoT/Fog more than a buzzword*
- Early bits will be posted on GitHub
- Follow #IoX on Twitter