T2TRG: Thing-to-Thing Research Group

IETF97 summary meeting
November 16, 2016, Seoul, KR

Chairs: Carsten Bormann & Ari Keränen

Note Well

- You may be recorded

- The IPR guidelines of the IETF apply:
  see **http://irtf.org/ipr** for details.

Administrivia (I)

- Pink Sheet
- Note-Takers
- Off-site (Jabber, Hangout?)
  - **xmpp:t2trg@jabber.ietf.org?join**
- Mailing List: **t2trg@irtf.org** — subscribe at: **https://www.ietf.org/mailman/listinfo/t2trg**
- Repo: **https://github.com/t2trg/2016-ietf97**

Agenda

15:20 RG Status Update (Chairs)

15:30 W3C WoT Update (Matthias Kovatsch)

15:40 Security considerations (Mohit Sethi)

  draft-irtf-t2trg-iot-seccons

15:55 RESTful Design and Hypermedia (Authors)

  draft-keranen-t2trg-rest-iot
  draft-koster-t2trg-hsml
  draft-hartke-t2trg-coral
  draft-hartke-t2trg-cbor-forms
  draft-hartke-t2trg-data-hub

16:10 CoMI/YANG interaction model for IoT (Alexander Pelov)

T2TRG scope & goals

- Open research issues in turning a true "Internet of Things" into reality
  - Internet where low-resource nodes ("things", "constrained nodes") can communicate among themselves and with the wider Internet
- Focus on issues with opportunities for IETF standardization
  - Start at the IP adaptation layer
  - End at the application layer with architectures and APIs for communicating and making data and management functions, including security

Done so far

- Chartered in December 2015. Multiple meetings before official chartering co-located with IETF meetings and with W3C Web of Things (WoT) group
- 2016: RG meetings at Nice and Lisbon co-located with W3C WoT, at San Jose co-located with IAB IoT**SI** WS, at Buenos Aires and Berlin with the IETF meetings; participated in Dublin IAB IoT**SU** WS; RIOT summit in Berlin; Implementers' meeting in Ludwigsburg (Stuttgart); joint meeting with ICNRG in Seoul
- Three RG deliverable documents in progress on REST and security; multiple new documents on REST interaction
- Outreach (e.g., organizations like OCF and Bluetooth SIG)

Where are we going

- Work on RG deliverables and outreach continues
- Future meetings co-located with good research venues (2017)
- Meetings co-located with open source activity
    - RIOT summit in Berlin (July)
    - Eclipse IoT meeting (October)
- Benchmark/reference scenarios
    - Initial discussion in various drafts and slides
    - More elaborate documentation by end of 2016

Next meetings

- 2017 planning TBD

Cooperating between ICNRG and T2TRG

- ICNRG has been working on IoT topics from an ICN perspective ("IoT over ICN") for a while
- T2TRG has been discovering issues in IP based IoT protocols (e.g., on naming of endpoints and security) where ICN mechanisms or thinking could be useful
- Workshop: several ICN IoT projects were presented and concepts of endpoints, naming, semantics, security and IP Internet interworking were discussed
- Joint activity seemed useful and collaboration between the two groups will continue e.g., with cross review of documents

ICNRG/T2TRG joint meeting

Morning

Presentations 9:00-10:15

- Research and Development of the Hyper-connected IoE Network Technology — Taewan You
- Device and Network naming structures and ICN for IoT applications — Lopez Jairo
- A RESTful, Distributed and Enhanced ICN System for IoT — GQ Wang
- I3: some thoughts towards an Industrial Information-Centric Internet of Things — Thomas Schmidt

Break 10:15-10:40 [coffee, cookies -- thanks, ETRI]

- Discussion 10:40-12:00
- Introduction to discussion - Chairs
- Discussion

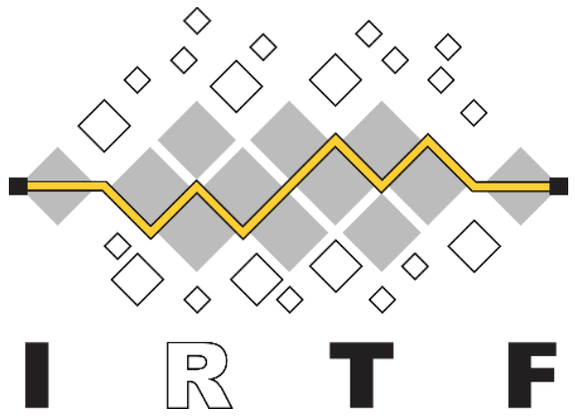
Next steps, Next meeting?, etc

12:00 Lunch

Move to NMRG Workshop for the afternoon (Kensington Yoido)

Web of Things

T2TRG Summary Meeting at IETF 97
Seoul, Republic of Korea, 2016



W3C WoT Mission

Not to be yet another standard

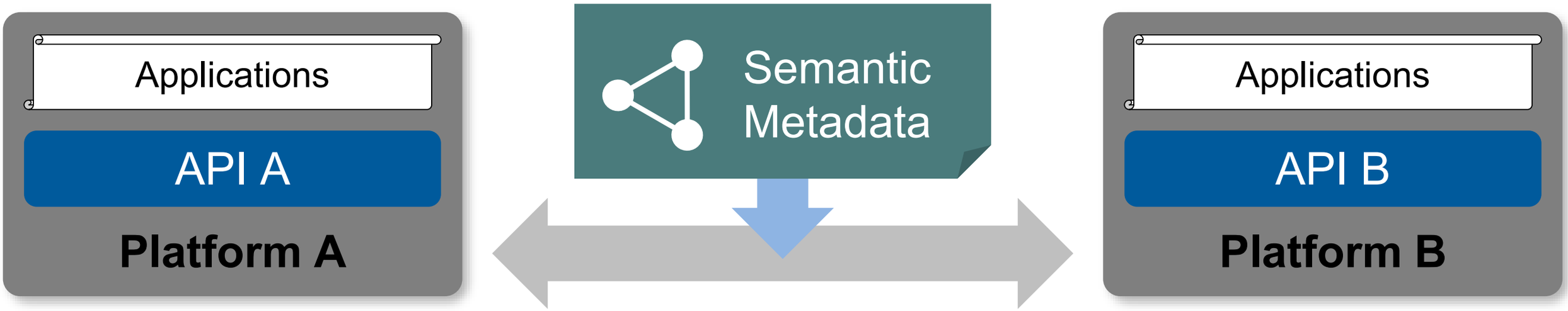
Web of Things

...

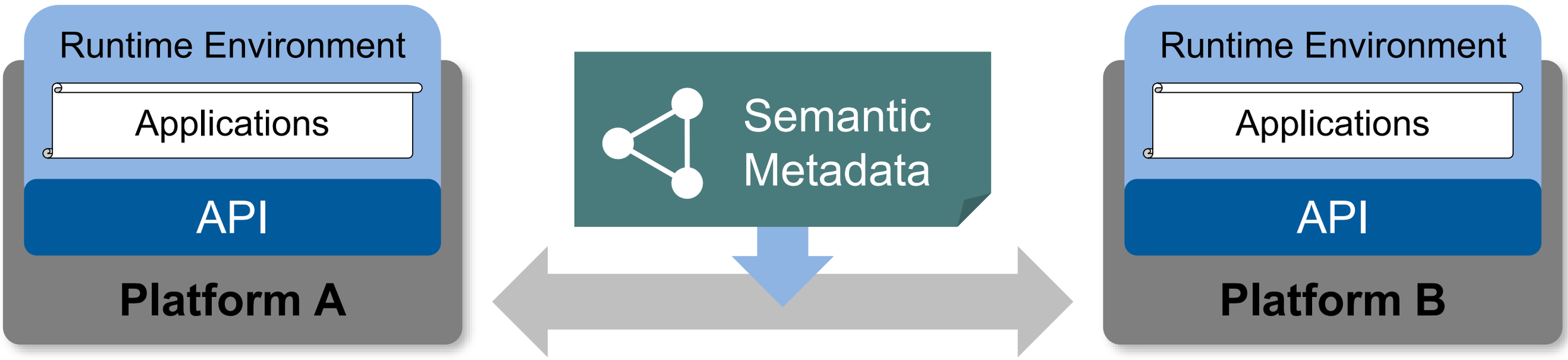
“enable easy integration across IoT platforms and application domains”

“complementing available standards”

Semantic Metadata for Interoperability



Portable IoT Applications



W3C WoT Building Blocks

WoT Scripting API:

A standardized API to simplify IoT application development and enable portable scripts across vendors and device, gateway, and cloud platforms. The API allows to expose and consume Things according to the TD Interaction Model.

WoT Thing Description (TD):

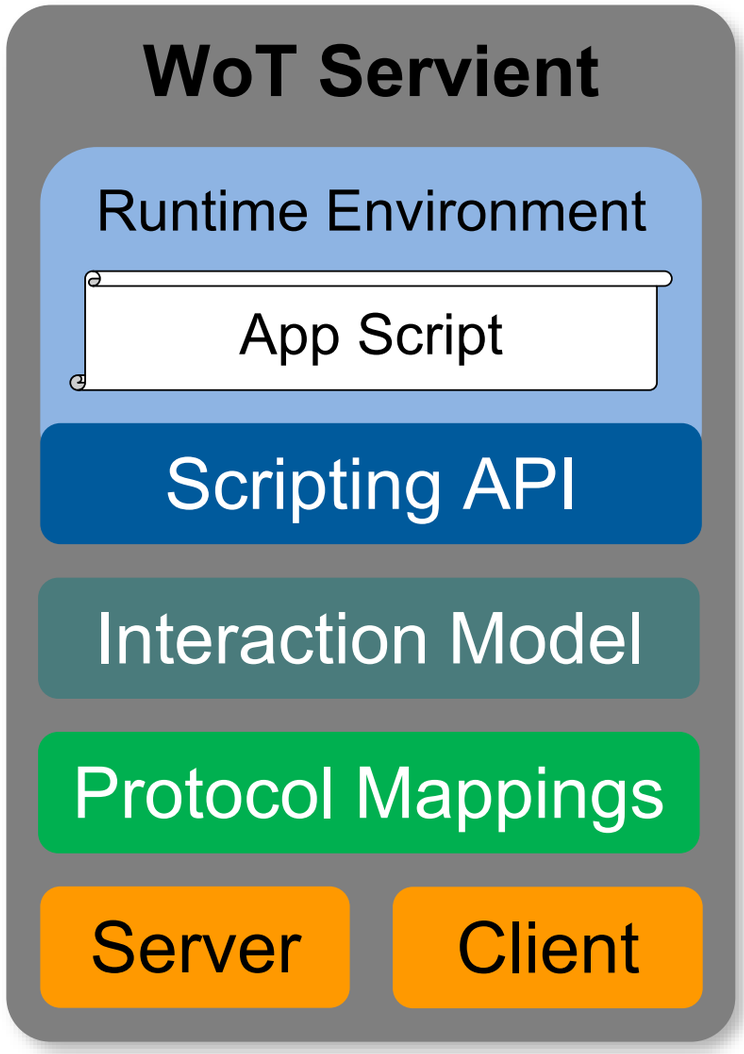
Provides metadata of the interactions, data model, communication, as well as security mechanisms of the Thing. Using JSON-LD, the TD can be consumed by classic JSON parsers, but provides extension points for optional rich semantic tooling.

WoT Protocol Mappings:

The TD also describes the usage of protocols. A vanilla protocol stack can be configured at runtime to produce message that will be understood by the targeted Thing (cf. different HTTP APIs or OCF, oneM2M, and LWM2M dialects of CoAP).

Security & Privacy:

W3C WoT does not invent new mechanisms, but ensures that all building blocks provide means to describe the security and privacy mechanisms used in a specific platform and provides adversary testing of Things.



WoT Interest Group

- Exploration and collaboration
- Since April 2015, re-chartered in August 2016
  - https://www.w3.org/2016/07/wot-ig-charter.html
- 210 participants
- 7 face-to-face meetings
  - April 2015, Munich, Germany
  - July 2015, Sunnyvale, CA, USA — Joint T2TRG (Prague IETF 93)
  - October 2015, Sapporo, Japan — Joint T2TRG (Yokohama IETF 94)
  - January 2016, Nice, France — Joint T2TRG
  - April 2016, Montreal, Canada
  - July 2016, Beijing, China
  - September 2016, Lisbon, Portugal — Joint T2TRG

(Proposed) WoT Working Group

- Normative standardization work
- Proposed Charter
  - https://www.w3.org/2016/09/wot-wg-charter.html
- AC Review September 2016
  - https://www.w3.org/2002/09/wbs/33280/wotwg2016/results
  - 49 support as is
  - 4 comments, but support anyway
  - 2 comments, formally object if not changed
- Resolving comments
  - RDF dependency / complexity of semantic frameworks
  - Scope
  - Security

W3C WoT Online Resources

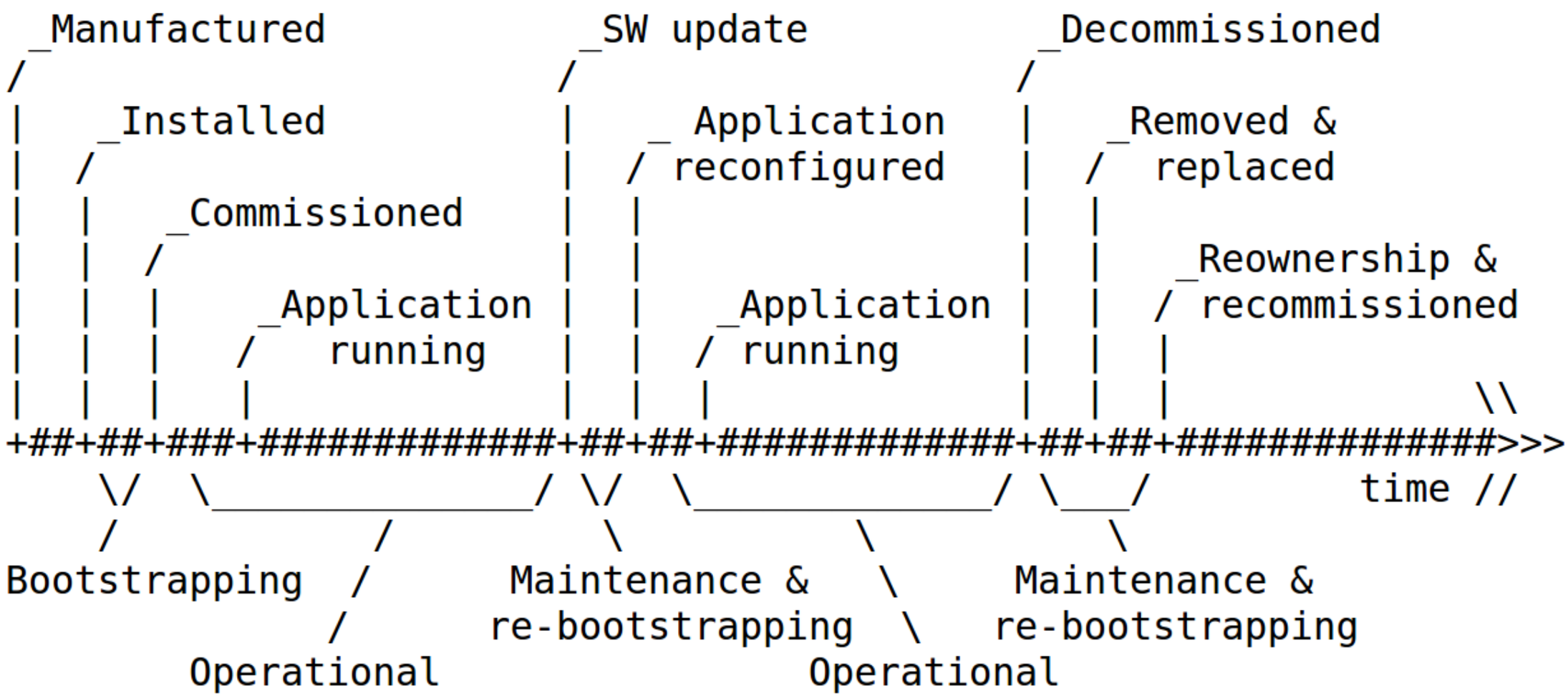
- W3C WoT Interest Group
  - https://www.w3.org/2016/07/wot-ig-charter.html
  - https://www.w3.org/WoT/IG/
  - https://lists.w3.org/Archives/Public/public-wot-ig/ (subscribe to list)
- (Proposed) W3C WoT Working Group
  - https://www.w3.org/2016/09/wot-wg-charter.html
  - https://www.w3.org/2002/09/wbs/33280/wotwg2016/results
- Technical work: GitHub
  - https://github.com/w3c/wot
- Organizational work: Wiki
  - https://www.w3.org/WoT/IG/wiki/Main_Page

Security consideration for the IoT

IETF97

Sandeep, Oscar (Philips)
Mohit (Ericsson)

Thing Lifecycle



Threat Analysis

- Cloning of things
- Substitution
- Eavesdropping/Man-in-the-middle
- Privacy
- Denial-of-Service
- Firmware replacement
- Routing attacks

Challenges

- Device heterogeneity
- Protocol translation vs. end-to-end security
- Software update
- Verifying device behavior
- End-of-life
- Penetration testing
- Quantum resistance

Profiles/Architecture/State-of-the-art

- Home/managed home/industrial
- Trade-offs between centralized/distributed management of security
- Profiles for network/application security
- State-of-the-art: IPSec, Minimal IKEv2, DTLS

Contents in old draft-garcia-core-security-06

- Thing lifecycle
- Architectural considerations
- State of the art
- Challenges
  - Constraints
  - Bootstrapping
  - Operation
- Security profiles

Contents in https://tools.ietf.org/html/draft-irtf-t2trg-iot-seccons-00

Reordering

- Thing lifecycle
- Architectural considerations <- updated
- State of the art <- some cleaning
- Challenges
  - Constraints
  - Bootstrapping <- removed, linked to bootstrapping draft.
  - Operation
  - Added challenges
- Security profiles

Next steps (1)

- Draft is rather long
- We would like to make the structure more consistent
- We suggest a uniform structure for each of those sections according to “Security pillars”:
  1. Security architecture (centralized/distributed)
  2. Security model of a “thing” (tamper-resistant h/w)
  3. Security bootstrapping
  4. Network security
  5. Application security

Next steps (2)

- Threats:
  - Threats that are included are relatively generic. A more exhaustive overview can be included
  - Possibly classify them according to different phases of the lifecycle

Next steps (3)

- Security profiles
  - Different application areas tend to have different security requirements
  - Further detail them, in particular, with the expected security properties that are to be provided
  - Keep classification based on “security pillars”

Next steps (4)

- State of the art
  - State of the art is outdated (old internet draft)
  - Classify according to security pillars
  - Include newer references

Next steps (5)

- Challenges
  - Classify them according to the “security pillars”
  - Include for each of them:
    - What the specific challenge is
    - What the potential solution direction might be
  - Note that some challenges are still to be added: https://github.com/t2trg/2015-ietf94/blob/master/t2trg-b.mkd

RESTful IoT Work at T2TRG

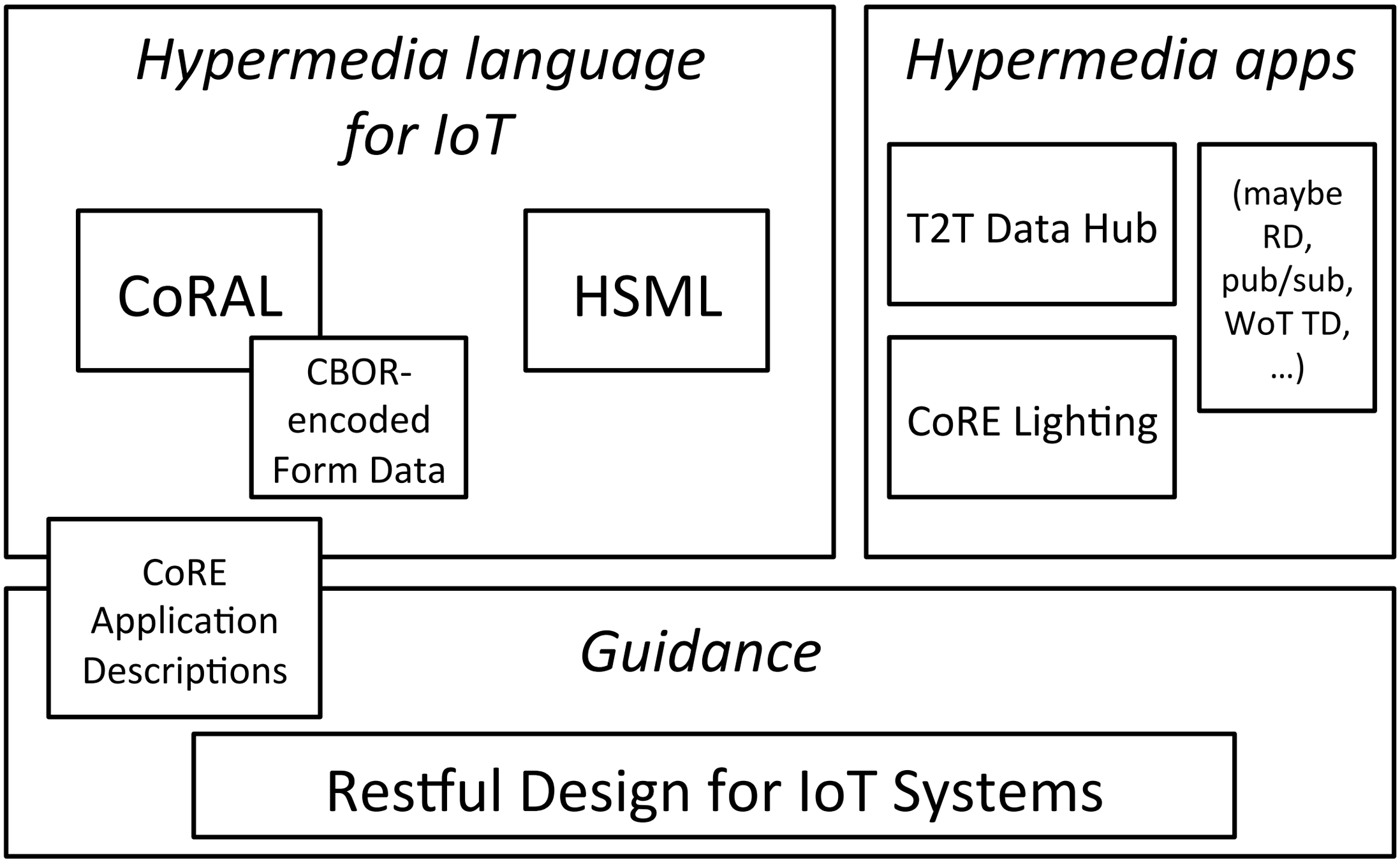
Ari Keränen

(with Michael Koster, Klaus Hartke, Matthias Kovatsch)

T2TRG @ IETF97

Seoul, South Korea

Overview


Hypermedia language for IoT
CoRAL
CBOR-encoded Form Data
HSML
Hypermedia apps
T2T Data Hub
CoRE Lighting
(maybe RD, pub/sub, WoT TD, …)
CoRE Application Descriptions
Guidance
Restful Design for IoT Systems

RESTful Design for IoT Systems

- Guidance for designing IoT systems that follow the principles of the REST architectural style
- Collection of "basic" information and terminology that has been found useful
- Taking into account IoT characteristics
  - data formats, interaction patterns, and other mechanisms minimizing need for human interaction
  - enabling use of constrained devices and networks
- draft-keranen-t2trg-rest-iot

CoRE Application Descriptions

- A way to describe the APIs of constrained, RESTful, hypermedia-driven applications
  - URI schemes
  - media types
  - link relation types
  - form relation types
  - form field names
- draft-hartke-core-apps

Hypermedia Language for IoT

- How to express resources with hypermedia controls (e.g., links and forms) in constrained-thing friendly way
- "HTML for IoT"
  - But less focus on content, more on control
  - Also see work at W3C Web of Things groups: https://www.w3.org/WoT/

CoRAL: Constrained RESTful Application Language

- Efficient hypermedia representation format for links and forms
  - Compact representation with CBOR, defaults, numeric IDs. Often only few bytes needed.
- Reduce round trips with embedded representations
- Simple implementations
- draft-hartke-t2trg-coral & draft-hartke-t2trg-cbor-forms

HSML: Media Types for Machine Interaction

- CoRE link format + SenML => HSML Collections
  - JSON & CBOR representations
- Link annotation for application semantics
- draft-koster-t2trg-hsml

CoRAL & HSML

- Similarities
  - Collections of links and items
  - Forms to drive resource state updates
  - Interoperable data models
  - HSML can be encoded in CoRAL
- Differences
  - CoRAL: data model derived from HAL
  - HSML: CoRE Link-Format and SenML
  - CoRAL: media types to define application semantic vocabulary and data serialization
  - HSML: link annotation to embed application semantics

CoRAL & HSML: going forward

- Experimentation and evaluation through use case prototyping
- Eventually converge to single representation format and interaction model

Hypermedia Applications

- Core Lighting
  - Control smart objects in simple lighting scenario
  - Draft outdated; to be updated
- Thing-to-Thing Data Hub
  - RESTful, hypermedia driven web app
  - for publishing information to central location
  - Discover&Read Hub, CRUD+Observe & Find items
  - Evolvable API based on hypermedia
  - draft-hartke-t2trg-data-hub

YANG interaction model for IoT

Alexander Pelov <a@ackl.io>
Michel Veillette <michel.veillette@trilliantinc.com>

A huge thanks to:

Peter van der Stok

Andy Bierman

Benoit Claise

And to our chairs:

Ari and Carsten

A huge thanks to:

Jaime Jimenez

Hannes Tschofenig

Dave Thaler

For writing:

draft-iab-iotsi-workshop

A huge thanks to:

Matthias Kovatsch

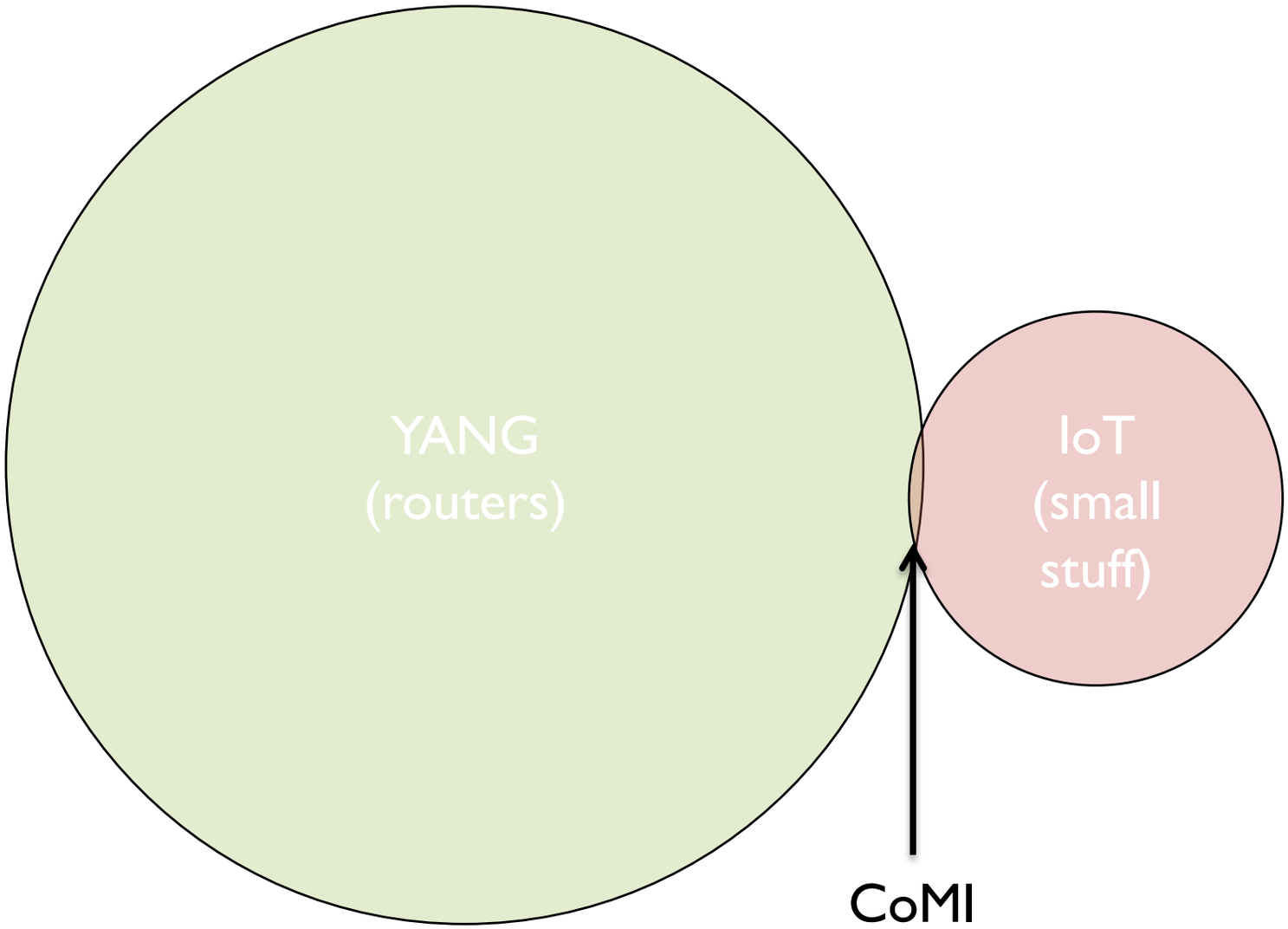
Klaus Hartke

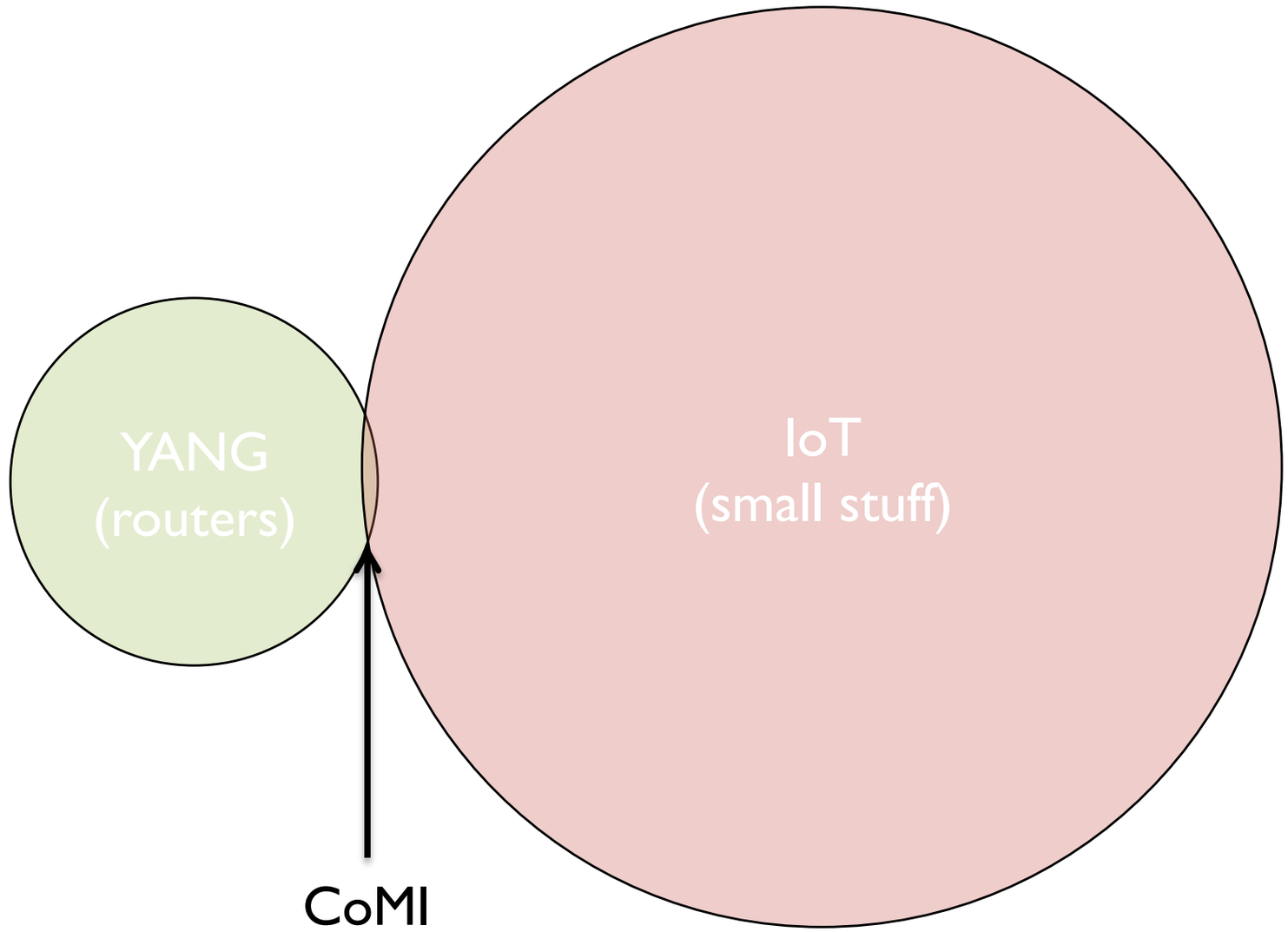
Michael Koster

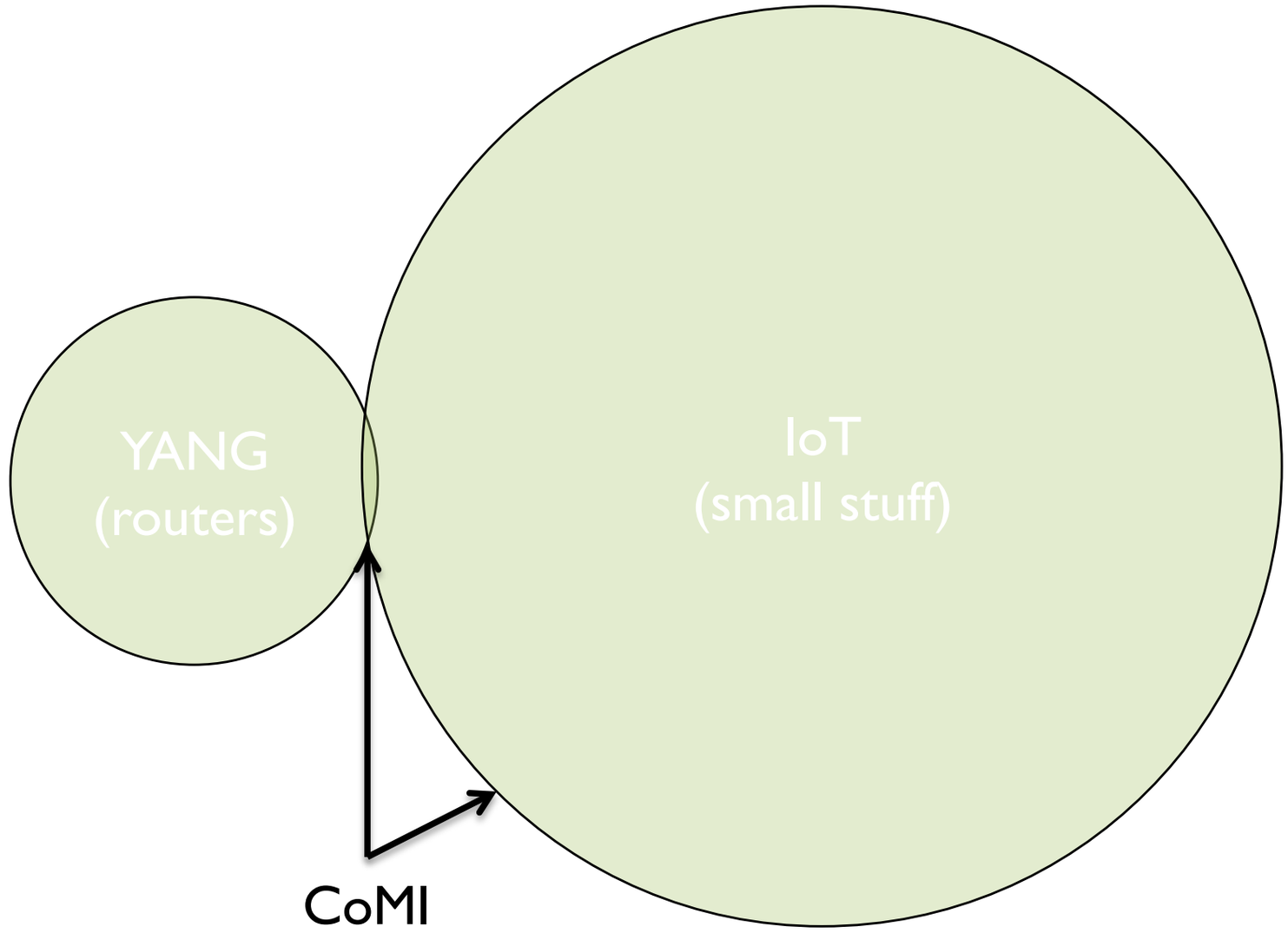
(and lots of people I've certainly omitted)

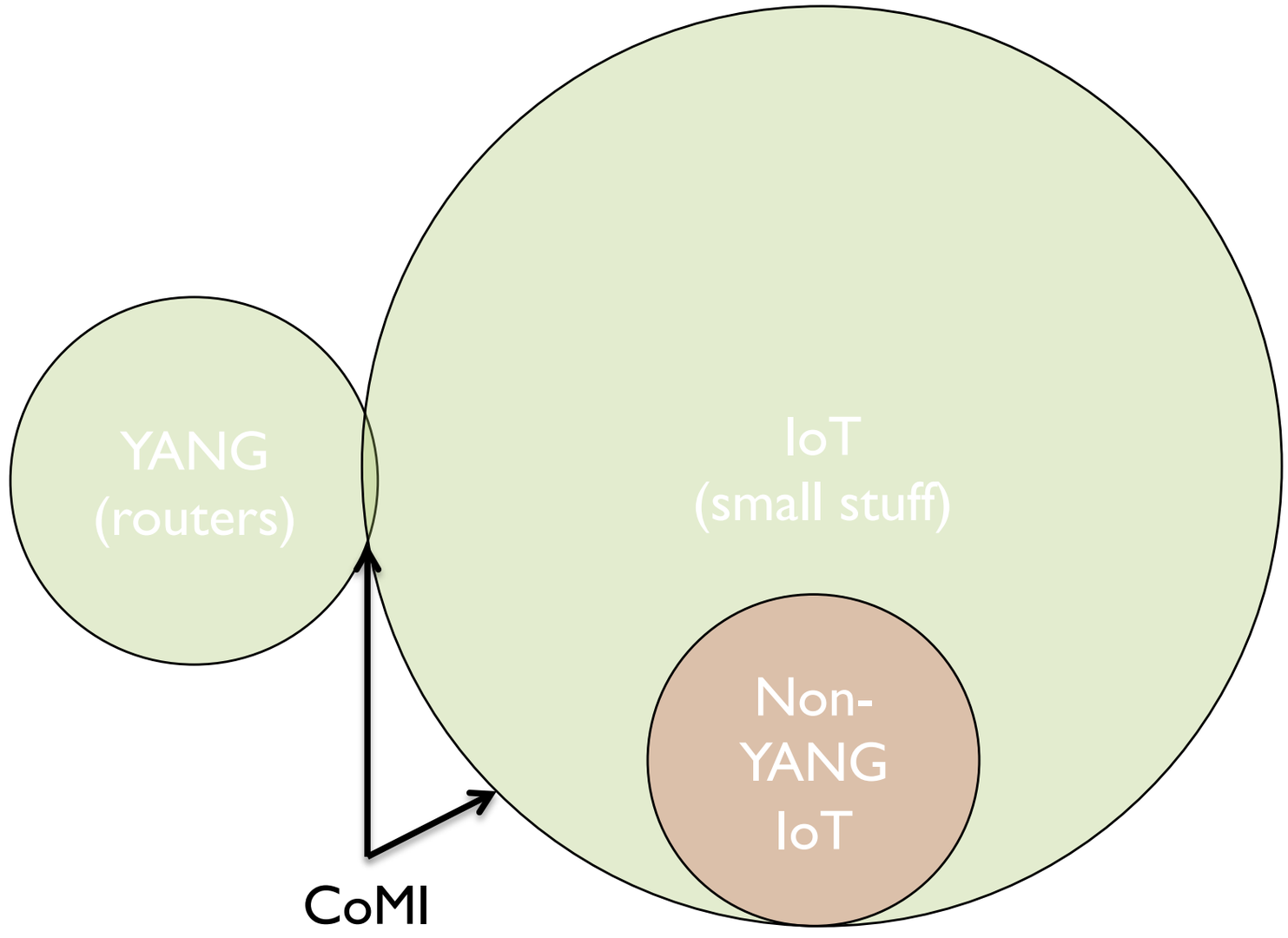
For:

Being RESTfull


YANG
(routers)
IoT
(small
stuff)
CoMI


YANG
(routers)
IoT
(small stuff)
CoMI

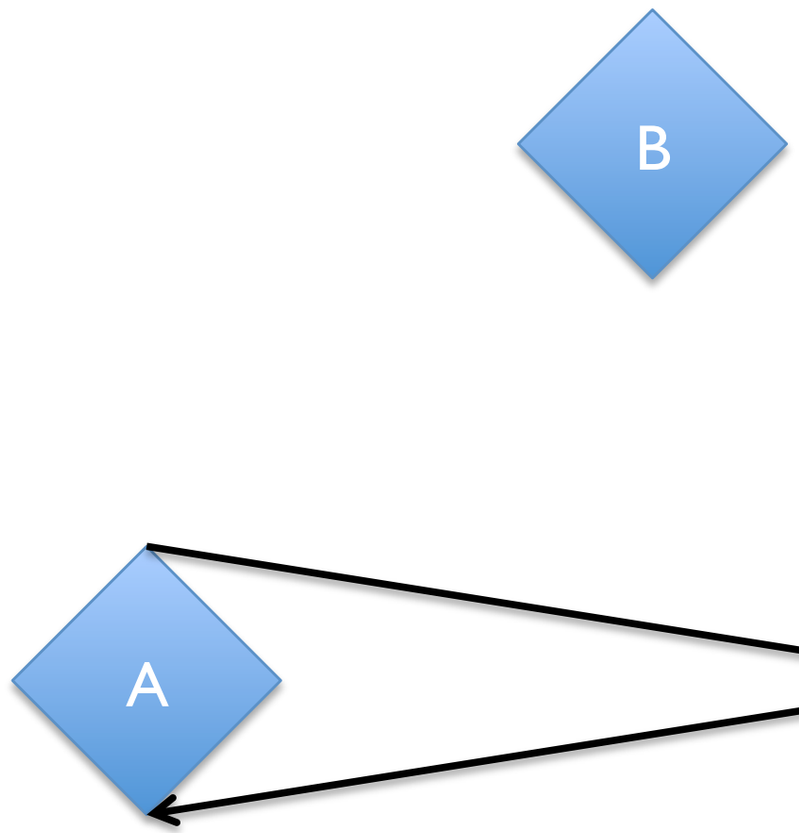

YANG
(routers)
IoT
(small stuff)
CoMI


YANG
(routers)
IoT
(small stuff)
Non-
YANG
IoT
CoMI

NOT

Replacement for:

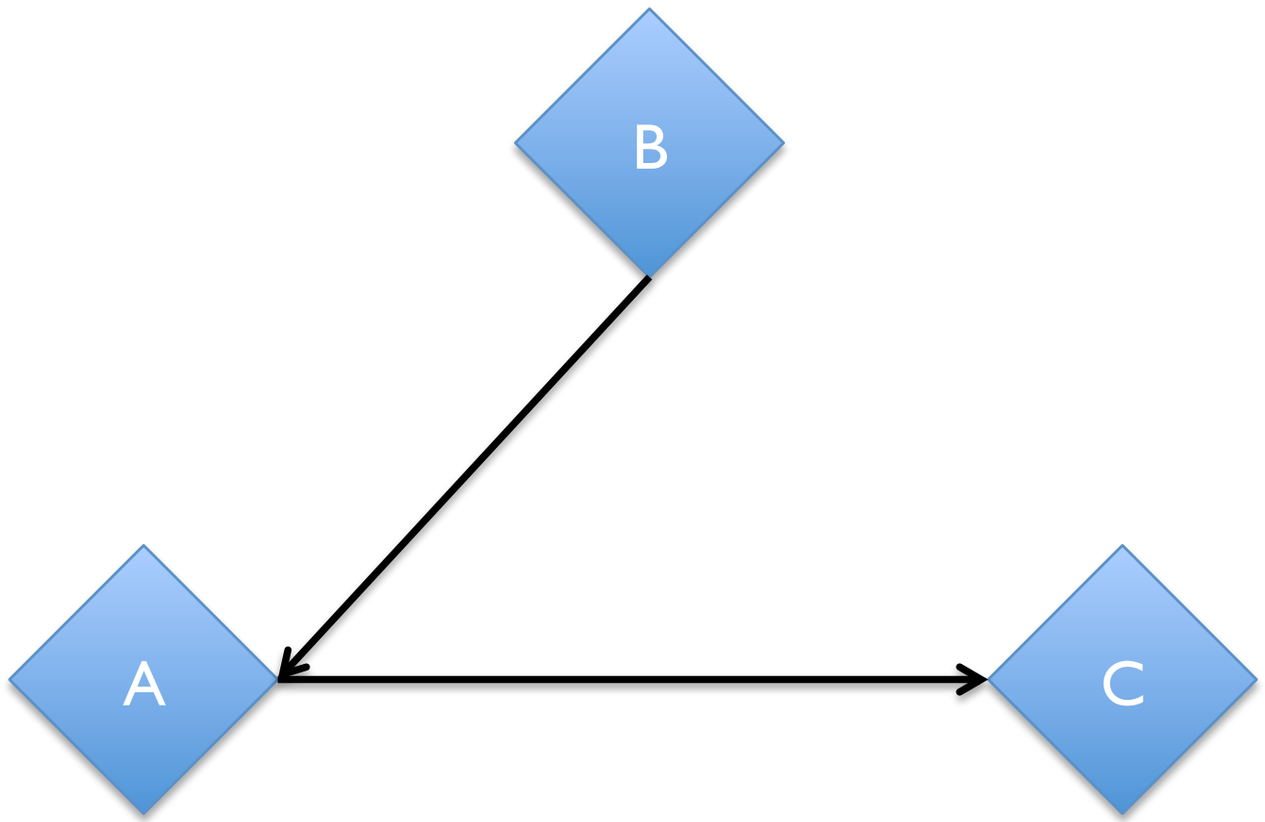
- All CoRE stuff



NOT

Replacement for:

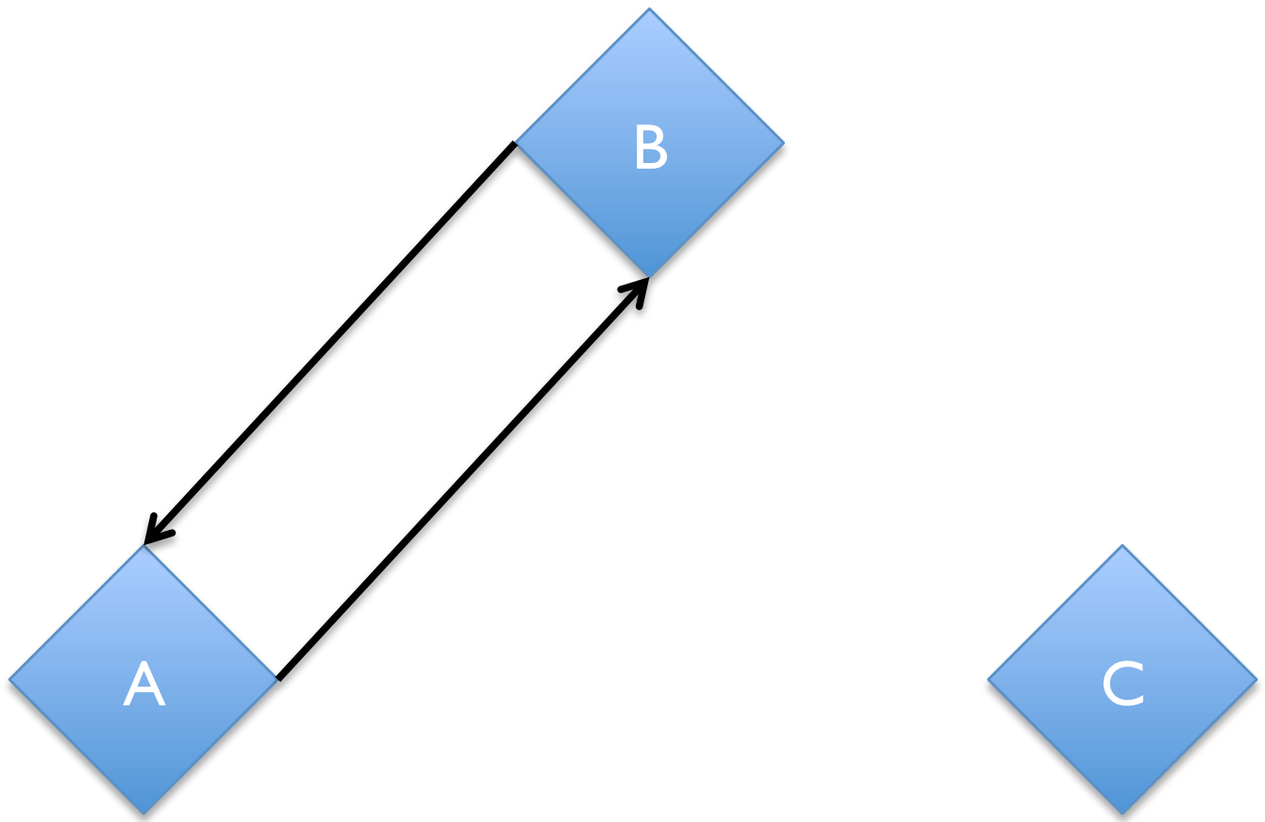
- Linked Data
- HATEOAS
  - REST
- PubSub
- …



NOT

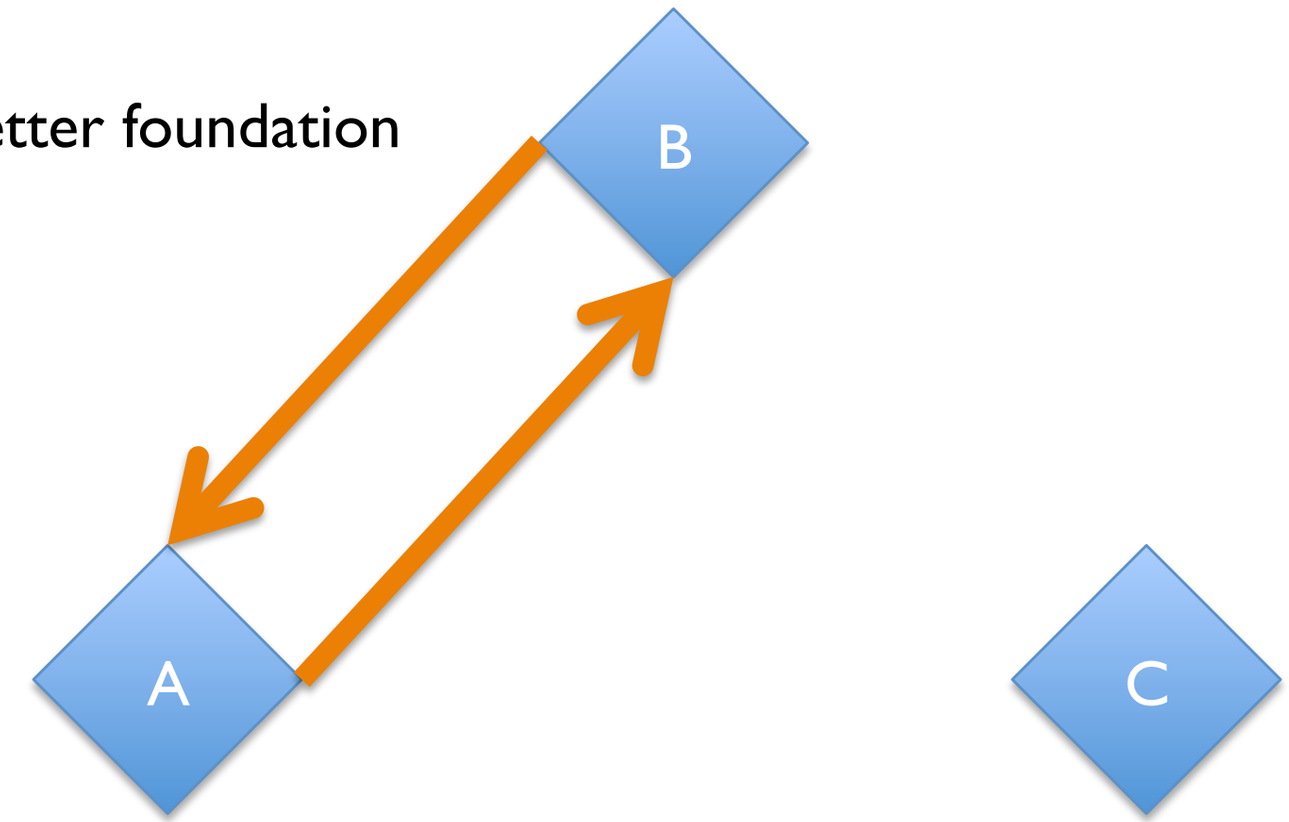
Replacement for:

- Semantics
- RDF
- …



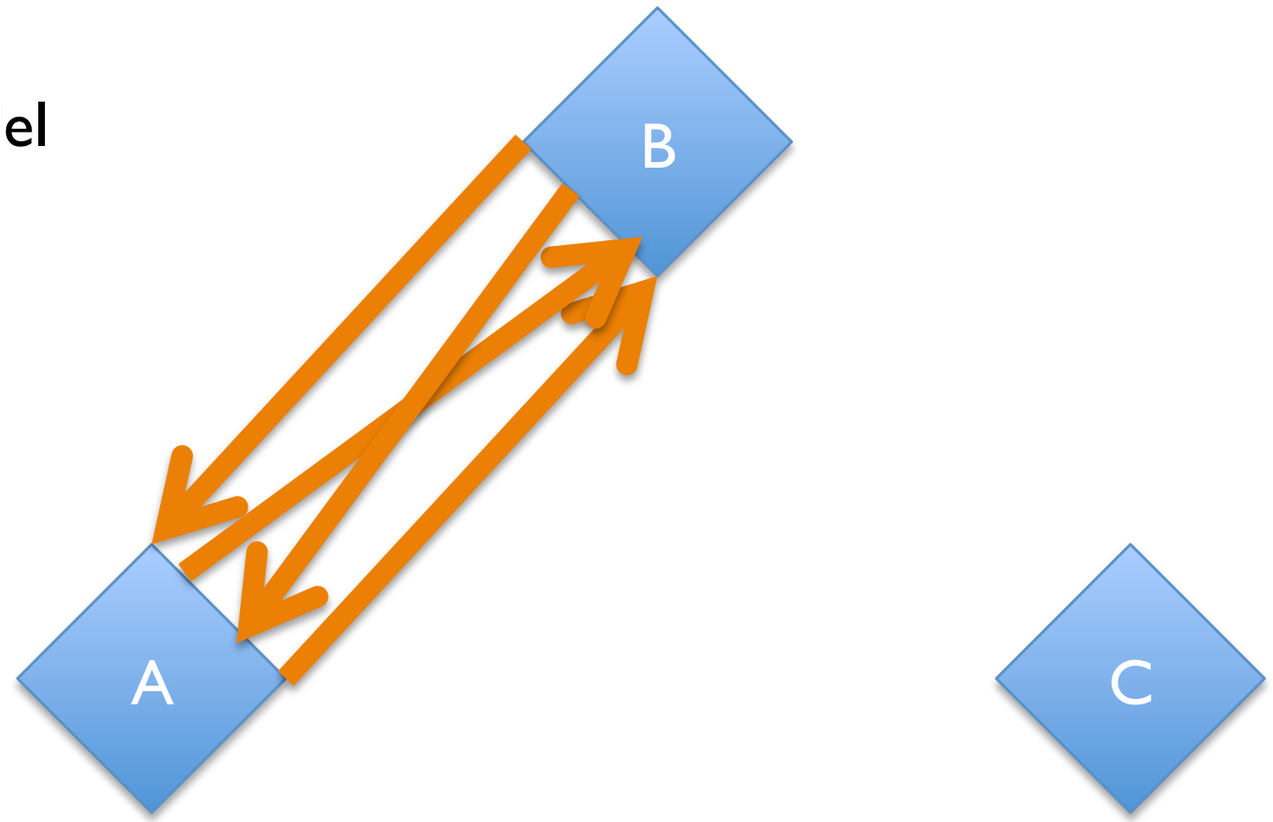
IS

Richer vocabulary, better foundation to build upon



IS

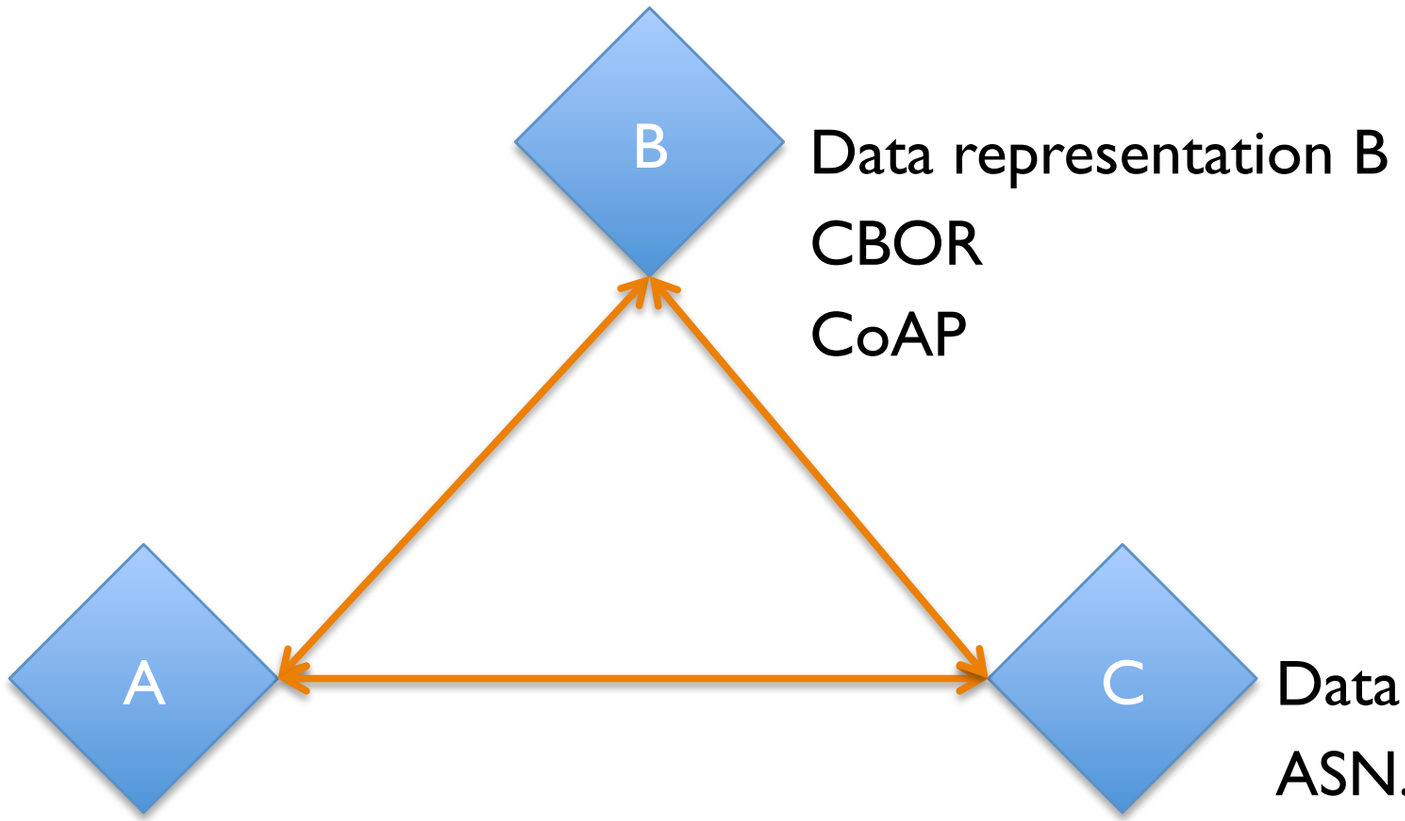
Richer exchange model between two entities



Interaction model (IN)

Defines how data is accessed and retrieved from the endpoints **, being therefore tied to the specific communication pattern that the system has (e.g. REST methods,Publish/ Subscribe operations or RPC-calls).**

A non-interaction



Data representation A
IDL
CORBA

Data representation C
ASN.1
SNMP

Interaction model description

- REST
  - Follow the links
  - Get the content formats
  - Submit the forms

PUT /temp CBOR 25

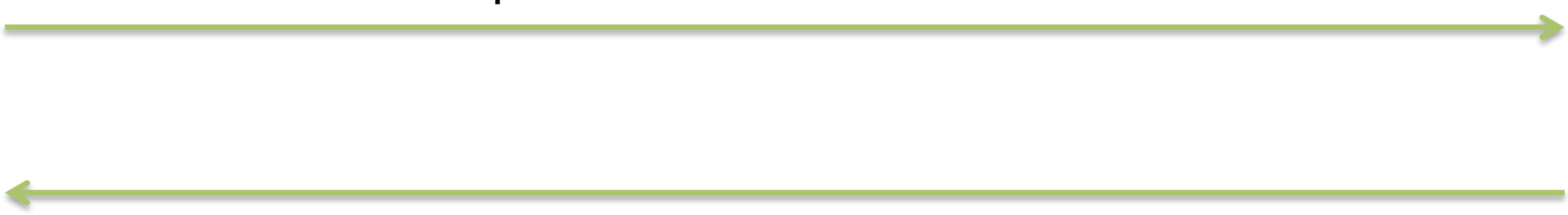
PUT /temp CBOR 25

200 OK

METHOD	+	URI	+	DATA SYNTAX	+	DATA VALUES
PUT		/temp		CBOR		25

200 OK

Why? When?	(what?)		(where?)		(content format) (how?)		(how much?)
	METHOD	**+**	**URI**	**+**	**DATA SYNTAX**	**+**	**DATA VALUES**
	PUT		/temp		CBOR		25



200 OK

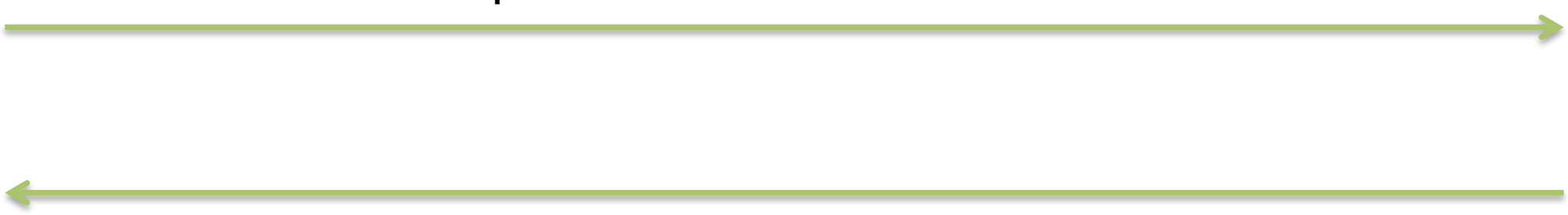
SEMANTICS

(content format)

Why?
When?

(what?) (where?) (how?) (how much?)

METHOD	+	**URI**	+	**DATA SYNTAX**	+	**DATA VALUES**
PUT		/temp		CBOR		25



2.04 Changed

SEMANTICS

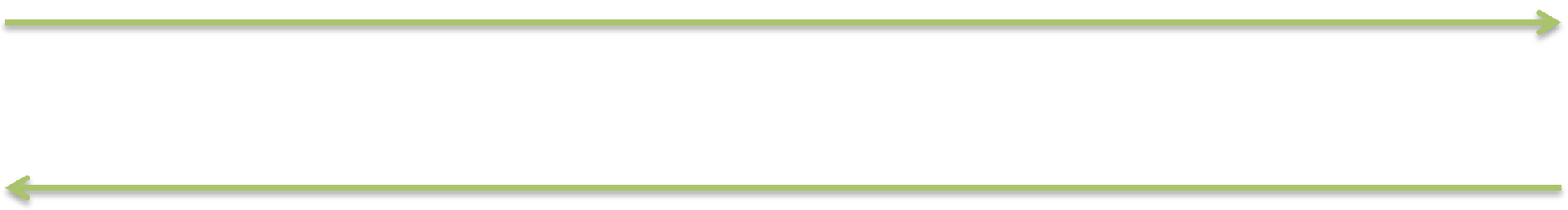
(content format)

Why?
When?

(what?) (where?) (how?) (how much?)

METHOD + URI + DATA SYNTAX + DATA VALUES

PUT /temp CBOR "One more Kimchi, please"



4.00 Bad Request

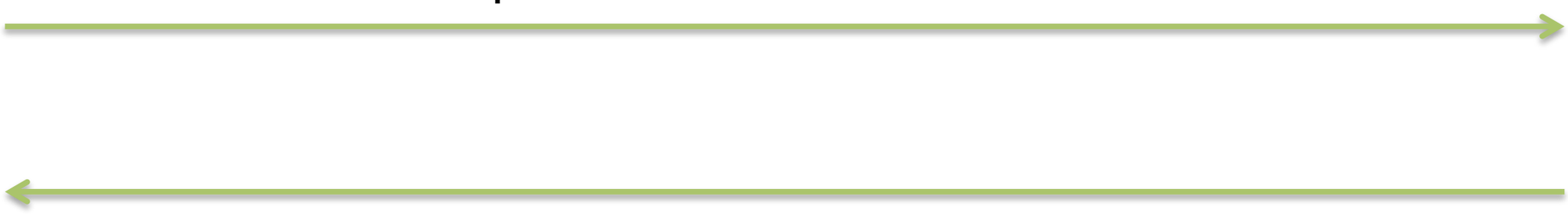
SEMANTICS

(content format)

Why?
When?

(what?) (where?) (how?) (how much?)

METHOD	+	**URI**	+	**DATA SYNTAX**	+	**DATA VALUES**
PUT		/temp		CBOR		189 756



4.00 Bad Request

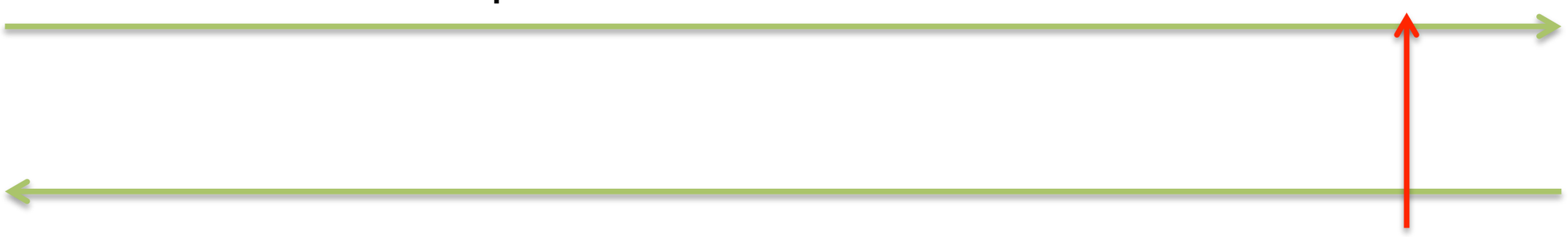
SEMANTICS

(content format)

Why?
When?

(what?) (where?) (how?) (how much?)

METHOD	+	**URI**	+	**DATA SYNTAX**	+	**DATA VALUES**
PUT		/temp		CBOR		189 756



4.00 Bad Request

How does the client know the schema of the data? How to handle collections? …

SEMANTICS

(content format)

Why?
When?

(what?) (where?) (how?) (how much?)

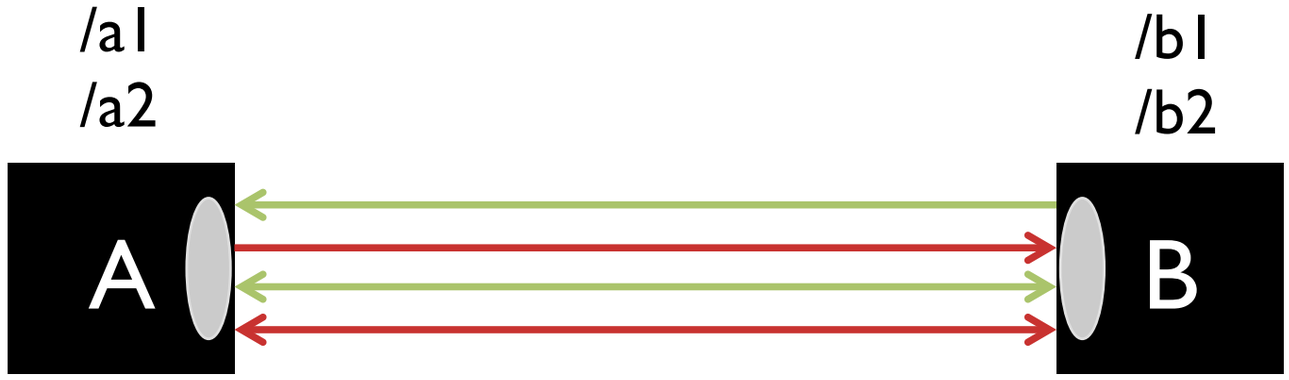
METHOD + URI + DATA SYNTAX + DATA VALUES

PUT /temp application/cbor+positive-temp-less-than-100

Interaction model description

- REST
  - Follow the links
  - Get the content formats
  - Submit the forms
- How are these billions of potential content formats handled?
  - Are we doomed of always referring to HTTP/CoAP primitives?
    - I know of little Web devs that use Sockets today

CoMI/YANG



Instead of limiting to "low-level" REST API,
use high-level CoMI API

Use HATEOAS to discover the CoMI entry point(s)

Why?

- YANG community – primarily routers
- CoRe / T2T / W3C community – primarily IoT

- Powerful tool… Disjoint communities… Getting together…

- Topic in T2TRG?
  - Something else?
  - Nothing else?

Thanks!

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