



CNS/CP – composable lightweight
interoperation for the distributed
web and internet of things

Toby Considine, TC9

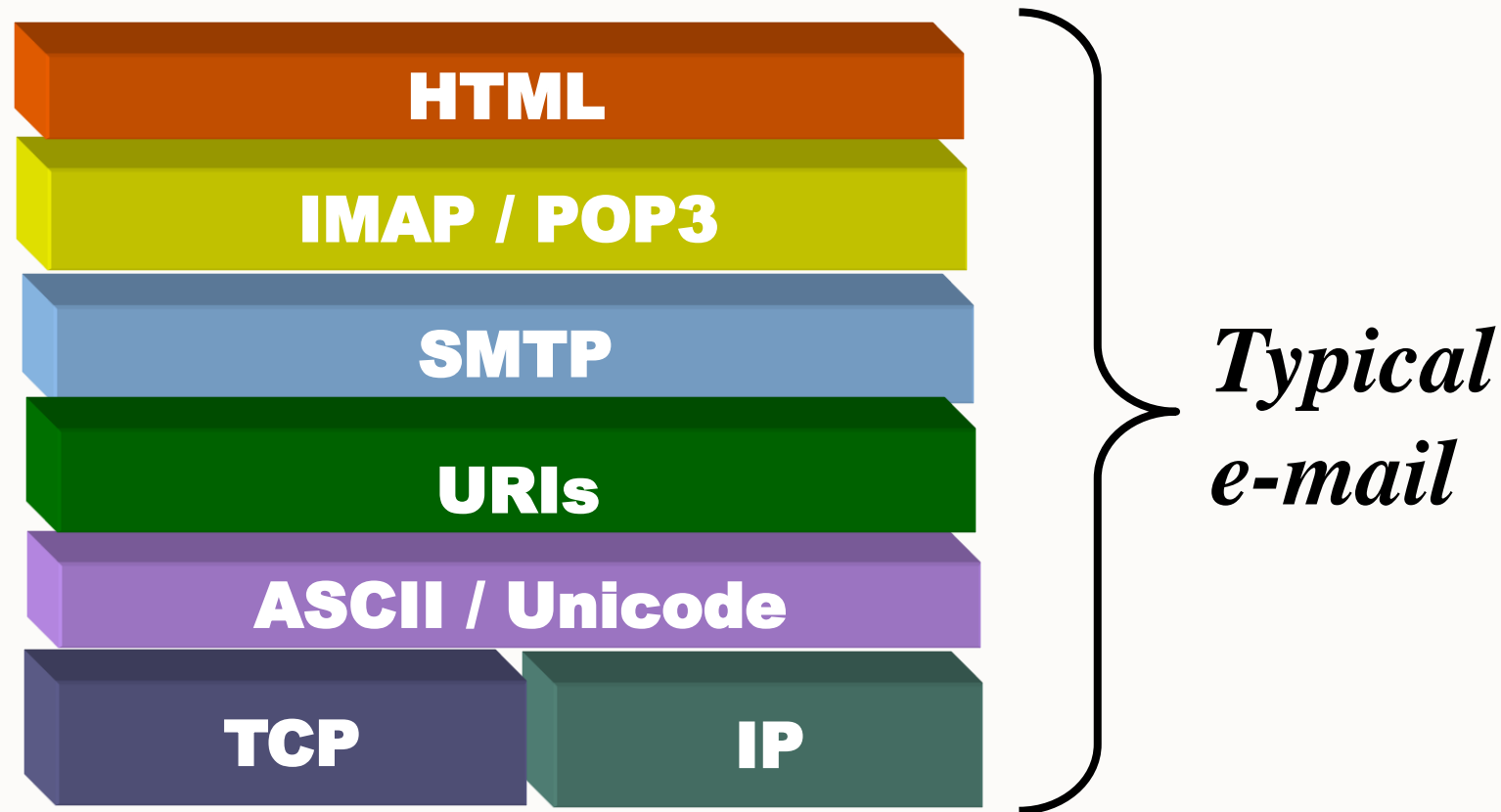
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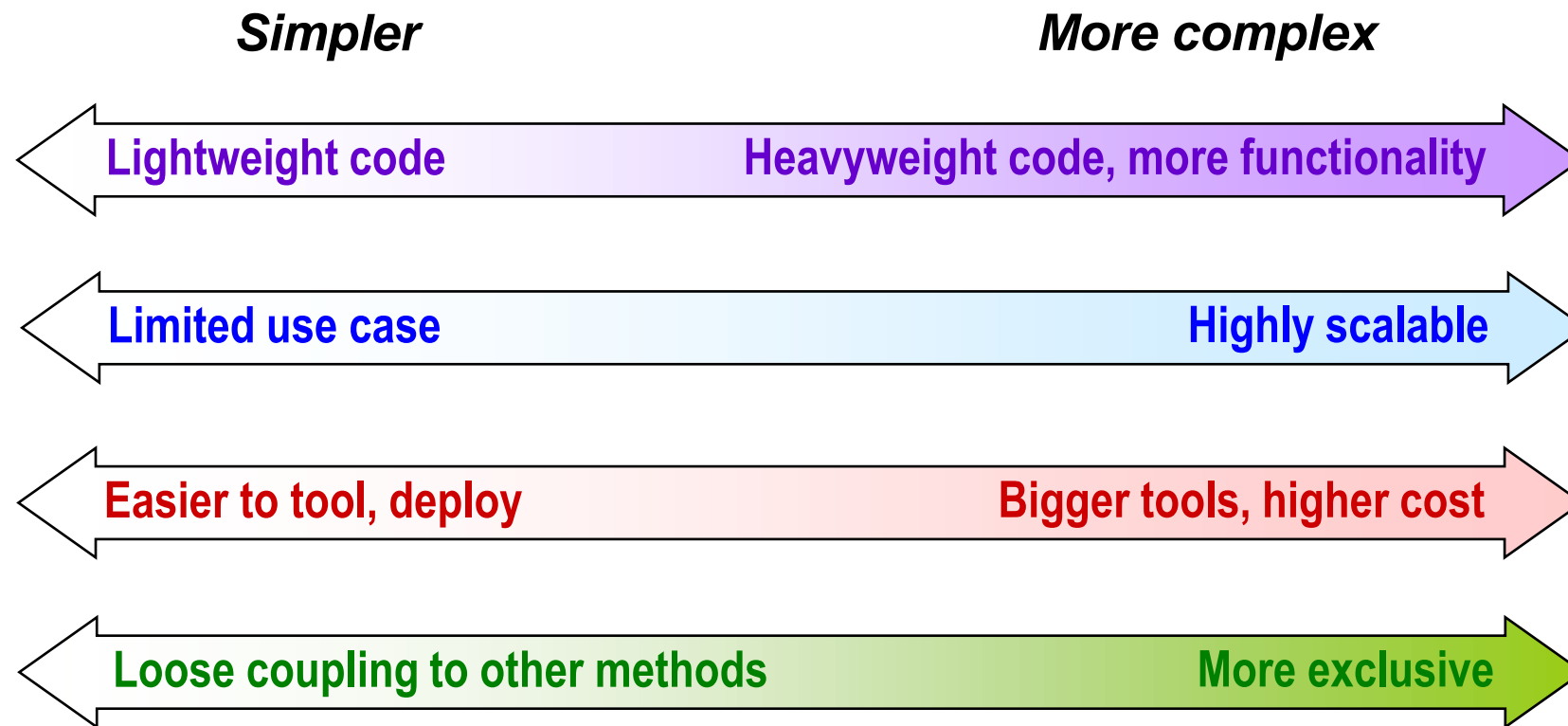
Open standards cause interoperability & convergence

- Good standards are stable
- Good standards are visible
- Good standards are modular
 - Users and developers test whether the method can be used in conjunction with other specifications
 - Modular methods can be phased into legacy architectures
 - Modular methods are less vulnerable to vendor lock-in
 - No-one uses just ONE standard

Evolvable applications are composed of multiple standards



Modularity of standard determines how code evolves



Toby Considine

- 25 years of integrating BAS and other district control systems
- Significant author of US National Smart Grid Roadmap
- Key participant in development of multiple specifications
 - OBIX
 - WS-Calendar (M2M schedule negotiation) (and update of iCalendar family)
 - Smart energy
 - EMIX (Energy market information)
 - Energy Interoperation (and OpenADR)
 - Common Transactive Services
 - IEEE Spatial Web / Web 3.0
 - Connection Profiles
- The Energy Mashup Lab
 - FOSS for fractal microgrid operation based on transactive energy

Challenge of Internet of Things

- Much more diverse than typical IT
- Usually longer lived
- Not built for Interoperation
- Cyberphysical security is complex
- System configuration may require deep domain knowledge
 - Arrogant to feel one can just mash the buttons
- New realms of privacy concerns
 - Both personal and corporate

Connection profiles can define abstract interfaces essential for internet-scale system interoperation

- Break up the span of control
- Isolate diversity
- Let system experts publish interfaces
- Empower developers
- Enable virtuous markets
 - IoT specifications must not slow down rapid evolution and development



Proposed CNS/CP specification

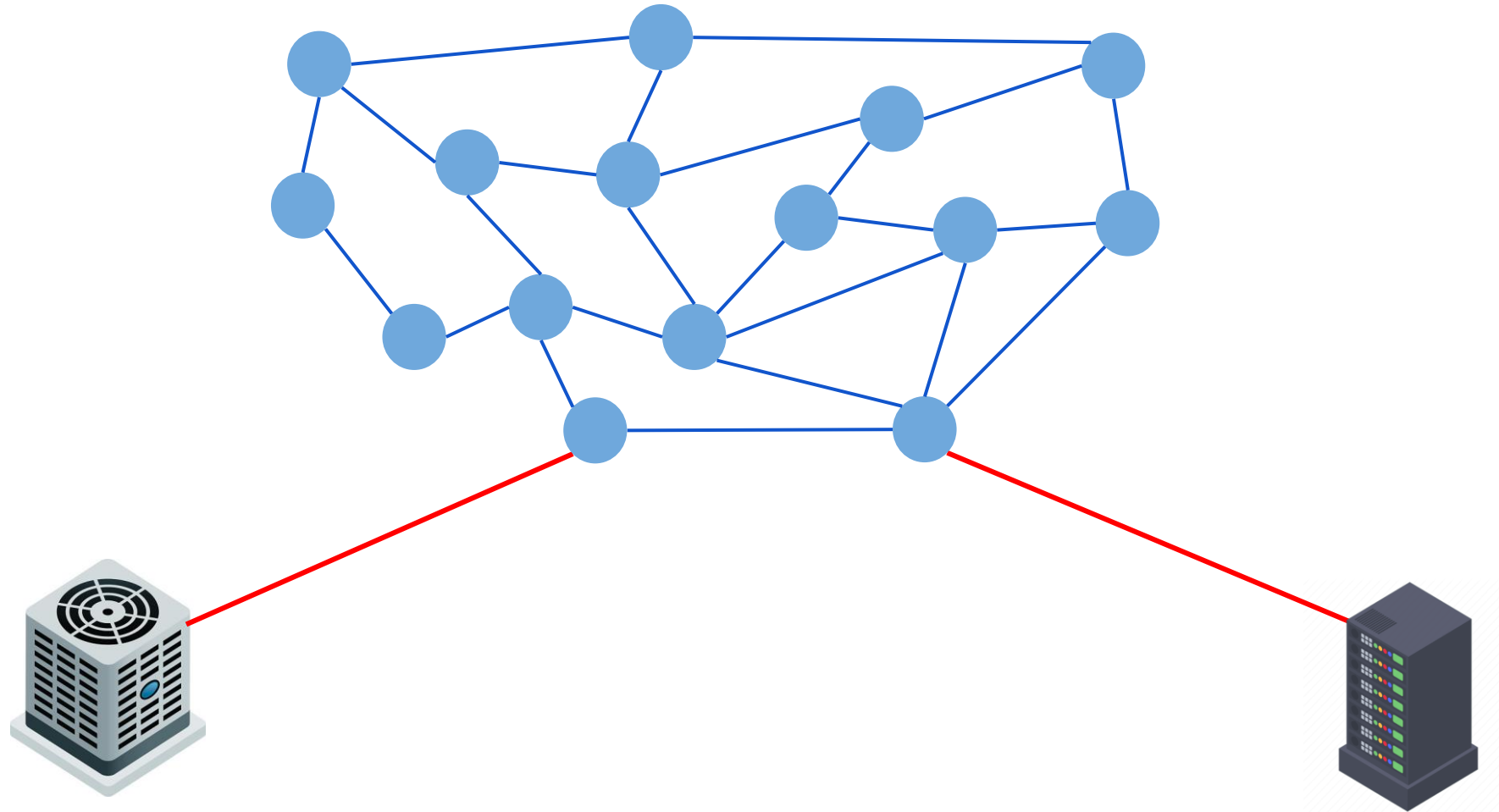
- Enables anyone to publish interfaces
- Interfaces are abstract and discoverable
- Run-time access to specifications not required
- Supports composition of
 - Cybersecurity
 - Connections
 - Application gateways
 - Line protocols
 - Semantic overlays

Connection Brokers provide “control plane” as a service

Connection brokers can:

- Enable edge-based interaction without central queries
- Advanced logging and forensics where required
- Document interoperation to support maintenance as systems evolve
- Support advanced cybersecurity models, including
 - Inter-domain trusts
 - Decentralized identity realms and self-sovereign identities

Composability of Connections



CNS/CP provides a seed-standard for composition into other efforts

- Example: IEEE P2874 “Spatial Web” or “Web 3”
 - Distributed mesh capable
 - Geolocation — VR — AI/ML — AR
 - Access to semantic interoperation unmediated by central gatekeepers
 - Support for decentralized identities (DID)
 - Digital Twins as full peers

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Discussion

- following slides are references

Knowledge Problems and Spontaneous Order

- F. A. Hayek, "The Use of Knowledge in Society," *The American Economic Review*, vol. 35, no. 4, pp. 519-530, 1945.
- L. Kiesling, "The Knowledge Problem, Learning, and Regulation: How Regulation Affects Technological Change in the Electric Power Industry," *Studies in Emergent Order*, vol. 3, pp. 149-171, 2010.

Using Markets for Control

- B. Huberman and S. H. Clearwater, "Thermal markets for controlling building environments," *Energy Engineering*, vol. 91, no. 3, pp. 26-56, January 1994.
- B. Huberman and S. H. Clearwater, "A multi-agent system for controlling building environments," in *First International Conference on Multiagent Systems*, 1995.

Thing-Related OASIS Specifications

- OASIS Energy Interoperation 1.0. 2012.
 - Designed to work to, from, inside, and outside microgrids
 - <http://www.oasis-open.org/committees/energyinterop>
- Common Transactive Services (in second public review)
 - Lightweight profile of Energy Interoperation for actor model integration
 - <https://docs.oasis-open.org/energyinterop/ei-cts/v1.0/csd02/ei-cts-v1.0-csd02.html>
- OASIS Energy Market Information Exchange (2012)
 - Price and product definition/description
 - <http://docs.oasis-open.org/emix/emix/v1.0/emix-v1.0.html>
- OASIS WS-Calendar Platform Independent Model (PIM) (2015)
 - <https://docs.oasis-open.org/ws-calendar/ws-calendar-pim/v1.0/ws-calendar-pim-v1.0.html>
- OBIX – Abstract communications with control systems
 - <https://docs.oasis-open.org/obix/obix/v1.1/obix-v1.1.html>

Smart energy and distributed microgrid architecture

- Grid Fault Recovery and Resilience: Applying Structured Energy and Microgrids. Cox, William T and Considine, Toby. 2014. Washington, DC : IEEE Conference Publications, 2014. 2014 IEEE PES Conference on Innovative Smart Grid Technologies.
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- Energy, Micromarkets, and Microgrids. Cox, William and Considine, Toby. 2011. Phoenix, AZ : GridWise Architecture Council, 2011. Grid-Interop 2011.
- Architecturally Significant Interfaces of the Smart Grid. Cox, William T and Considine, Toby. 2009. Denver, CO : Gridwise Architectural Council, 2009. Grid-Interop Proceedings.
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