

Heterogeneous device interaction using an IPv6 enabled service-oriented architecture for building automation systems

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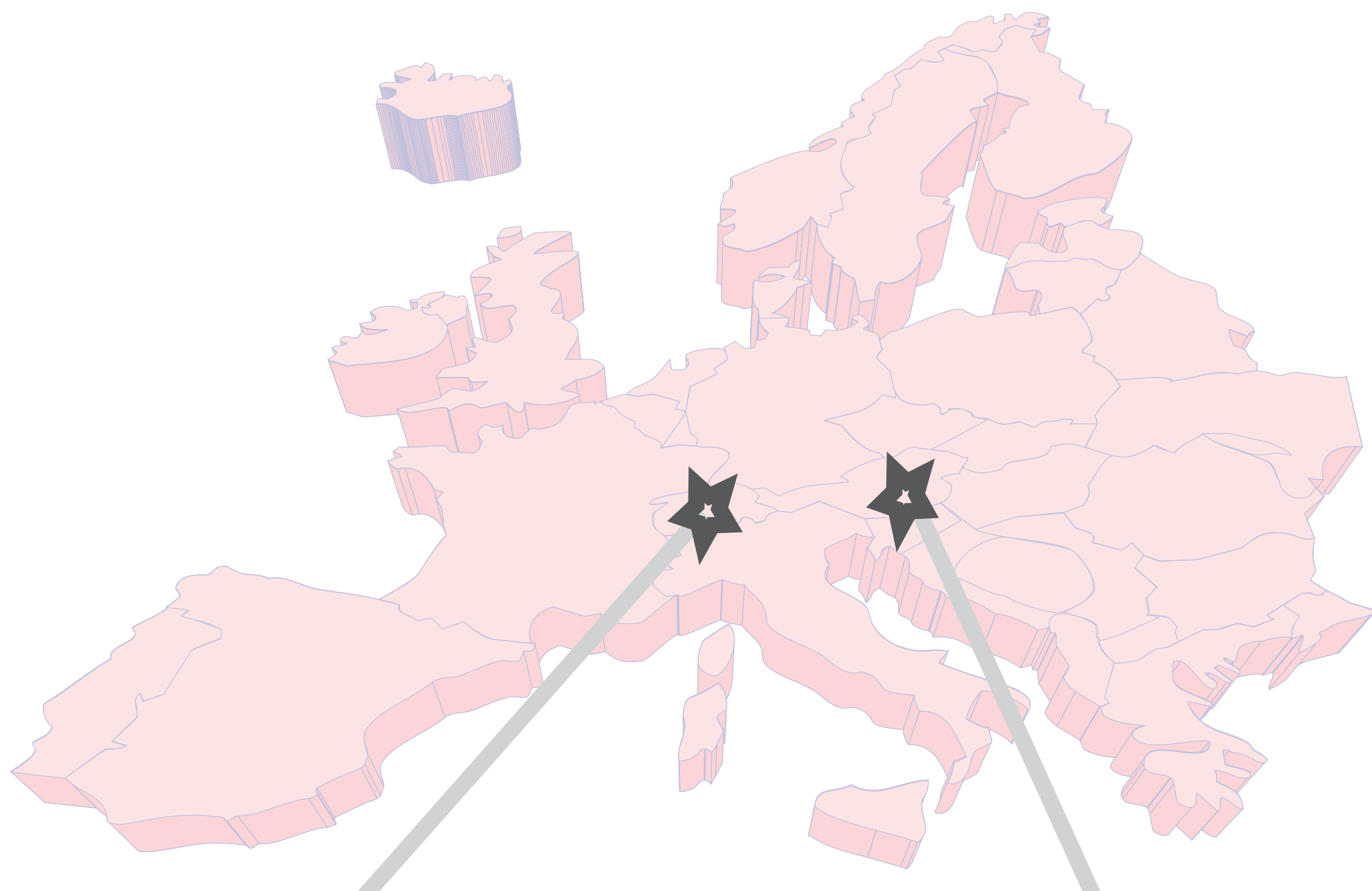
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1 Introduction

In the domain of home and building automation systems the non-IP technologies are dominant, and with the advent of Internet of Things it is an interesting idea to provide the devices which use these technologies with internet connectivity. This paper shows how to satisfy this objective using a IPv6 multi-protocol gateway, where every device is mapped to an oBIX contract and the gateway is reachable through web service interfaces.

2 Problem

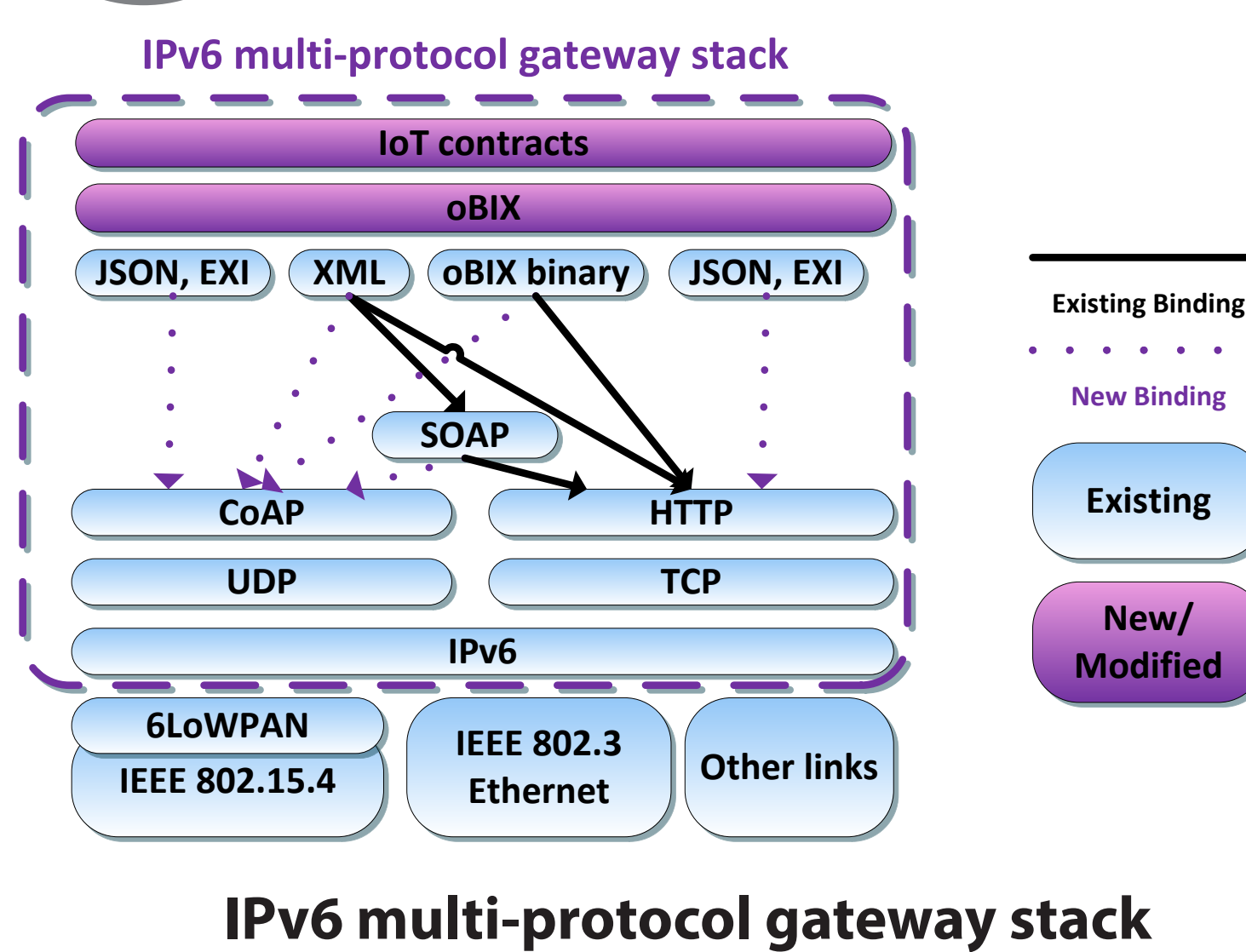
Many technologies for business automation system exist, but the most commonly used (KNX, BACnet, ZigBee, ...) are non-IP compliant. To exploit their functionalities in some scenarios, like smart grids or smart cities, they need to be integrated into the Internet of Things. The problem that arises is how to provide a standardized infrastructure that can allow this integration.



Testbed Sierre, Switzerland
Technology:
ZigBee

Testbed Vienna, Austria
Technologies:
KNX, BACnet, W-MBus

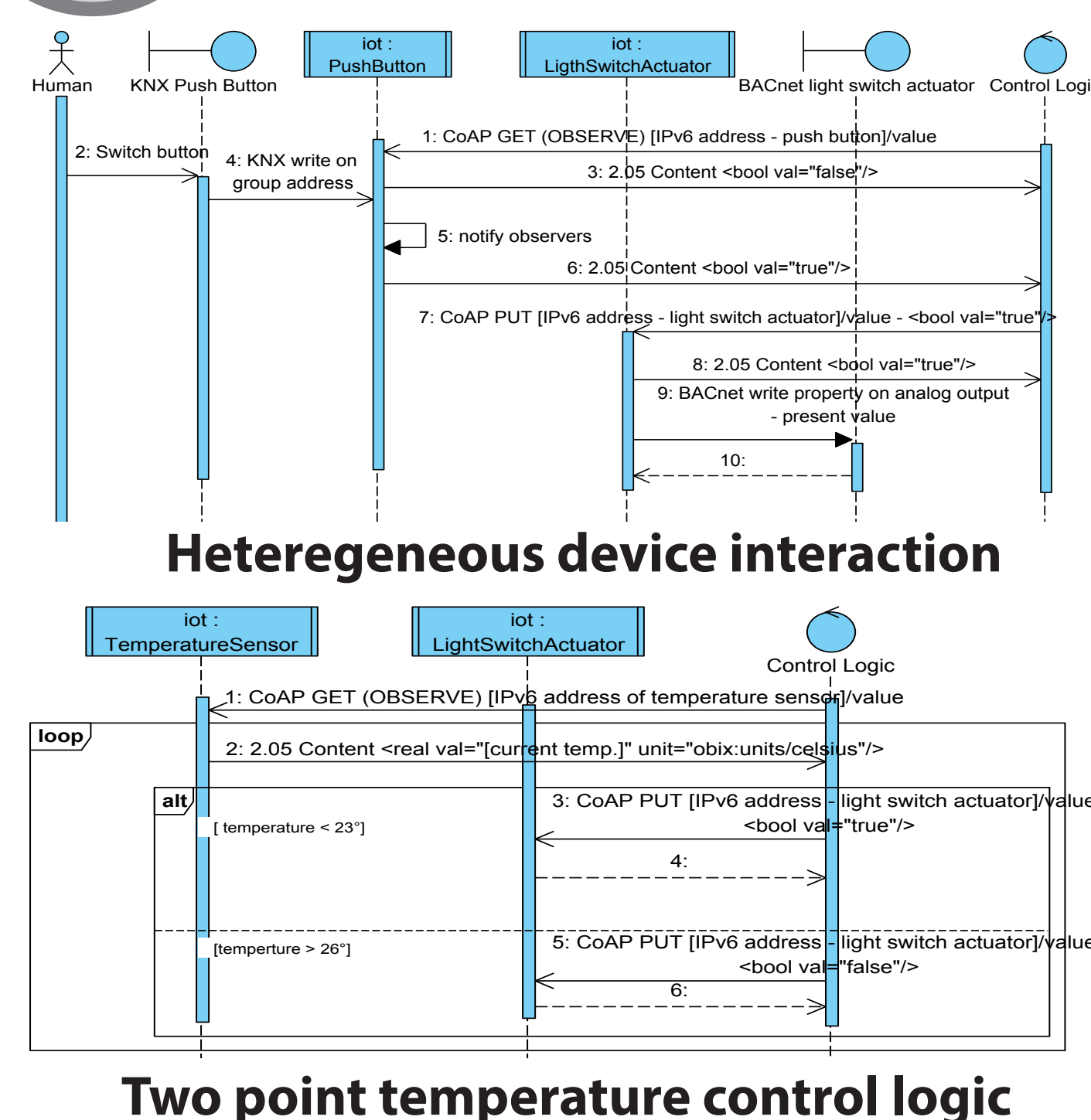
3 Protocol Stack



The IPv6 multi-protocol gateway offers for each legacy device a per-device Web service interface bound to a unique global unicast IPv6 address.

- Layers:
- oBIX: provides a RESTful interaction protocol and an object model to represent the devices;
 - information representation: JSON/EXI as innovation;
 - application and transport protocols:
 - HTTP/TCP;
 - CoAP/UDP (needs ulterior mechanisms).
 - network: IPv6.

4 IPv6 Enabled SOA



IPv6 multi-protocol gateway offers protocol adapters for various non-IP technologies and it is the core component of the IPv6 enabled service-oriented architecture.

The BAS technologies need to be mapped into IoT-oBIX contracts in order to provide a common object oriented representation.

An oBIX server takes care about the requests and dispatch them to the mapped underlying technology.

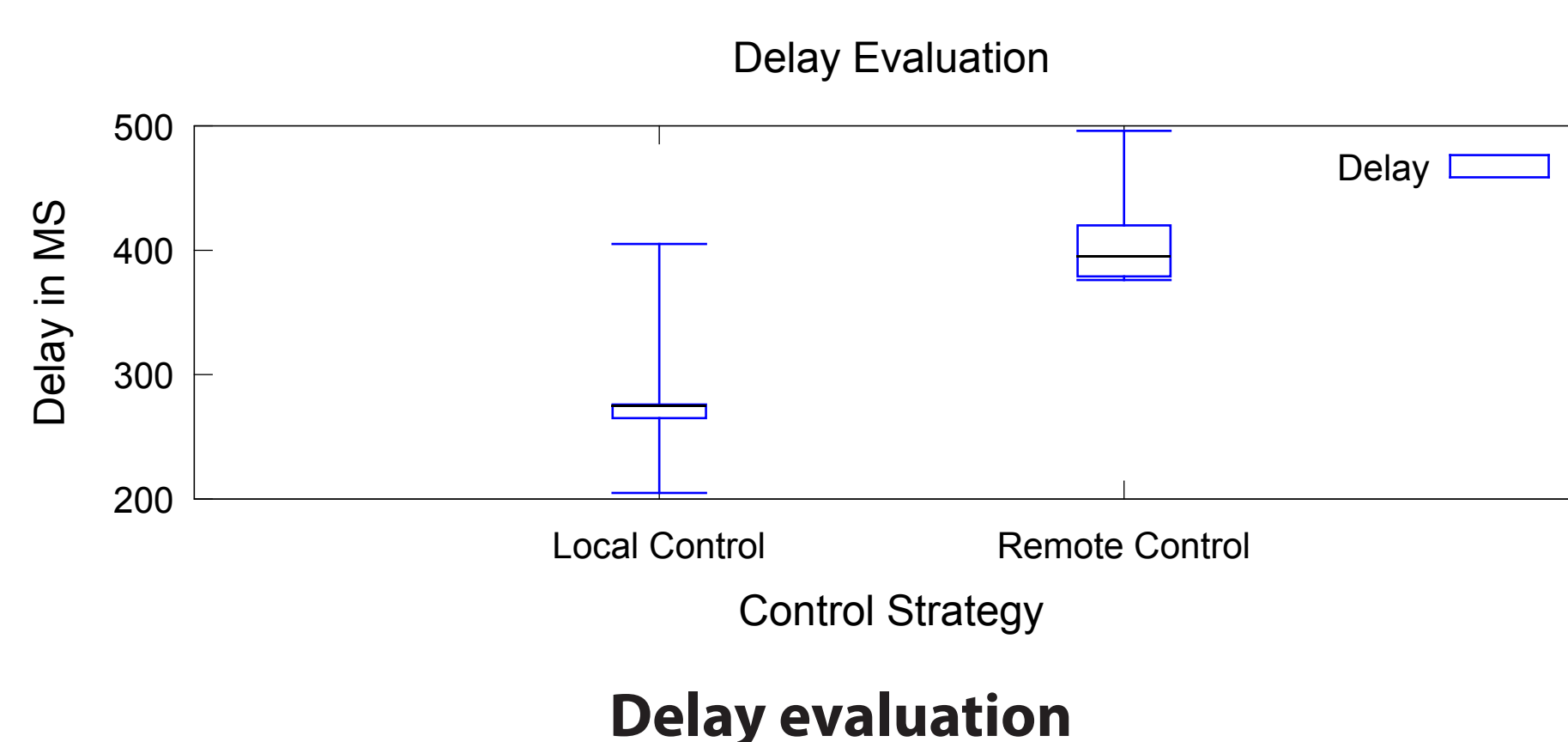
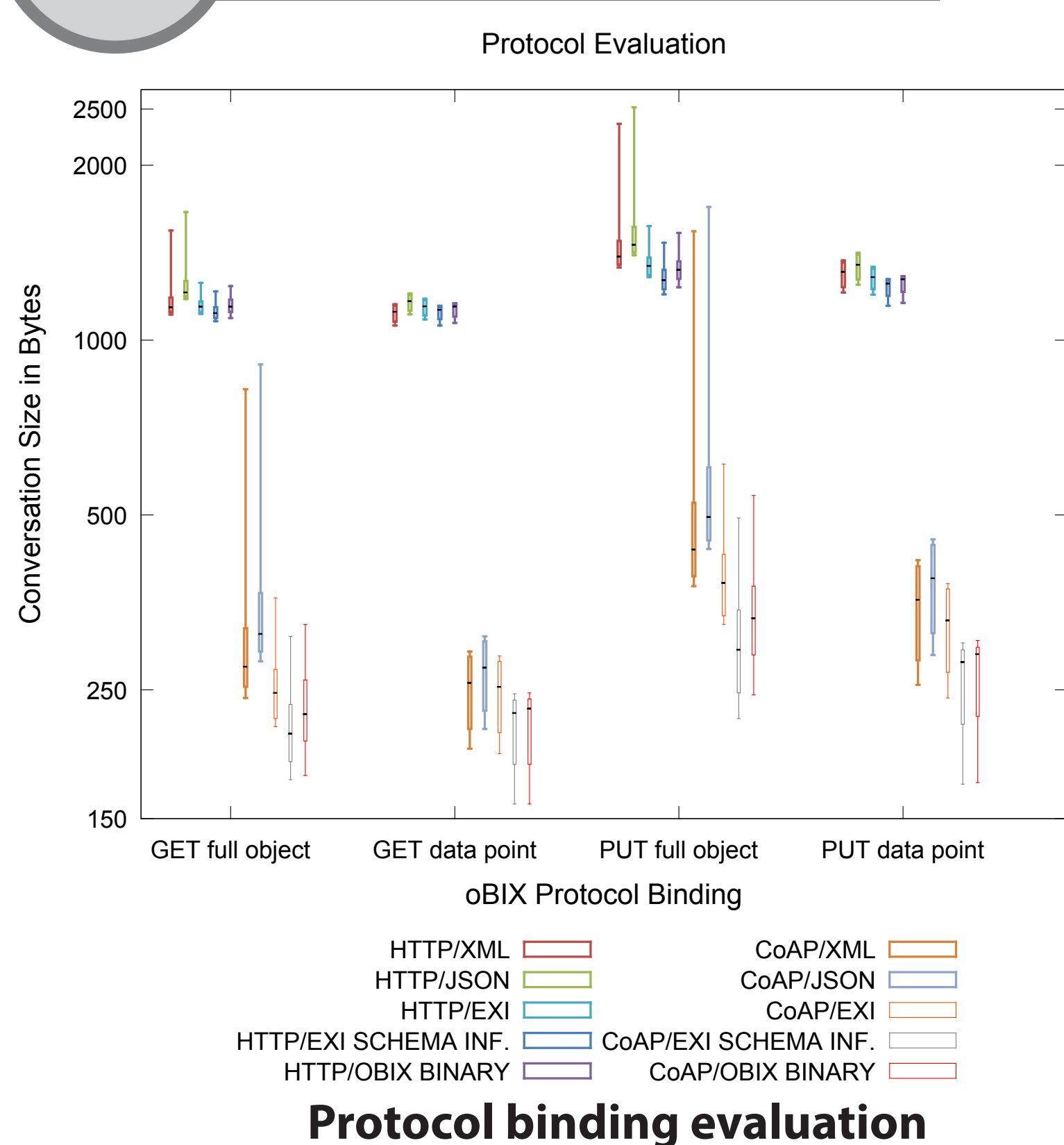
In that way it is possible to integrate different technologies, hiding everything behind web services, providing local or remote control logics.

5 Evaluation

The evaluation shows the performance of the information exchange in different conditions, analyzing the traffic and measuring the message sizes. Various samples with different information representations and different CoAP and HTTP methods are analyzed.

Results and observations:

- > CoAP/EXI: is the most efficient protocol binding;
- > EXI encoding: is more efficient than the custom oBIX binary encoding;
- > JSON encoding without loss of information is less efficient than plain XML encoding;



Regarding the remote control an evaluation about the delay in the commands is showed. The test is based on the heterogeneous device interaction showed in section 4, where from Sierre (CH) we control some devices in Vienne (A). The delay in the commands execution is less than one second.

6 Conclusion

This paper presents how a service-oriented architecture based on an IPv6 multi-protocol gateway can be used for control logic that spans heterogeneous devices and geographically distributed sites.

From the tests two conclusions can be extrapolated:

- the protocol binding based on CoAP and EXI encoding is as efficient as a binary encoded protocols, but based on standardized Web technology rather than proprietary encoding definition.
- the delay using a remote control is lower than the latency bound that negatively affects usability.