

Lecture 5 : Web Service for Device

Associate Professor Stéphane Lavirotte

<http://stephane.lavirotte.com/>

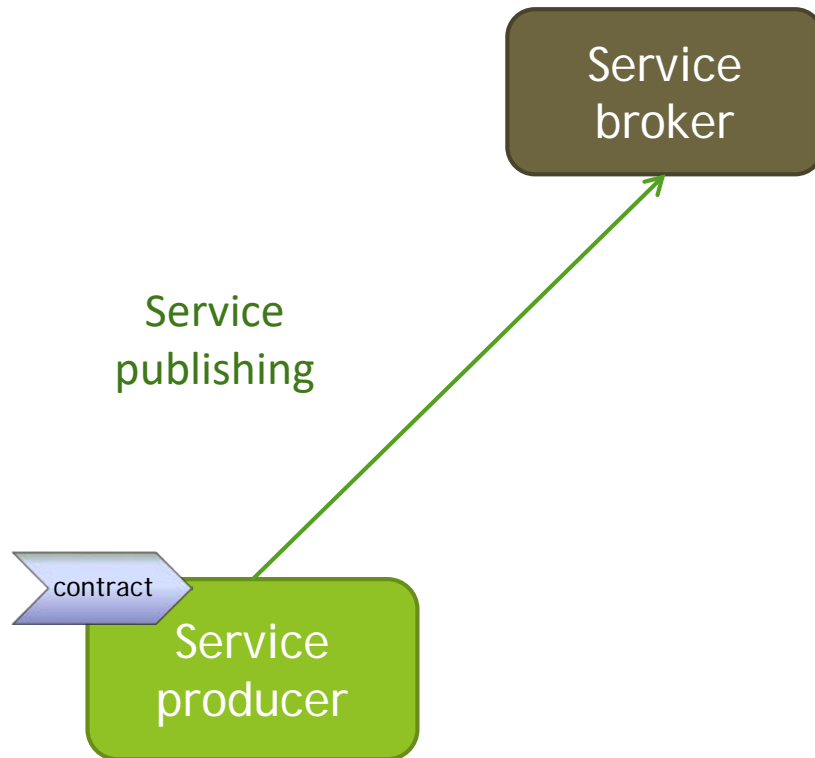
at Polytech of Nice - Sophia Antipolis University

[Email : stephane.lavirotte@unice.fr](mailto:stephane.lavirotte@unice.fr)

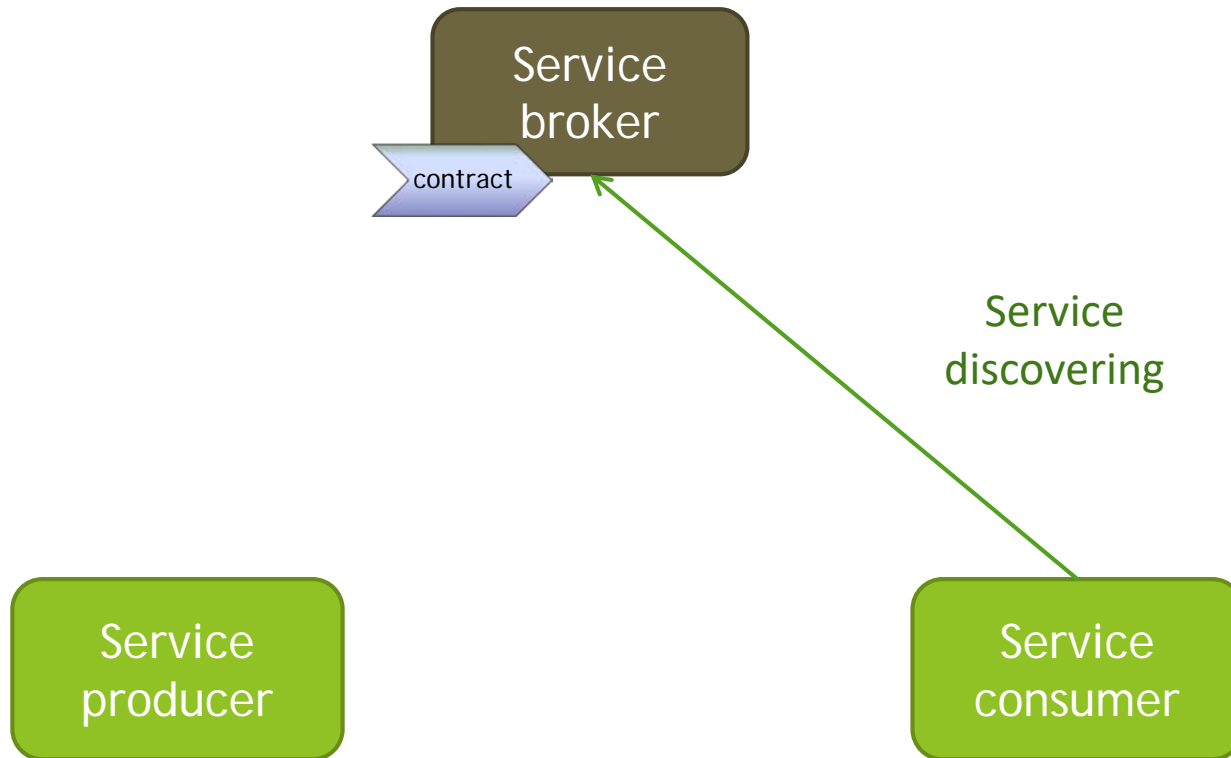
Introduction

A World of Services

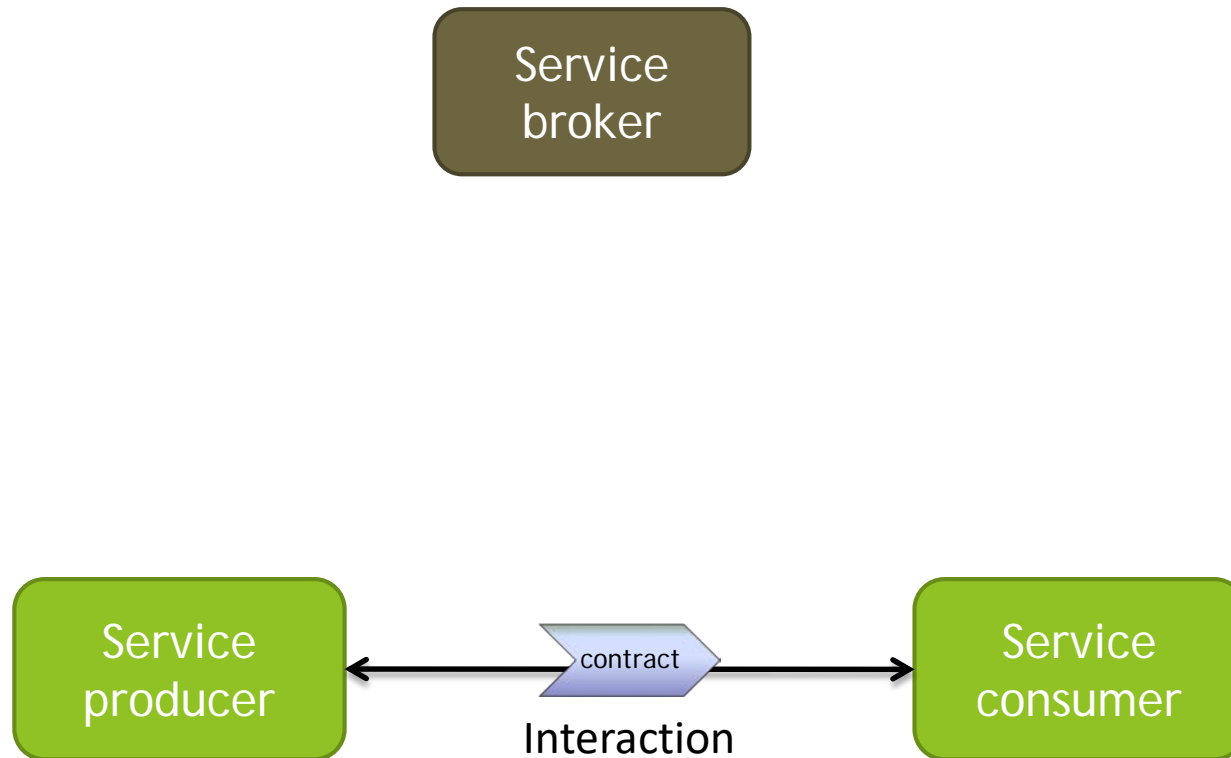
Advertising: Service Publishing



Service Discovery



Loose Coupling



Interoperability (Web standards)

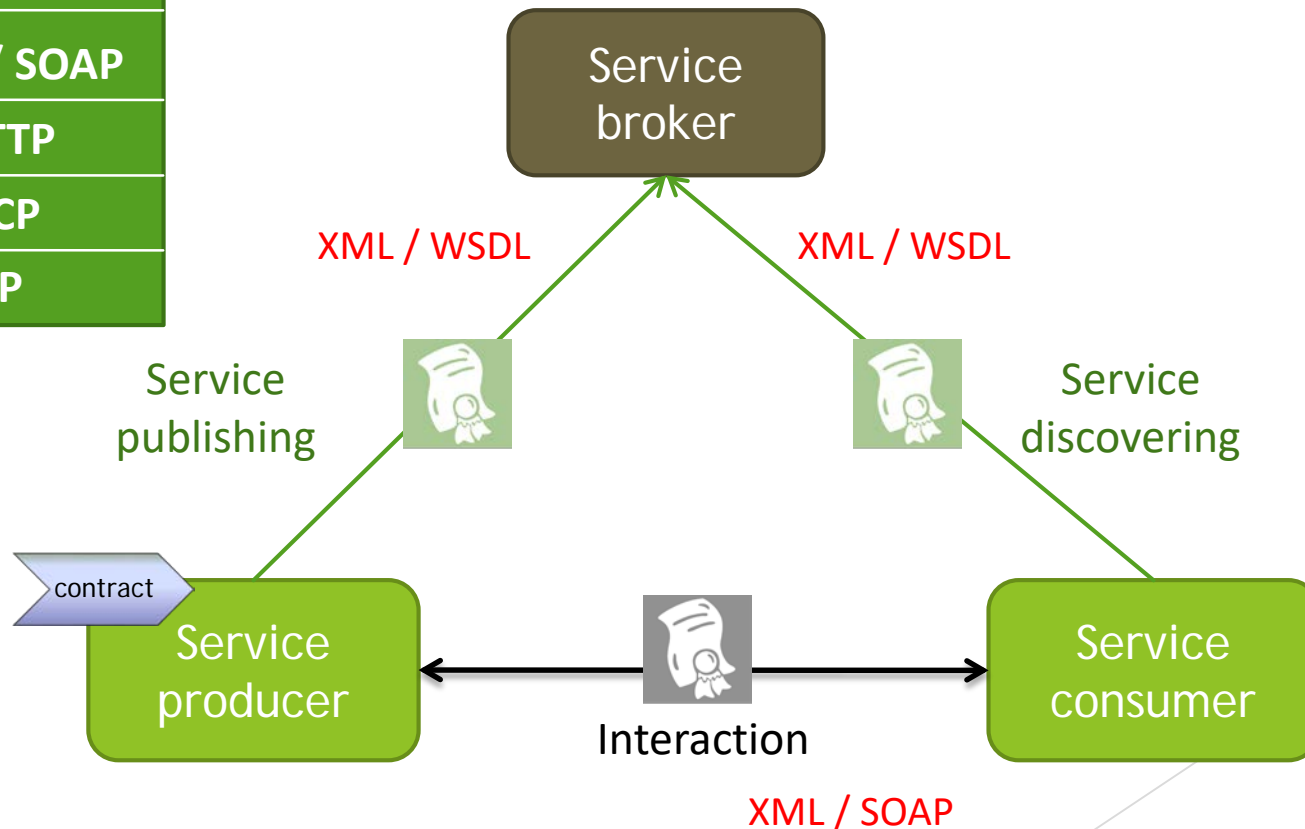
XML / WSDL

XML / SOAP

HTTP

TCP

IP



From (Web) Services...

- ▶ To sum up advantages of services approach:
 - ▶ Reusability (by sharing)
 - ▶ Modularity (replacing services by another one)
 - ▶ Advertising (by publishing)
 - ▶ Discovery (by subscribing and describing)
 - ▶ Loose coupling (between entities of application)
 - ▶ Interoperability (due to Web Services)
 - ▶ Scales (from “world wide” to devices)
- ▶ But...

Lacks of Service Oriented Approach

- ▶ Remember from the lack of SoM:
 - ▶ Low level abstraction
 - ▶ Leaves a lot to be implemented
 - ▶ Interaction pattern have to be build
 - ▶ One-to-one and request-reply provided
 - ▶ « one to many » and « many to many » ?
 - ▶ No location transparency (good or bad thing ?)

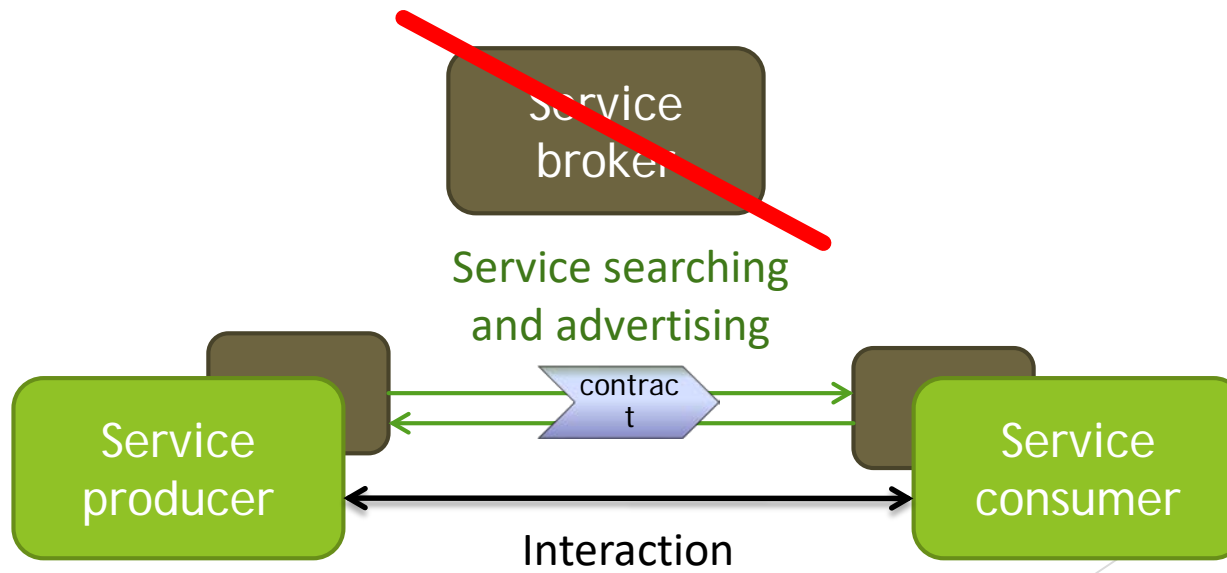
... to Web Services for Device

- ▶ Due to Ubiquitous Computing Context
 - ▶ For physical and multiple devices
 - ▶ Spontaneous Communication
 - ▶ Communications between systems not made until runtime
 - ▶ “Should compute at the right time”
- ⇒ New challenges
 - ▶ Dynamicity
 - ▶ Distributed dynamic research and discovery
 - ▶ Reactivity and Response Time
 - ▶ Evented interaction mechanism

Challenges for New Services

High Dynamicity

- ▶ Distributed dynamic Research and Discovery
 - ▶ Appearance and Disappearance management
 - ▶ Allow contextual research and discovery

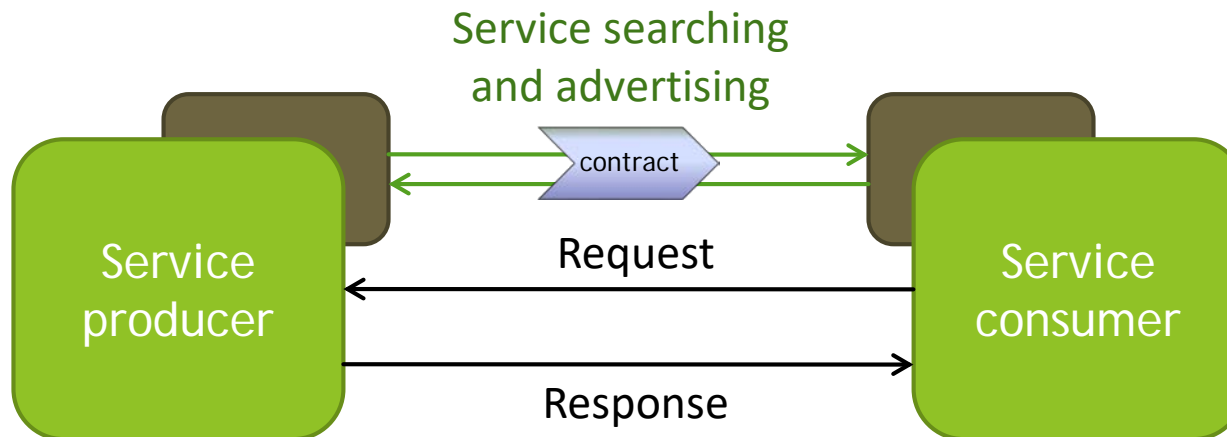


Service Discovery Protocols

- ▶ Multicast DNS/DNS-SD: Apple's protocol
 - ▶ Multicast DNS: uses API similar to unicast DNS
- ▶ SLP: IETF proposed standard
 - ▶ Supported by HP, Novell, Sun Microsystems, Oracle
- ▶ SSDP: Microsoft's protocol
 - ▶ Uses HTTP notifications (see below), used since Windows XP
- ▶ WS-Discovery: Defined by OASIS
 - ▶ Latest defined protocol, used in DPWS (see below)

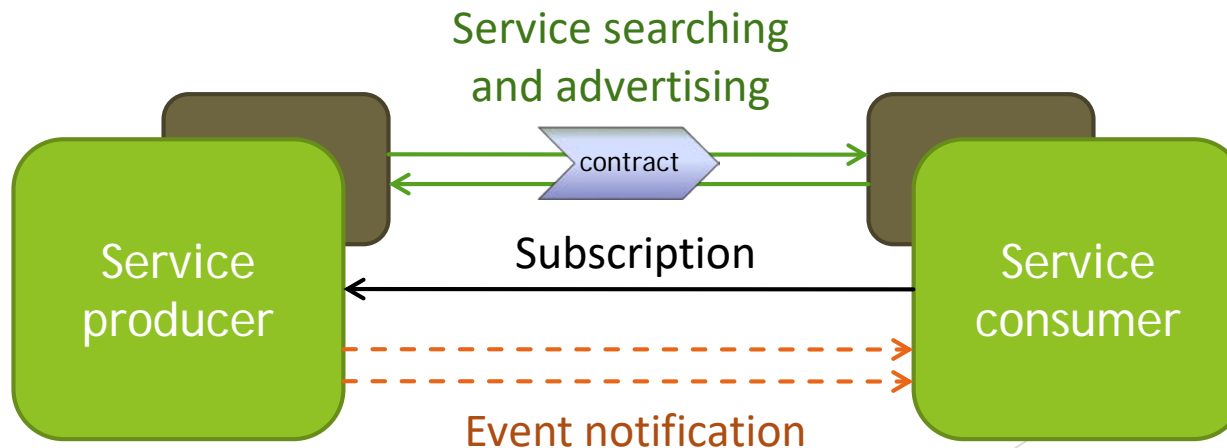
Traditional Interactions: Invocations

- ▶ “Classical” way to interact between services
 - ▶ Request-Response mechanism



Reactivity

- ▶ “New way” of interacting: Eventing interaction model
 - ▶ Based on publish/subscribe design pattern
 - ▶ Asynchronous messaging (based on push mode)



Web Services for Devices

Standards and Protocols

DPWS

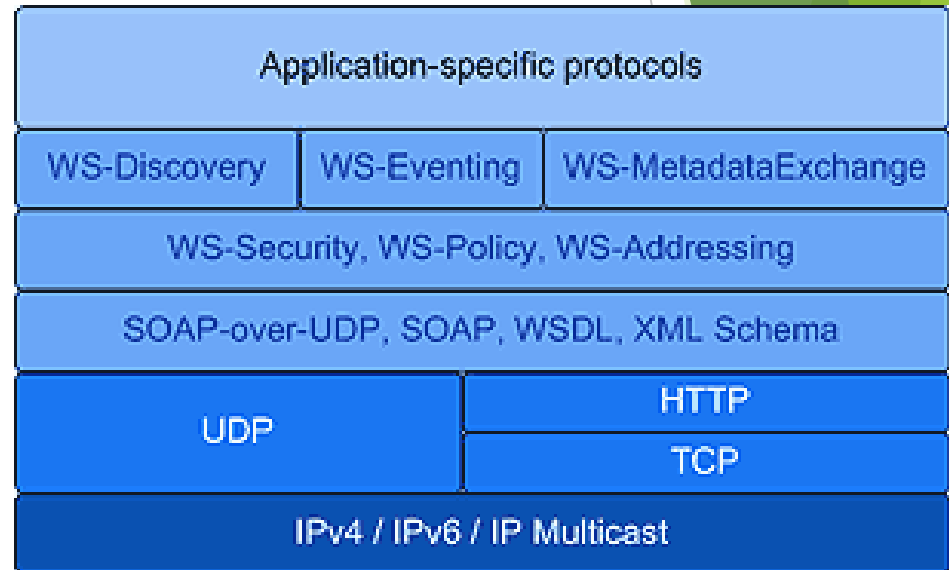
Device Profile for Web Services

Device Profile for Web Services

- ▶ Reusing standards:
 - ▶ XML Schema, SOAP, WSDL, ...
- ▶ Or defining new standards:
 - ▶ WS-Discovery, WS-Eventing, ...
- ▶ Approved as OASIS standard on 30, june 2009
- ▶ All or some parts of DPWS already included in Vista, Micro .NET, Windows CE, ...

DPWS Stack and Protocols

- ▶ Only based on standards
 - ▶ [SOAP 1.2](#),
 - ▶ XML,
 - ▶ [XML Schema](#),
 - ▶ [WSDL 1.1](#),
 - ▶ [WS-Addressing](#),
 - ▶ [WS-Transfer](#),
 - ▶ [WS-Policy](#),
 - ▶ [WS-Security](#),
 - ▶ [WS-MetadataExchange](#),
 - ▶ [WS-Discovery](#)
 - ▶ [WS-Eventing](#)



DPWS implementations emerged with the help of Research Projects

- ▶ European Research Initiative ITEA
 - ▶ SIRENA project (2003-2005)
 - ▶ [SOA4D](#): SOA for Devices (Java and C Stack)
 - ▶ [WS4D](#): Web Services for Devices (Java, Java ME and C Stack)
 - ▶ SODA project (Service Oriented Device and Delivery Architecture) (2006-2008)
- ▶ EU Research Project
 - ▶ SOCRADES (2006-2009) composed by heavyweights like ABB, SAP, Schneider Electric, and Siemens

Using DPWS

- ▶ Also Microsoft implementations
 - ▶ Micro .NET framework
 - ▶ .NET framework (.NET 4.0)
 - ▶ Included since Vista (WSDAPI)
- ▶ But...
 - ▶ For the moment, the 3 main implementations (SOA4D, WS4D, Microsoft) of DPWS do not communicate with other ones...
 - ▶ So everybody is a standard !

Comparing Implementations



Explorer Stack	Java Explorer	WS- Management	Hello/Bye Event Catcher Micro .NET	Hello/Bye Event Catcher WCF
WS4D - JMEDS				
DPWS Core				
Micro .NET	Exception System.Xml.XmlExceptio n			
WCF			Hello/Bye message received	

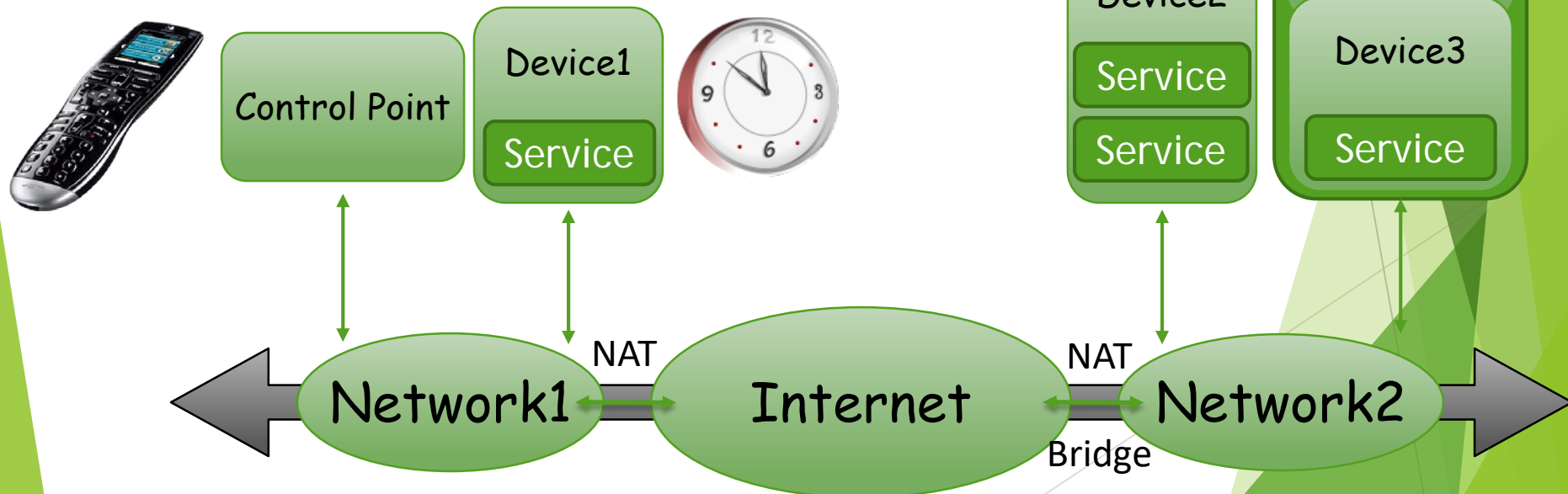


UPnP

Universal Plug and Play

Universal Plug and Play

- ▶ Control Point
 - ▶ The client which discover and control UPnP servers
- ▶ Device
 - ▶ The server (receive actions)
- ▶ A physical device can be twice (CP and Device)

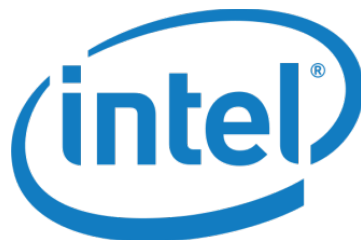




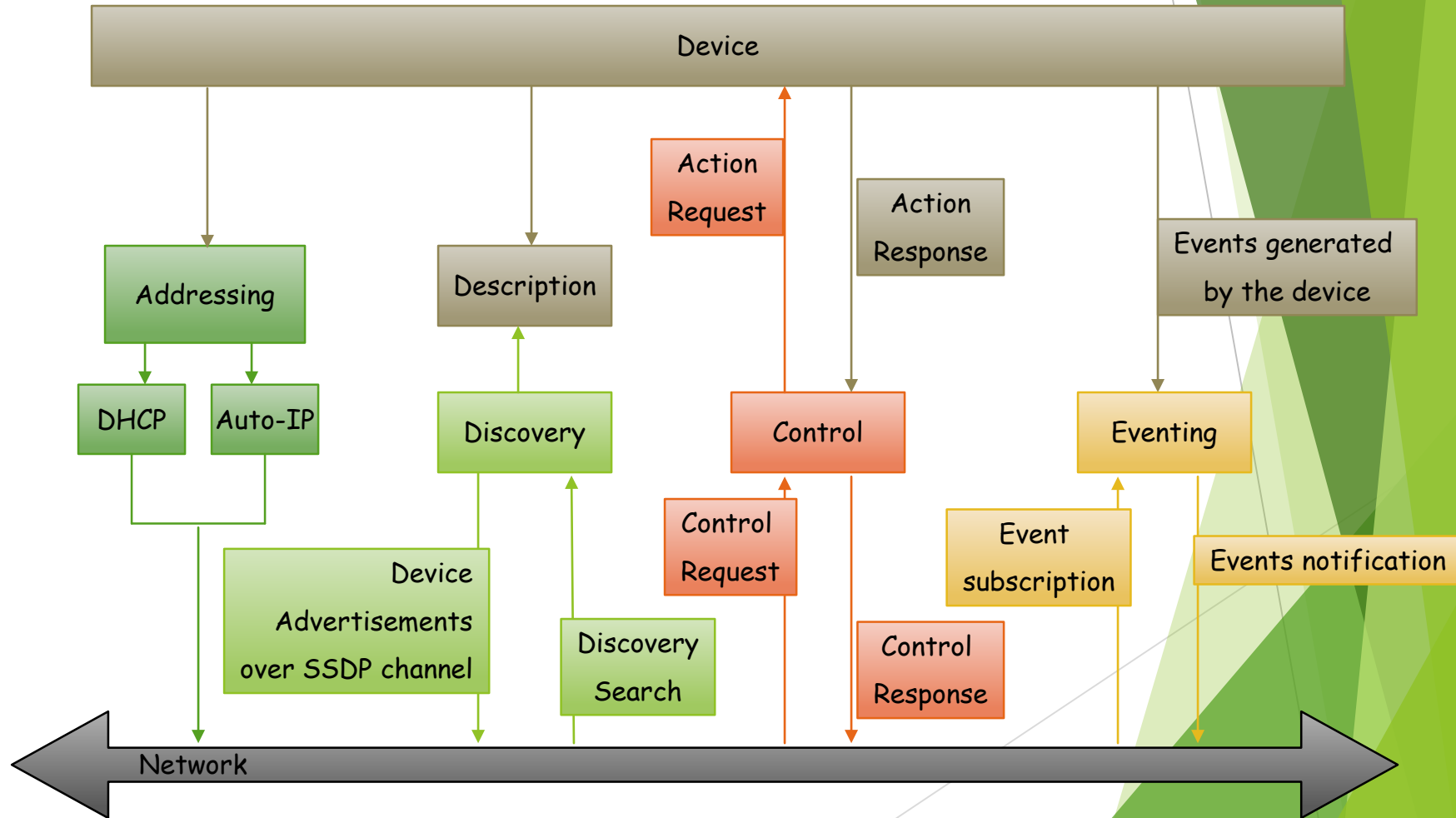
Full Tutorial of the Intel® Authoring Tools for UPnP Technologies

Ylian Saint-Hilaire

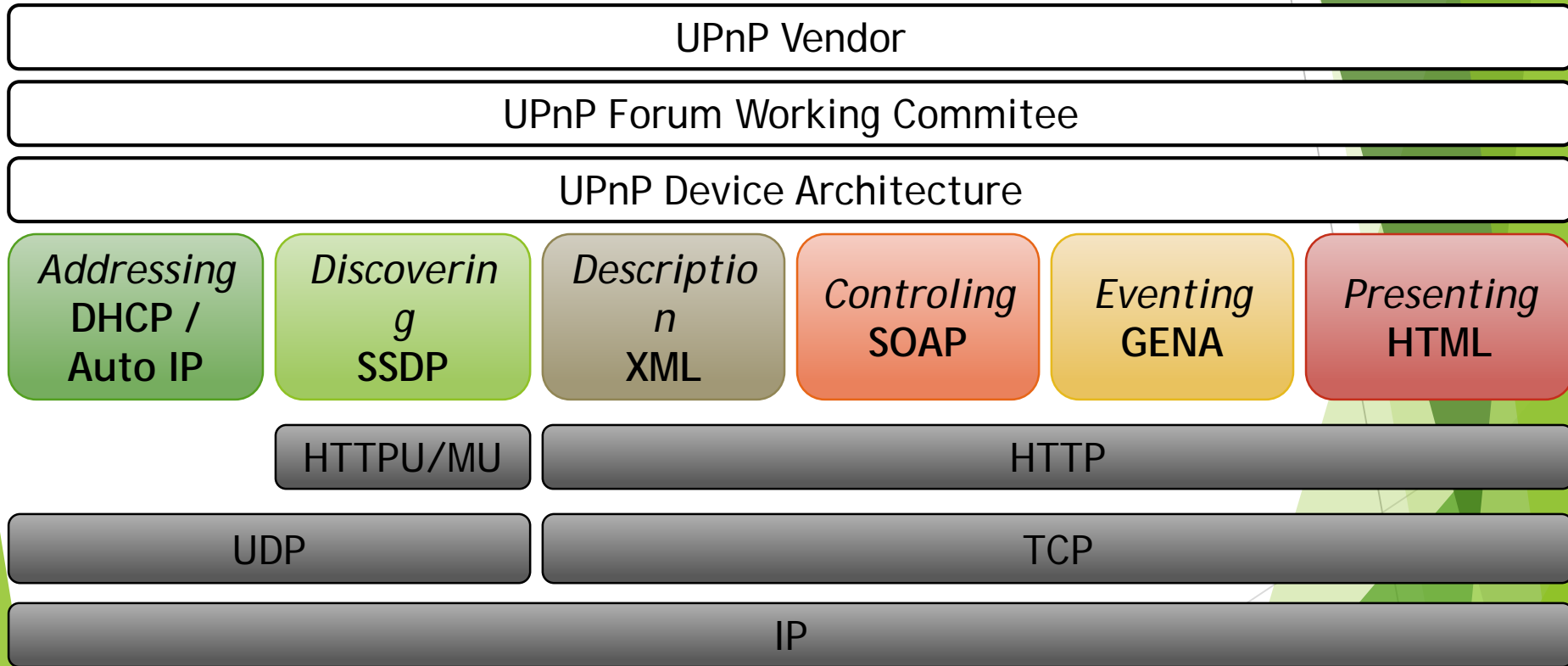
Senior Architect



Example of UPnP Device Communications



UPnP Stack and Protocols



Drawbacks of UPnP Technology

- ▶ Heavy protocol for tiny devices (web server + xml parser + soap + ...): bridge solutions
- ▶ Based on non-standards protocols:
 - ▶ Discovery: SSDP over HTTPU, HTTPMU (not standardized since 2000)
 - ▶ Description: XML dialect, not standardized
 - ▶ Events: GENA (not standardized)
- ▶ No authentication protocol (security)^[4]

DPWS vs UPnP

	DPWS	UPnP
Year	2009	1999
Addressing	DHCP, AutoIP	DHCP, AutoIP
Discovery	WS-Discovery	SSDP
Description	WSDL 1.1	UDA Schema
Control	SOAP 1.2	SOAP 0.9, 1.1
Eventing	WS-Eventing	GENA
Presentation	HTTP, HTML	HTTP, HTML

References

Web Service for Device

References

Web Service for Device

1. **“Service and device discovery: protocols and programming”**, G. G. Richard, McGraw-Hill Professional, ISBN 0-07-137959-2, 2001.
2. **“Integration of Embedded Devices Through Web Services: Requirements, Challenges and Early Results”**, G. B. Machado, F. Siqueira, R. Mittmann, C. Augusto, V. e. Vieira, in *Proceedings of the 11th IEEE Symposium on Computers and Communications*, pp 353-358, 2006.
3. **“Web Based Service for Embedded Devices”**, U. Topp, P. Müller, J. Konnertz and A. Pick, LNCS, volume 2593, pp 141-153, 2009.
4. **“The device service bus: a solution for embedded device integration through web services”**, G. M. Araújo, F. Siqueira, in *Proceedings of the 2009 ACM symposium on Applied Computing*, pp 185-189, 2009.
5. **“Towards an Architecture for Runtime Interoperability ”**, Amel Bennaceur, Gordon S. Blair, Franck Chauvel, Gang Huang, Nikolaos Georgantas, Paul Grace, Falk Howar, Paola Inverardi, Valérie Issarny, Massimo Paolucci, Animesh Pathak, Romina Spalazzese, Bernhard Steffen, Bertrand Souville, in *ISoLA*, pp 206-220, 2010.

References

DPWS, UPnP

1. “Service-Oriented Device Communications Using the Devices Profile for Web services” , F. Jammes, F., A.Mensch, H. Smit, in Proceedings of 21st International Conference on Advanced Information Networking and Applications Workshops, 2007.
2. “Towards the UPnP-UP: Enabling User Profile to Support Customized Services in UPnP Networks” , T. B. M. de Sales, L. M. de Sales, M. Pereira, H. Almeida, A. Perkusich, K. Gorgônio and M. A. de Sales, in *Proceedings of the 2008 The Second International Conference on Mobile Ubiquitous Computing, Systems, Services and Technologies (UBICOMM)*, pp 206–211, 2008.