An extensible and dynamic service description framework for mobile environments

Rohit Verma

Outline

- Introduction
- Background
- Research Problem
- Proposed Approach
- Validation
- Related Work
- Conclusion
- References

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Inspiration

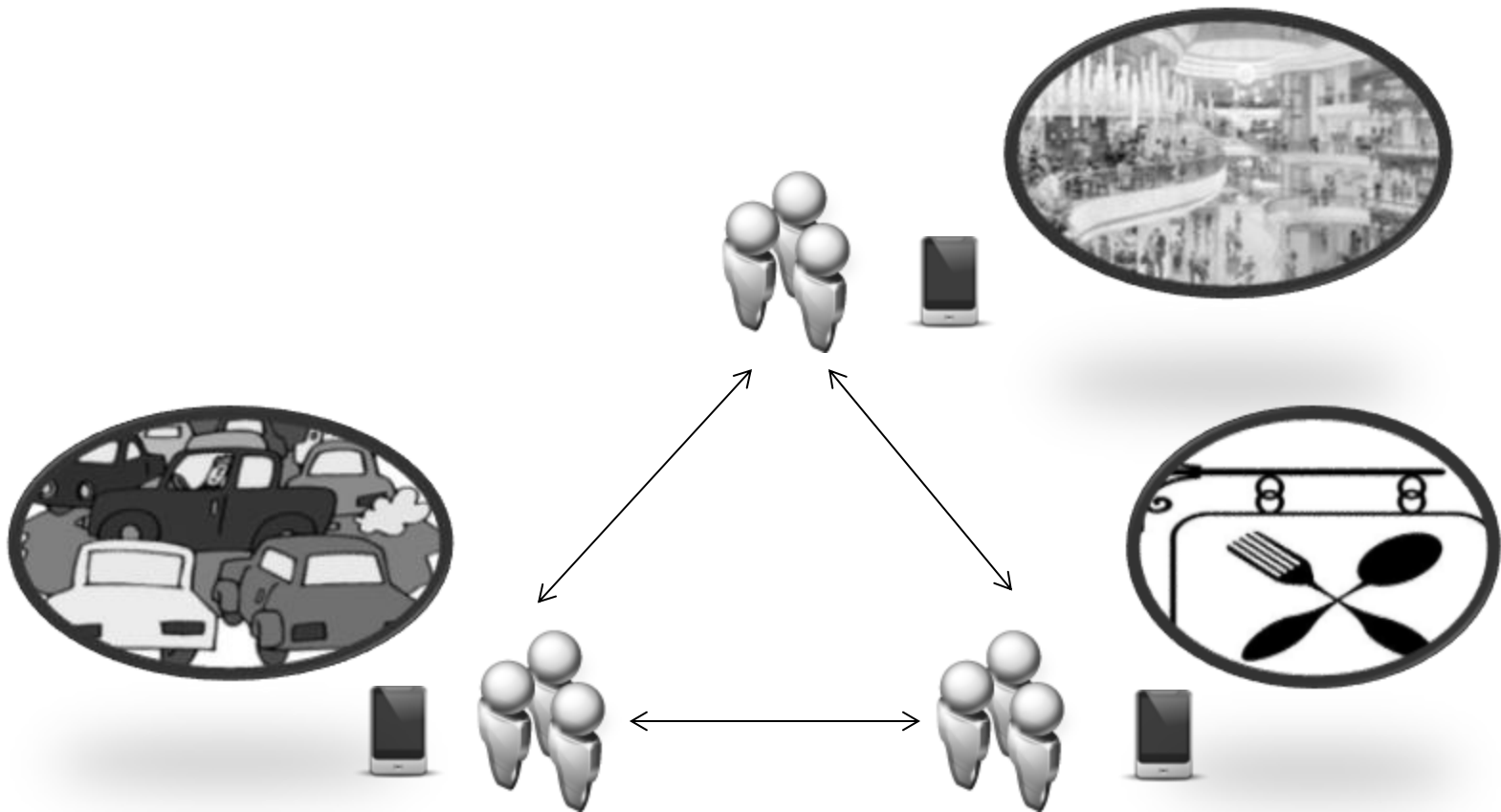"Our mobile phone has more computing power than all of NASA in 1969.

NASA launched a man to the moon.

And

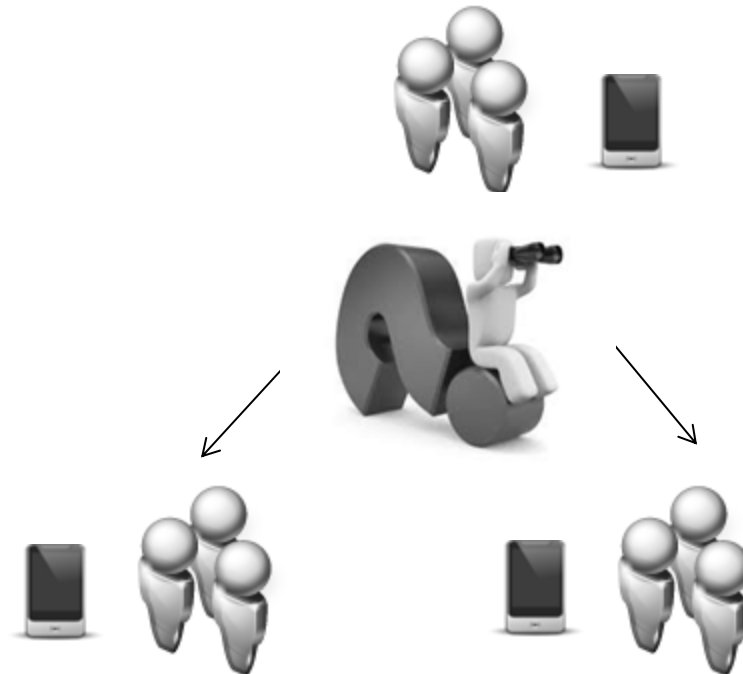We are launching birds into pigs."

Introduction

▸ Modern mobile phone users are capable of providing services from their mobile phones.

Introduction

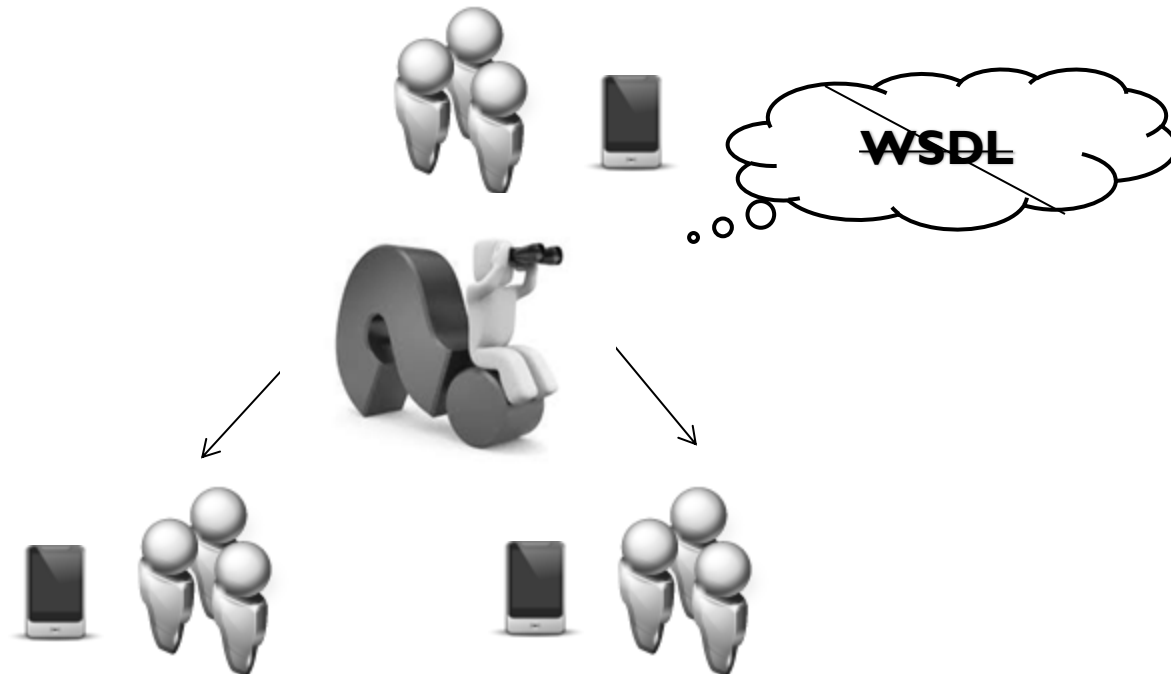▸ "Service Description" designed for mobile environment is still lacking.

Introduction

‣ Traditional approach of service description (WSDL) has limited adaptability in dynamic mobile environment.

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Introduction

▸ A rich description to accommodate functional, non-functional, contextual, and business information of mobile service is proposed.

Functional
Contextual
Non-functional
Business

Service Description

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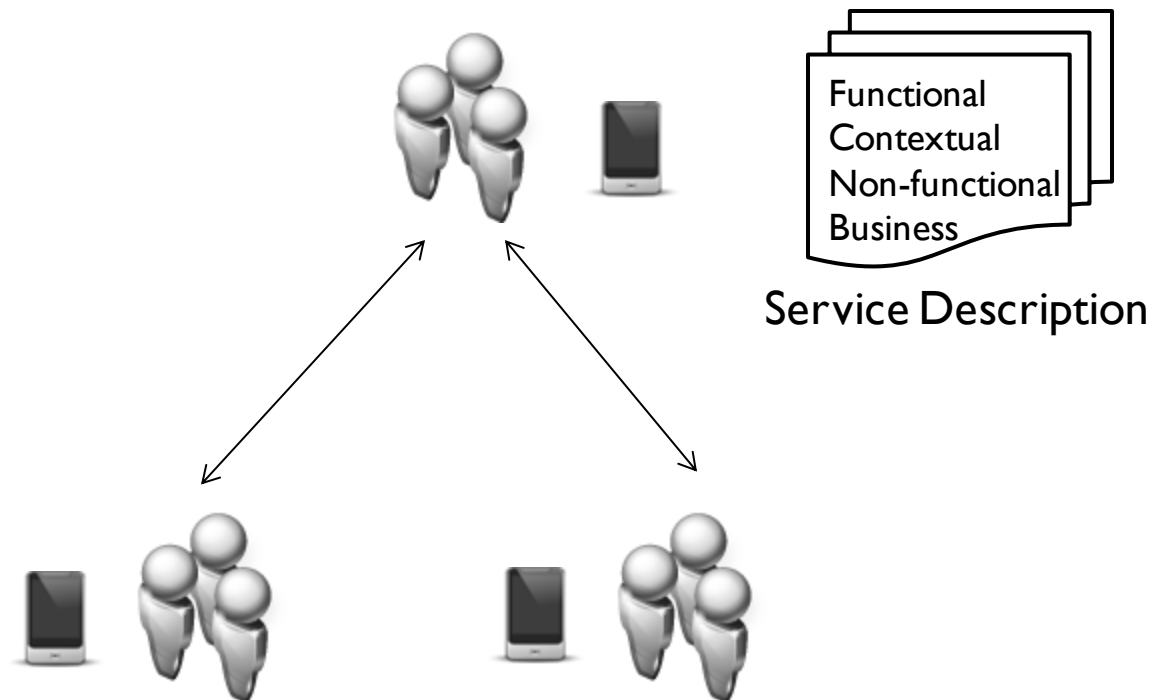
Background

- Service description:
  - Enables automated device-to-device communication and run time discovery and binding.
  - Expresses the characteristics of the offered service to unknown prospective consumers.

- Several other descriptions are required to describe the mobile services in addition to functional and business descriptions.

- However, these descriptions cannot be archived in the service registry along with the functional description due to dynamic nature of mobile environment.

Research Problem

▶ Need of a mobile service description that should :

- ▶ Acknowledge dynamic and uncertain behavior of mobile environment.

- ▶ Support legacy wired systems and modern wireless mobile systems.

- ▶ Complement current solutions for wider adaptability.

- ▶ Have lightweight architecture.

- ▶ Have detailed, rich, and dynamic description.

- ▶ Be run-time update-able.

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Proposed Approach

▶ WSDL 2.0 is extended to accommodate requirements of mobile environment.

▶ WSDL 2.0 provides mechanisms for:

▶ Describing SOAP and REST based services.

▶ Arbitrary message exchange and message-oriented operations using MEP (Message Exchange Patterns).

▶ Service Description is extended to accommodate:

▶ Functional Description

▶ Non-functional Description

▶ Contextual Description

▶ Business Description

▶ Data Source Description

▶ Collaboration Description

▶ Hardware Description

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Proposed Approach

Non-Functional Description	<<import>>		<<import>>	Data Source Description
Contextual Description	<<import>>	Functional Description	<<import>>	Collaborator Description
Business Description	<<import>>		<<import>>	Hardware Description

<import namespace="URI" location="URI"><documentation/></import>

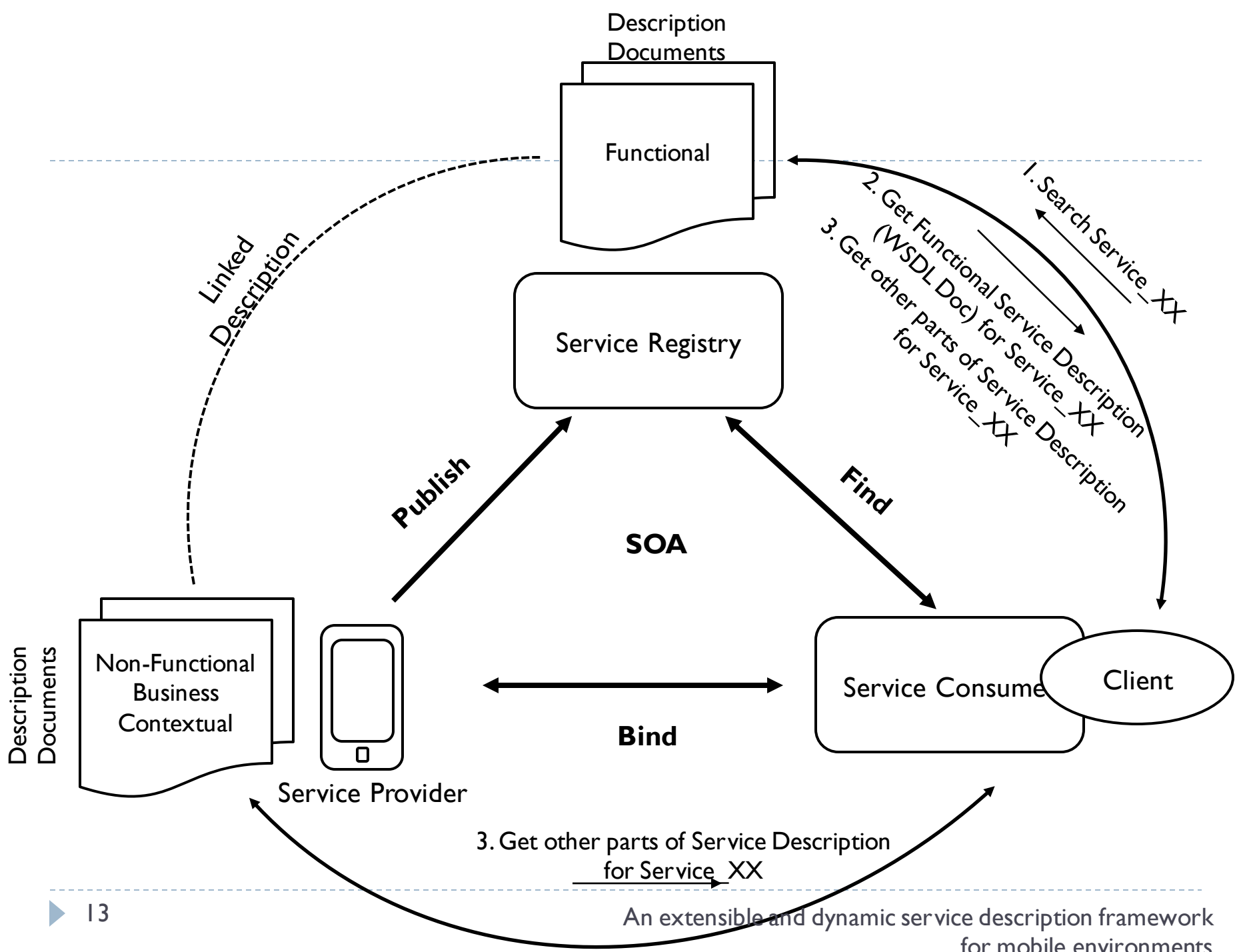An extensible and dynamic service description framework for mobile environments
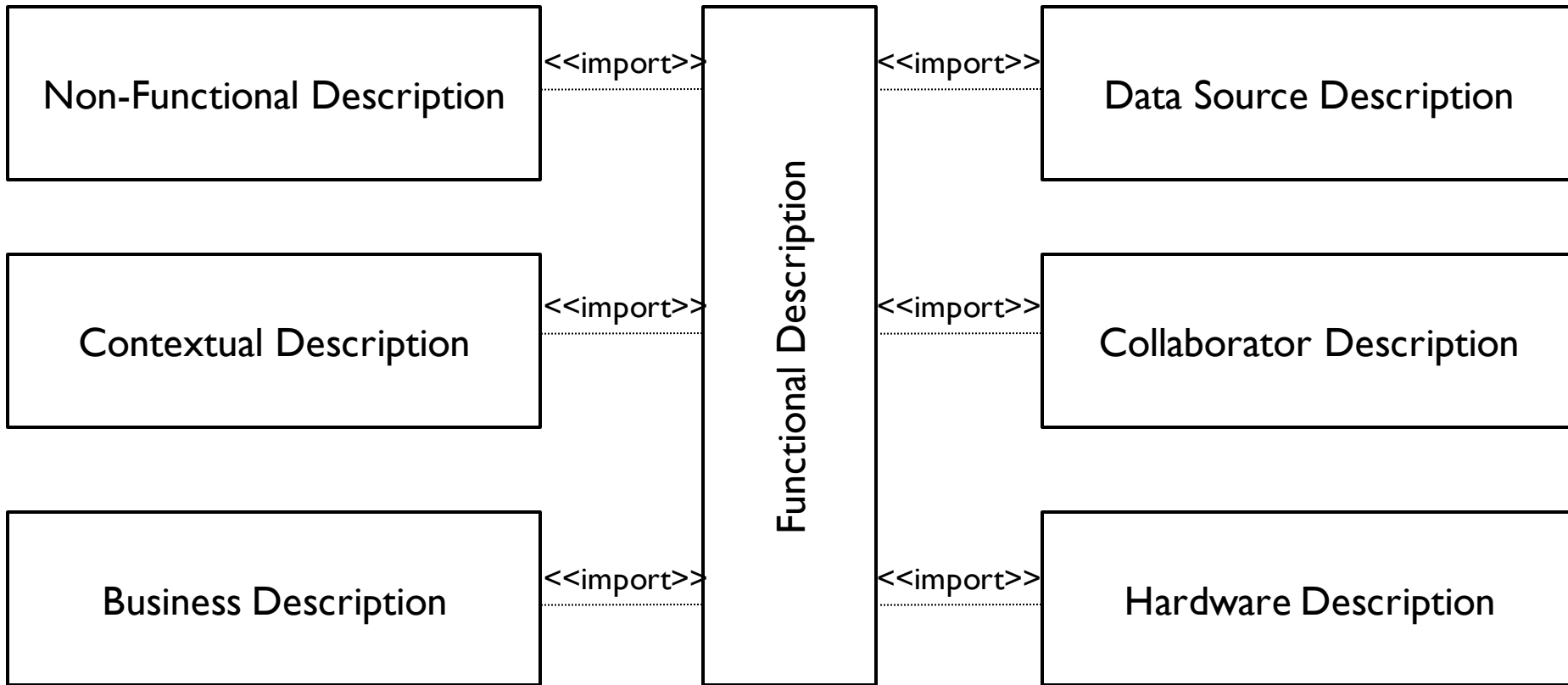
Proposed Approach

- Service descriptions are split into multiple documents and located at:
    - Service Registry
    - Service Provider
- Splitting and placing of multiple parts of the description at different locations facilitates:
    - Faster, independent, and dynamic updates in the descriptions.
    - Up-to-date description .
    - Overall consistency of description in case of simultaneous updates.
    - A lightweight and detailed service description
- Various descriptions are linked to WSDL document using "import".

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Description Documents

Functional

Service Registry

SOA

Linked Description

Non-Functional Business Contextual

Description Documents

Service Provider

Publish

Find

Bind

Service Consumer

Client

1. Search Service_XX

2. Get Functional Service Description (WSDL Doc) for Service_XX

3. Get other parts of Service Description for Service_XX

3. Get other parts of Service Description for Service_XX

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Validation

- Approach is validated by:
  - Feature Comparison
  - Empirical Evaluation
  - Conceptual Evaluation

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Feature Comparison

Work	Domain	Environment	Representation	Dynamic Update	Description Aspect	Salient Features
WSDL[1]	SOA	Wired	XML	No	Functional	Provides service communication and discovery information for web services
WADL[2]	General	Wired/ Wireless	XML	No	Functional	Provides description for HTTP based applications, used primarily for RESTful services
USDL[3]	General	Wired	MOF meta-model	No	Functional, Business	A general purpose, domain independent language for describing Internet of Services
OWL-S[4]	Semantic Web	Wired	RDF	No	Functional	Provides semantic web description and enables automated discovery, invocation, composition
Adams[5]	SOA	Wired	XML	No	Functional	WSDL is extended to incorporate security parameters
D'Ambrogio[6]	SOA	Wired	XML	No	Functional, Non-Functional	Extension of WSDL to accommodate QoS characteristics

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Feature Comparison

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Juric[7]	SOA	Wired	XML	No	Functional	Extension of WSDL to support versioning of service interface
Dai[8]	SOA	Wired	XML	No	Functional, Non-Functional	Extension of WSDL to accommodate non-functional attributes from IOT perspective
Parimala[9]	SOA	Wired	XML	No	Functional	WSDL is extended to accommodate specification of criteria
Banato[10]	SOA	Wired	XML	No	Functional	Extension of WSDL to accommodate change management feature
Our Approach	**SOA (SOAP + REST)**	**Wired Wireless**	**XML**	**Yes**	**Functional, Business, Non-functional, Contextual, Data Source and other**	**WSDL 2.0 is extended to provide run-time updateable description for mobile hosted services**

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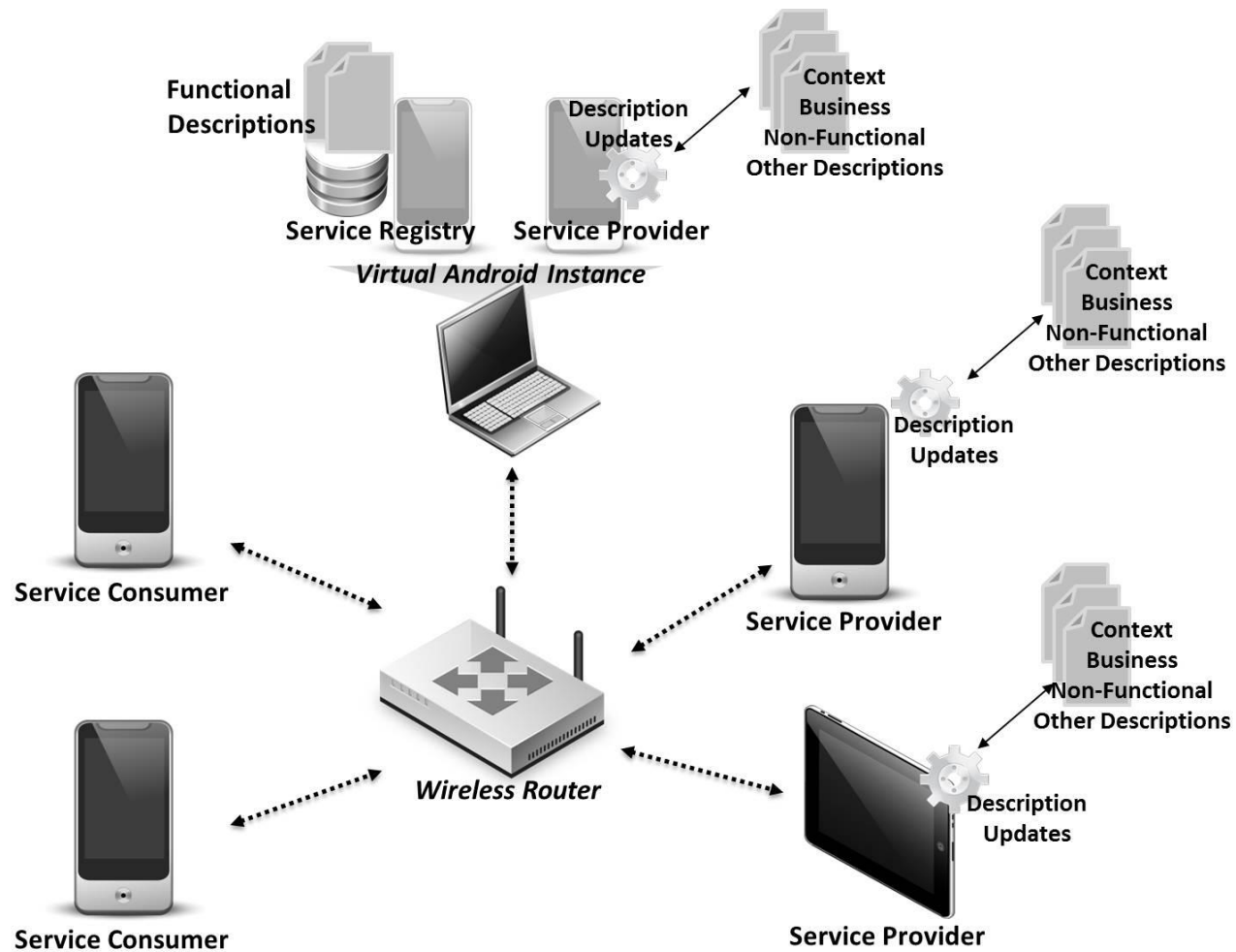
Empirical Evaluation
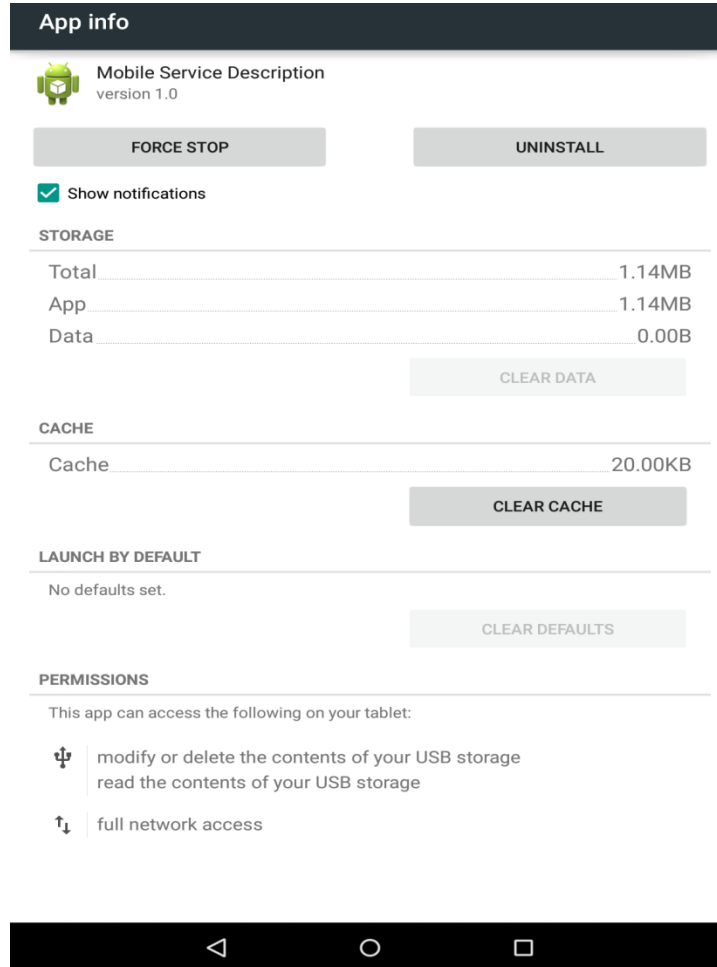
▶ Approach is also validated using working prototype deployed on actual mobile phones.

▶ Android application is developed.

▶ A 'watchdog' process is developed to sense the changes and accordingly keep the description documents updated.

▶ Prototype was deployed on volunteer's devices.

▶ Prototype shown feasibility of the approach on real mobile devices.

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Empirical Evaluation

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Prototype Memory Footprint

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Prototype CPU Usage

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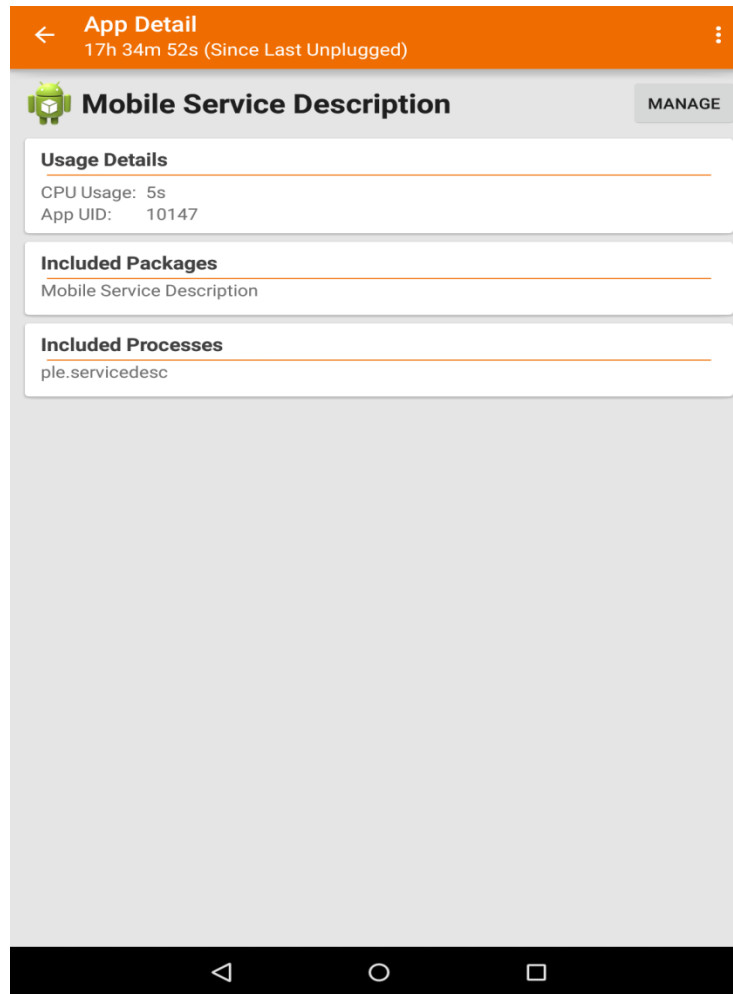
Prototype Battery Usage

App Sucker - View % Power Used
17h 34m 52s (Since Last Unplugged)

23.5% of battery consumed by:

Android System	8.8%	
Kernel (Android OS)	4.7%	
System UI	0.6%	
GSam Battery Monitor	0.4%	
System (sensors.qcom)	0.4%	
Chrome	0.3%	
Google Services	0.2%	
Mobile Service Description	0.1%	
System (dboxed_process2)	0.1%	
WhatsApp	0.1%	

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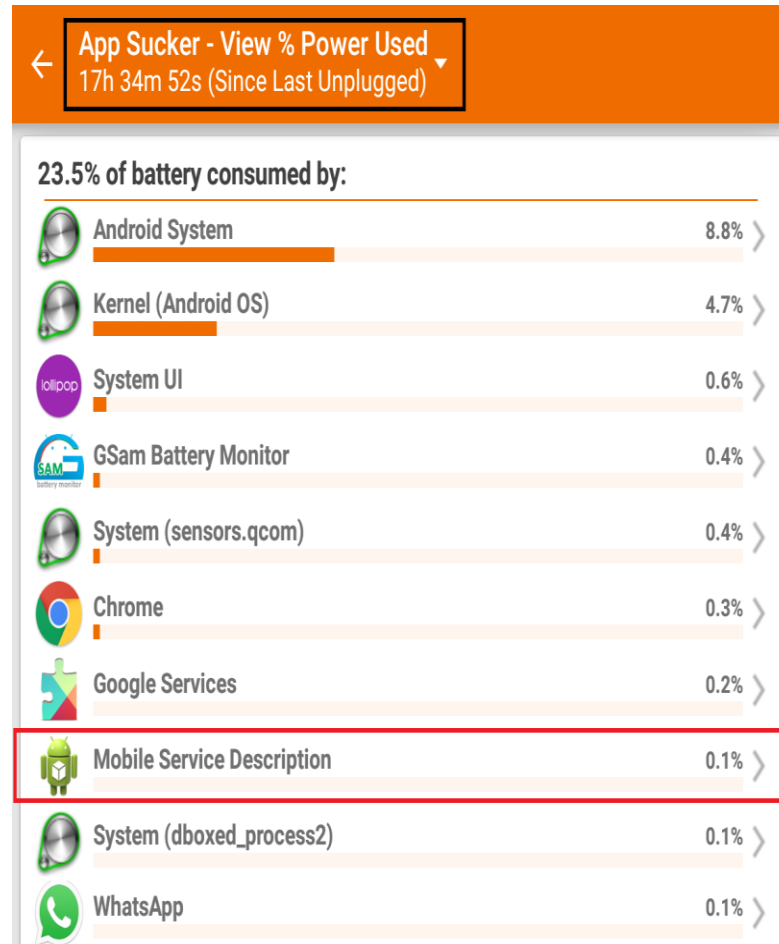
Conceptual Evaluation: Case Study

Service Name	Service Details
MallLatestOffer	**Type**: Semi-Automated Mobile Service **Dependencies**: Other services from Mall **Functions**: Provides latest offers from various brands of the Mall. Make use of existing services of brands that provides offer details and provides the offer information manually if offer service is not available.
SalesmanTracking	**Type**: Automated Mobile Service **Dependencies**: GPS sensor, Mapping Service **Functions**: Provides location information of the salesman that helps the manager to track the salesman's location and plan their next visit. This make use of mobile phone's GPS sensor and mapping service.
CarPoolingMate	**Type**: Manual Mobile Service **Dependencies**: None **Functions**: Provides the carpooling information. This helps the traveler to fetch the car pooling mate may be in a meeting or a remote public function. This requires to provide the information manually at the provider's end.

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Conceptual Evaluation: Case Study

Service Description		Case Study		
		MLO[1]	ST[2]	CPM[3]
Functional Description	Include	✓	✓	✓
	Types	✓	✓	✓
	Interface	✓	✓	✓
	Binding	✓	✓	✓
	Service	✓	✓	✓
Non-functional Description	ServiceQoS	✓	✓	✓
	NetworkQoS	✓	✓	✓
	SystemQoS	✓	✓	✓
	OtherQoS	✓	✓	x
Business Description	Legality	x	✓	✓
	Certification	✓	✓	x
	UsageRequirement	✓	✓	✓
	Cost/Price	✓	✓	✓
Contextual Description	DeviceContext	✓	✓	✓
	UserContext	✓	✓	✓
	ServiceContext	✓	✓	✓
	BusinessContext	✓	✓	✓
Data Source Description	LocationDetail	✓	✓	x
	CapacityDetail	✓	✓	x
	QoSDetail	✓	✓	x
	ContextualDetail	✓	✓	x
Collaborator Description	FunctionalDetail	✓	✓	x
	BusinessDetail	✓	✓	x
	ReputationDetail	✓	✓	x
	UpdateFrequency	✓	✓	x
Hardware Description	SensorList	x	✓	x
	MemoryDetail	✓	✓	✓
	PowerDetail	✓	✓	✓
	ManufacturerDetail	✓	✓	✓

[1]MLO - MallLatestOffer [2]ST - SalesmanTracking [3]CPL - CarPoolingMate

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Related Work

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Our Approach	SOA (SOAP + REST)	Wired Wireless	XML	Yes	Functional, Business, Non-functional, Contextual	WSDL 2.0 is extended to provide run-time updateable description for mobile hosted services

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Conclusion

▶ A novel, lightweight, dynamic and extensible description approach for mobile services was presented.

▶ Approach is designed around WSDL to accommodate both legacy wired systems and modern wireless systems.

▶ Service description is partitioned into multiple parts.

▶ The update-able parts are made local to mobile service providers for easier and frequent updates.

▶ Approach enabled dynamic updates in service description without compromising overall consistency of description.

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[8] C. Dai and Z. Wang, "A flexible extension of WSDL to describe nonfunctional attributes," in e-Business and Information System Security (EBISS), 2010 2nd International Conference on, May 2010, pp. 1–4.

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