Client-side Service Composition Using Generic Service Representatives

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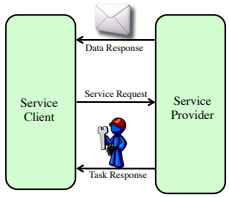
Business Web Service

- **Data Service:** processes client data completely at the server site.
- **Task Service:** processes client data partially or completely at the client site using the enterprise agent.



Background

Task Services

- We define "Task" formally as a triple:

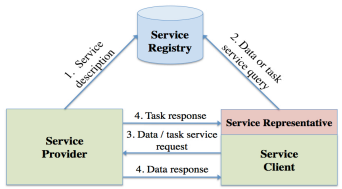
  Task = <**Task Model**, **Task Knowledge**, **Task Data**>

  Task Model : **what to do** (***Business Process Model***)
  Task Knowledge : **how to do it** (***Business Rules & Actions***)
  Task Data : **resources** (***Business Data***)

- **Task Service** performs a task at the client's side; it implies that some of the task data should remain at the client's side since they can not be transmitted efficiently to the provider.
  - **Privacy and security issues**
  - **Large client data files**

Background

Extended SOA Model



Service Representative (SR) is a software agent that performs a **task** on behalf of a service provider at the client side.

Task Service Example 1

Financial Adviser

Task Model

Task Knowledge

Give Buy Advice	Condition I	For each b ε provider. buyItem If (not exist p ε client. portfolio ∧ p.shareName = b.shareName)

	Action I	requiredCash = b.minPercentage * client. holdingValue;
		shareNo = min (requiredCash, client.cash) / b.sharePrice;
		Print " Buy" + shareNo + "of" + b.shareName;

	Condition II	For each b ε provider. buyItem If (exist p ε client. portfolio ∧ p.shareName = b.shareName ∧ p. percentage < b.minPercentage)
	Action II	requiredCash = (b.minPercentage – p.percentage) * client. holdingValue; shareNo = min (requiredCash, client.cash) / b.sharePrice; Print " Buy" + shareNo + "of" + b.shareName;
Give Sell Advice	Condition I	For each s ε provider. sellItem If (exist p ε client. portfolio ∧ p.shareName = s.shareName ∧ p. percentage > s.maxPercentage)
	Action I	shareNo = (p.percentage - s.maxPercentage) * client. holdingValue / s.sharePrice; Print "Sell" + shareNo + "of" + p.shareName;

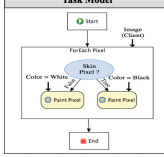
Task Data

Client-side: portfolio [shareName, shareNumber, percentage], holdingValue, cash
Provider-side: buyItem [shareName, minPercentage, sharePrice], sellItem [shareName, maxPercentage, sharePrice]

Task Service Example 2

Skin Detector

Task Model



Task Knowledge

Skin Pixel?	Business Rule	if (R > 95 and G > 40 and B> 20) and
		(max (R,G,B) - min(R, G,B) > 15) and
		(abs (R-G) > 15 and R > G and R > B))
		return true;
		else
		return false;

Paint Pixel	Business Action	SR.Internal.setPixelColor(pixel, Color);

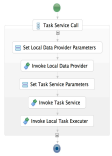
Service Time	Pixel WS	Block-Color WS	Block-Texture WS
Task Service (msec)	582	1241	1351
Data Service (msec)	1094	1519	1594

Progress

Composite Task Services

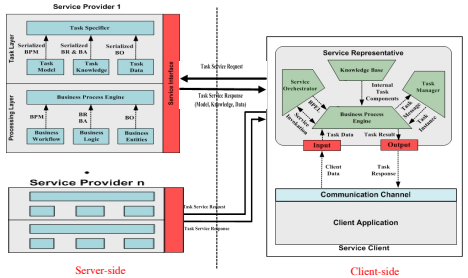
- Collaborating data and task services provide a **composite task service** to address the client-side service composition.
- Service representative is equipped with a **service orchestrator** to execute a composite task.

- A composite task service is modeled by a **BPEL process** including both data and task service invocations.

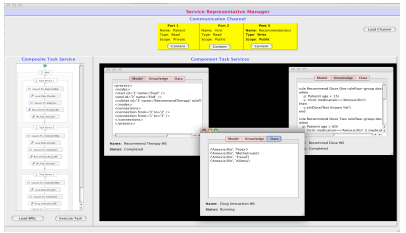


Progress

Proposed Architecture

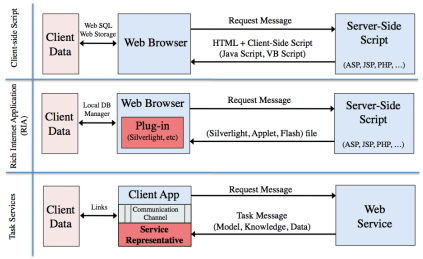


Prototype System



Snapshot of the prototype service representative manager *(EntRep version 1.1)* that is running a composite task service.

Client-side Processing Technologies



Comparison

	Script-based Technologies	Rich Internet Applications	Task Services
Requirements	Web Browser	Web Browser + Plug-in (Silverlight, Flash Player, JVM)	Host Application (e.g., Web Browser, Desktop App, Mobile App) + SR Plug-in
Local Data Access	WebSQL, WebStorage	Local DB Manager	Communication Channel
Composability	✘	✘	✔
Flexibility	✘	✘	✔

Case Study

Clinical Decision Support Systems (CDSS)

Guideline-based CDSS: takes patient information and matches it with the patterns obtained from medical experiments and observations.

- They require transferring patient's health information while they are highly sensitive.

Model-based CDSS: initially builds a decision model according to known data (training data) and then applies this model on unknown data (test data).

- They do not consider local data to build their decision models. The local data are often too large to be transferred efficiently to the services.

Secure and Context-aware CDSS

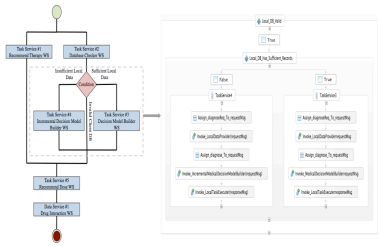
Using the proposed methodology and implemented tool *(EntRep version 1.1)* we modeled and developed a secure and context-aware CDSS by a composite task service.

Service Client
The service client puts its data and resources into the communication channel.

Patient	Visit	Patient DB	Visit DB	Recommendation
- name - age - weight - creatinine level - allergies - active medications	- patient name - date - diagnosis - medication - dose	Each row contains one patient record	Each row contains one visit record	- mMedication - gMedication - mDose - gDose - warning

Case Study – Collaborating Services

1. Recommend Therapy (task service): receives a diagnosis report and returns the corresponding medication guidelines.
2. Database Checker (task service): receives a database schema and returns a task to verify whether the client database matches with this schema.
3. Decision Model Builder (task service): receives a diagnosis report and returns a task to build and apply a decision model based on the client-side patient and visit databases.
4. Incremental Decision Model Builder (task service): receives a diagnosis report and returns a task to rebuild, complete, and apply an incremental decision model based on the client-side patient and visit databases.
5. Recommend Dose (task service): receives a medication and returns the corresponding dose guidelines.
6. Drug Interaction (data service): receives a target medication and a list of active medications and returns warnings if there is one or more drug to drug interaction.

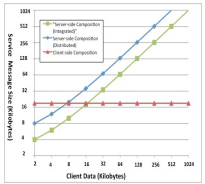


Client-side Vs Server-side Service Composition

Service Message Size (SMS)

$$SMS(s) = Size_{Request}(s) + Size_{Response}(s)$$

Using Task Services, SMS will be independent of the size of the client data.



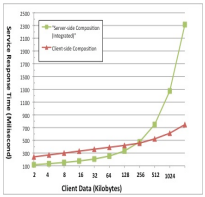
Client-side Vs Server-side Service Composition

Service Response Time (SRT)

$$SRT(s) = Network(s) + Process(s)$$

- 2.4 GHZ dual-core CPU
- $P_{Server\text{-}Side}(s) = \frac{1}{2} P_{ClientSide}(s)$
- (1 Mbyte/Sec) bandwidth connects the client to the servers.

Task Services overcomes the traditional approaches when the client data grows.



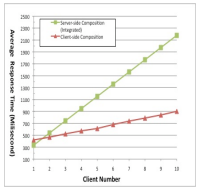
Client-side Vs Server-side Service Composition

Average Response Time (ART)

$$ART(s,n) = \frac{1}{n} * \sum_{i=1}^{n} SRT(S_i)$$

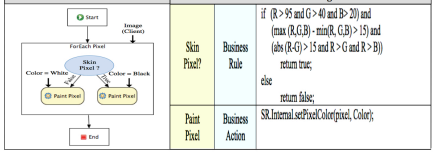
$$P_{ServerSide}(s,n) = n * P_{ServerSide}(s)$$

Using Task Services, client data can be processed in parallel.



Task Service Example 2

Skin Detector

Task Model	Task Knowledge		
	Skin Pixel?	Business Rule	if (R > 95 and G > 40 and B> 20) and (max (R,G,B) - min(R, G,B) > 15) and (abs (R-G) > 15 and R > G and R > B)) return true; else return false;
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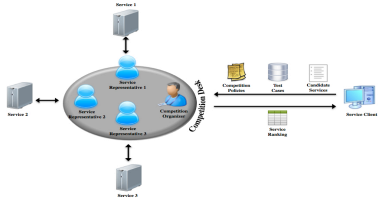
Future Work

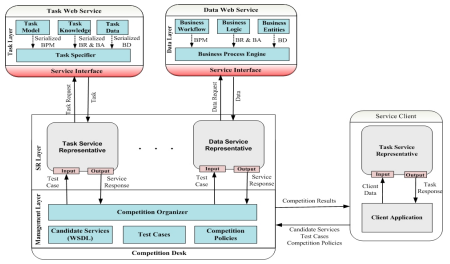
Web Service Competition



Goal : rank alternative services based on their performance in a specific client context.

Future Work

WS-Competition Architecture



Conclusion

An efficient model for Task Services using generic Service Representative enterprise agents improves the current state of SOA-based enterprise systems

- Maintaining client's privacy and security.
- Providing less network traffic and more processor power for the server.
- Separating business services from business rules, actions, and processes.
- Facilitating modeling of stateless service.
- Reducing the interoperability issues among collaborating services.

Thank you for your attention.