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Per-request Contracts for Web Services Transactions

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Outline

- Traditional Transactions
- Transactions for the Web Services environment
- Problems and Deficiencies
- Example Scenario
- Experimental Design
- Results
- Conclusion

Traditional Transactions

- Combine multiple actions into a logically single action
- Enforce ACID properties
 - Atomicity
 - Consistency
 - Isolation
 - Durability
- Designed for traditional systems
 - Single controlling authority
 - Short running time

Web Services Transactions

- Transaction Internet Protocol
 - Move traditional transactions to the Web environment
- Semantic Atomicity
 - Remove strict need for atomicity/isolation
 - Instead only require end result to be atomic
- Tentative Hold Protocol
 - Allow multiple holds on resources
 - Notify if/when resources become unavailable

Advanced Techniques

- Possible to avoid problems with isolation
 - Alrifai et al., 2006
 - Choi et al., 2005
- Possible to combine various different strategies
 - Limthanmaphon and Zhang, 2004
 - Fauvet et al., 2005
 - Mikalsen et al., 2002

Deficiencies

- Enforcing isolation is still costly
- Providers must agree on a certain subset of possible reductions
 - Many possible reductions unable to be used
 - Should be able to decide without regard to other providers
- Providers must always offer the same level of transaction support for a given action
 - Should be able to dynamically change based on current conditions

Example Scenario

- Three providers offering a competing service
 - Clients will use only one of these providers in their transaction
- Service offers clients a finite number of resources
 - Could be hotel room reservations, physical objects, etc
- Each provider offers an identical service except for level of transaction support provided
 - ie price, speed of delivery, etc. are not factors

Example Scenario

Provider Support

- Each provider offers either:
 - Semantic atomicity
 - Resources are booked when client first requests them. Client can later cancel the booking without a penalty.
 - Tentative holds
 - Resources are reserved when client first requests them. They are not booked until a client specifically books them. Provider cancels reservations if another client books the requested resources. Clients cannot cancel bookings without penalty.
 - Variable support
 - Provider offers semantic atomicity when resources are plentiful, but switches to tentative hold when a threshold is reached.

Example Scenario

Client Actions

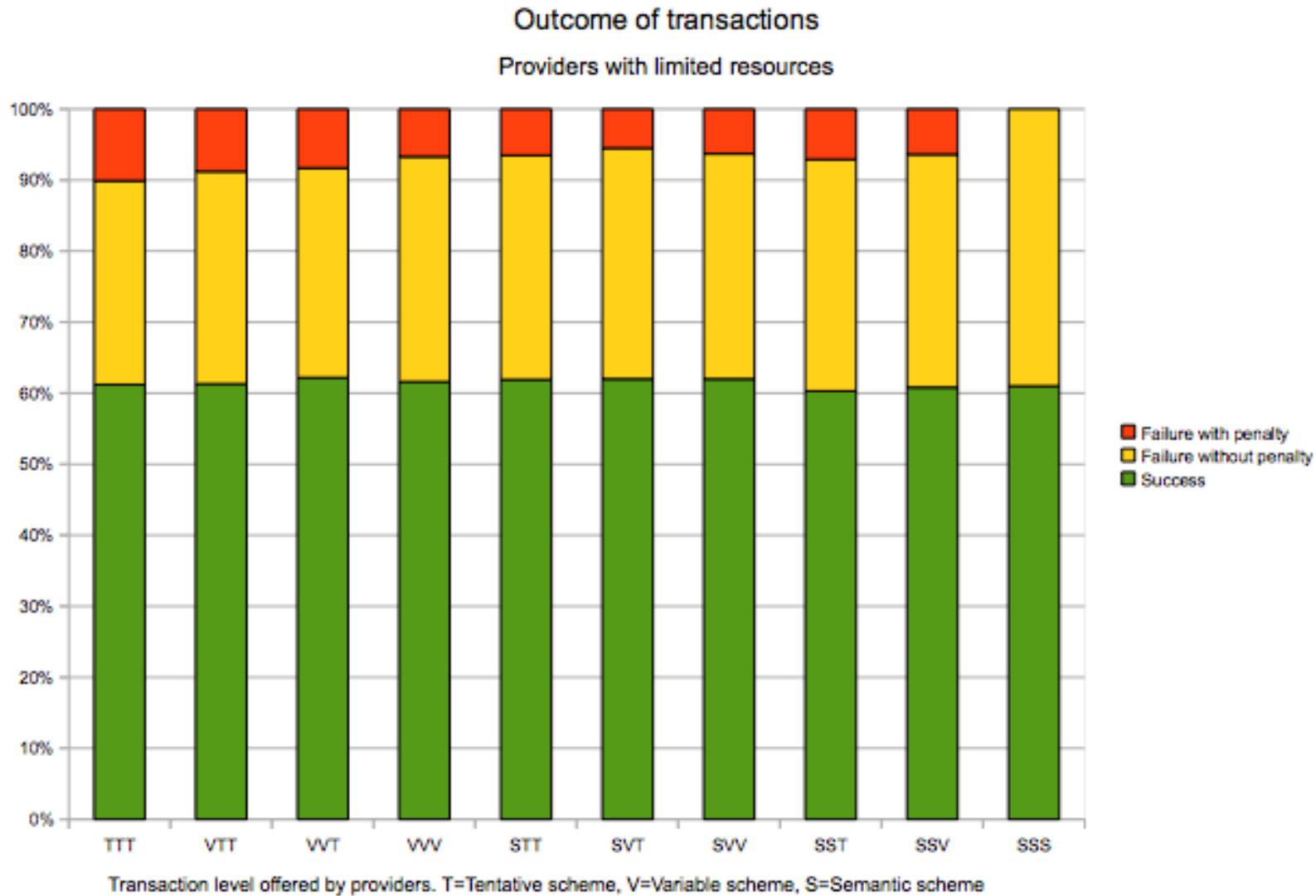
- Client finds suitable provider
 - If none exist, transaction fails without penalty
- Next step depends on level of transactional support offered:
 - Semantic atomicity
 - In worst case, transaction fails without penalty
 - Tentative hold
 - In worst case, transaction fails with penalty

Experiment Design

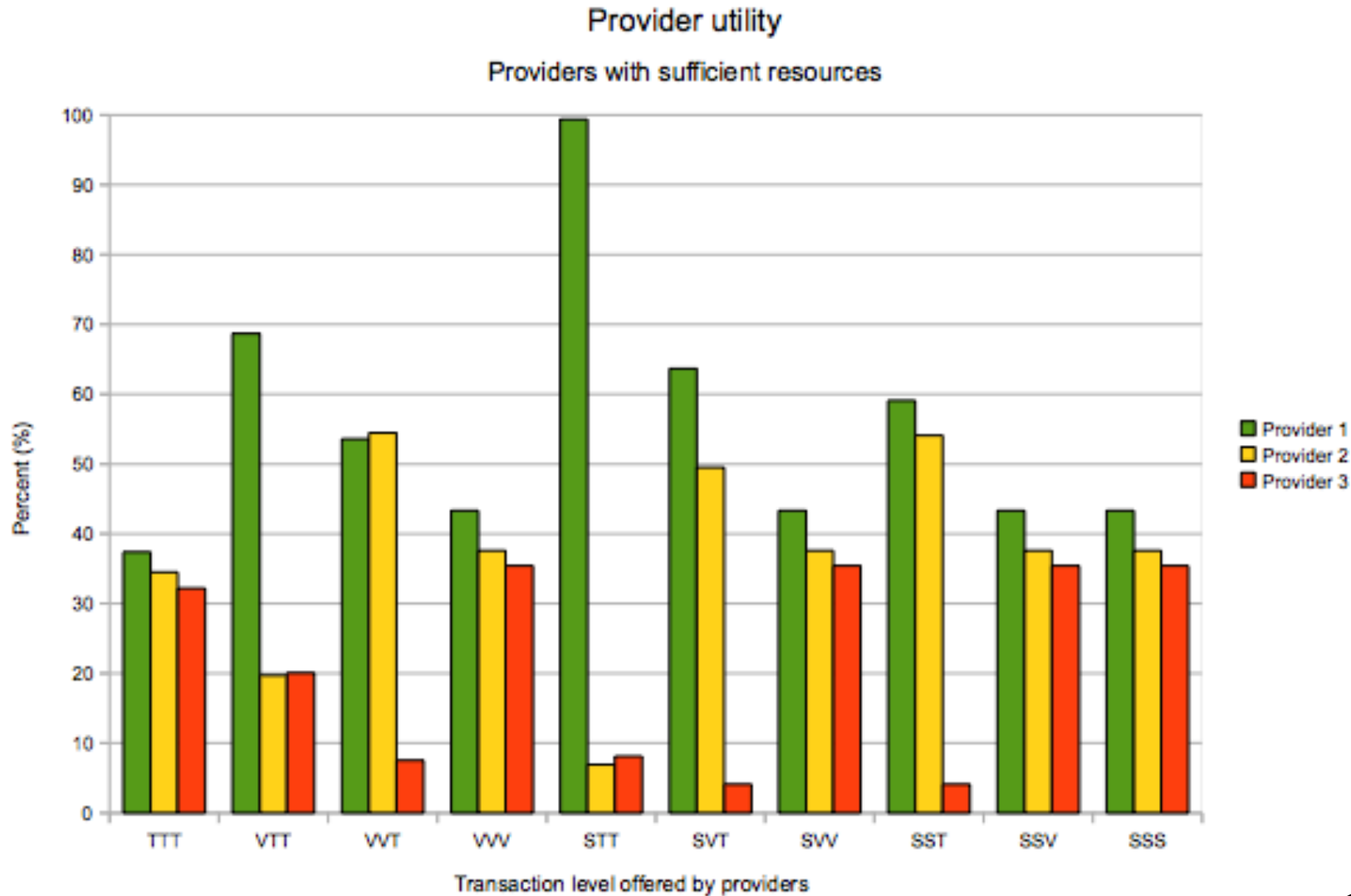
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- Simulator monitors all messages being sent
- 1000 client transactions randomly generated
 - 80% prefer semantic atomicity, 10% require semantic atomicity, 10% willing to use any level of transaction support
- Runs with each combination of transactional support possible for the three providers
 - Semantic Atomicity, Tentative Hold, Alternating
- Three experimental setups
 - Clients requesting between 1 and 10 resources
 - Providers with limited resources
 - Providers with sufficient resources
 - Half of clients requesting 50 resources

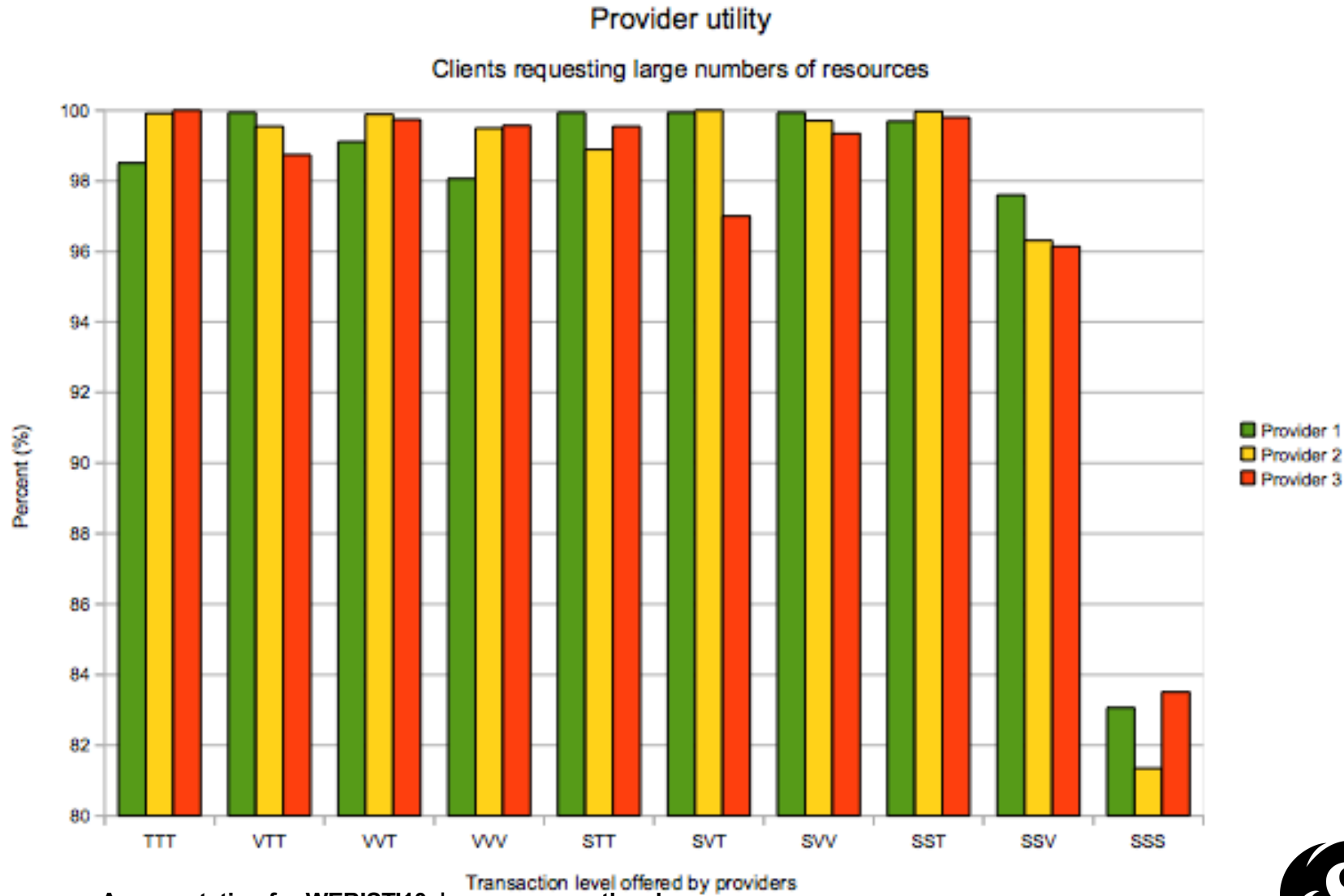
Results - Limited Resources



Results - Sufficient Resources



Results - Clients requesting large amounts of resources



Conclusions/Future Work

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- Transaction-like constructs are important in service-oriented environments
 - ACID often not the best choice
- Dynamically deciding on level of transactional support can be beneficial
 - For providers
 - For clients
- Determining what level to support/accept is an open problem
 - Providers want to maximise profit
 - Clients want an acceptable level of risk

THANK YOU

DISCUSSION

- **Per-request Contracts for Web Services Transactions**



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Results

- Limited Resources**

Table 1: Results when providers have limited resources.

Provider 1 Protocol	Provider 2 Protocol	Provider 3 Protocol	Clients (%)				
			Success	No penalty	Penalty on other activity	Penalty on this service	Any penalty
Tentative Variable	Tentative	Tentative	61.2	28.7	7.6	2.5	10.1
Variable	Variable	Tentative	61.3	29.9	6.3	2.5	8.8
Variable	Variable	Variable	62.2	29.5	5.7	2.6	8.3
Semantic	Tentative	Tentative	61.6	31.7	3.6	3.1	6.7
Semantic	Variable	Tentative	61.9	31.6	4.6	1.9	6.5
Semantic	Variable	Variable	62.0	32.5	3.0	2.5	5.5
Semantic	Semantic	Tentative	62.0	31.7	3.1	3.2	6.3
Semantic	Semantic	Variable	60.3	32.6	3.7	3.4	7.1
Semantic	Semantic	Semantic	60.8	32.8	2.1	4.3	6.4
Semantic	Semantic	Semantic	61.0	39.0	0.0	0.0	0.0

Results

- Sufficient Resources**

Table 2: Results when providers have sufficient resources.

Provider 1		Provider 2		Provider 3		Success (%)	Clients	
Protocol	Utility (%)	Protocol	Utility (%)	Protocol	Utility (%)		Failure with no penalty (%)	Failure with penalty (%)
Tentative	37.37	Tentative	34.49	Tentative	32.17	72.6	18.8	8.6
Variable	68.89	Tentative	19.71	Tentative	20.06	76.6	18.0	5.4
Variable	53.57	Variable	54.46	Tentative	7.51	80.0	18.8	1.2
Variable	43.31	Variable	37.60	Variable	35.40	80.7	19.3	0.0
Semantic	99.40	Tentative	06.91	Tentative	8.11	80.0	19.2	0.8
Semantic	63.66	Variable	49.51	Tentative	4.11	80.7	18.8	0.5
Semantic	43.31	Variable	37.60	Variable	35.40	80.7	19.3	0.0
Semantic	59.09	Semantic	54.09	Tentative	4.11	80.7	18.8	0.5
Semantic	43.31	Semantic	37.60	Variable	35.40	80.7	19.3	0.0
Semantic	43.31	Semantic	37.60	Semantic	35.40	80.7	19.3	0.0

Results

- Clients requesting large amounts of resources**

Table 3: Results when half of the clients request large amounts of resources.

Provider 1		Provider 2		Provider 3		Clients		
Protocol	Utility (%)	Protocol	Utility (%)	Protocol	Utility (%)	Success (%)	Failure with no penalty (%)	Failure with penalty (%)
Tentative	98.51	Tentative	99.91	Tentative	100.00	46.5	32.6	20.9
Variable	99.94	Tentative	99.54	Tentative	98.74	45.0	36.3	18.7
Variable	99.11	Variable	99.89	Tentative	99.74	43.4	43.0	13.6
Variable	98.06	Variable	99.49	Variable	99.57	43.0	48.0	9.0
Semantic	99.94	Tentative	98.89	Tentative	99.54	44.9	41.6	13.5
Semantic	99.94	Variable	100.00	Tentative	97.00	44.8	45.9	9.3
Semantic	99.94	Variable	99.71	Variable	99.34	42.2	53.4	4.4
Semantic	99.69	Semantic	99.97	Tentative	99.80	41.3	51.5	7.2
Semantic	97.60	Semantic	96.31	Variable	96.14	39.7	57.6	2.7
Semantic	83.06	Semantic	81.34	Semantic	83.51	34.8	65.2	0.0