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Interactive 3D Services over Windows Azure



**Czech
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Faculty of
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Engineering

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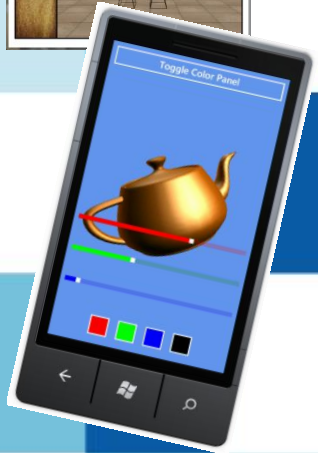
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Agenda

- Objectives
- Interactive 3D platforms in Windows Azure
 - 3D shop – single user
 - 3D teapot – multi-user
- Demo
- Performance
- Lessons learned & future work
- Shameless advert





Principal Questions

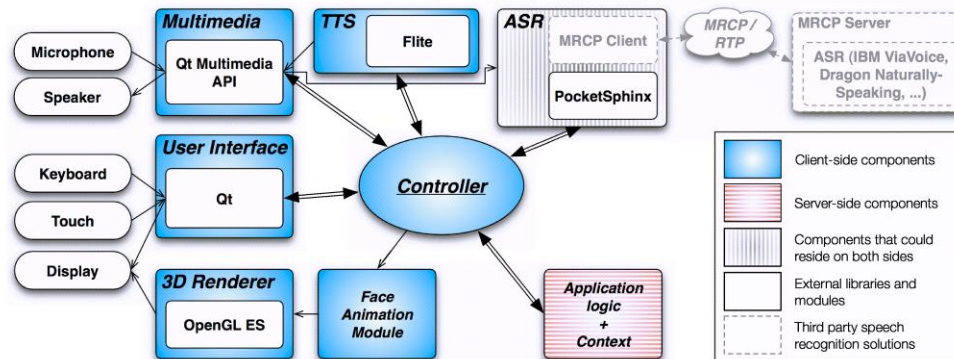
- How to create and distribute 3D interactive environments over the cloud?
- How to enable their creation for 3rd parties?
- How to do it on Windows Azure?



Inspiration: (own, past) 3D Mobile Internet Project



- Interactive 3D client-server solutions
 - 3D Mobile Talking Head
 - 3D e-Shop
- Technology
 - VRML, Server scripts
 - Standalone application or 3D-viewer plugin
 - Server-based speech recognition and synthesis
- internet3d.rdc.cz
- Best Paper Award, *Danihelka, Hak, Kencl, Zara*. 3D Talking-Head Interface to Voice-Interactive Services on Mobile Phones. SIMPE Workshop at MobileHCI 2010
- Android and iPhone licenses sold commercially
- Careful considerations of functionality distribution

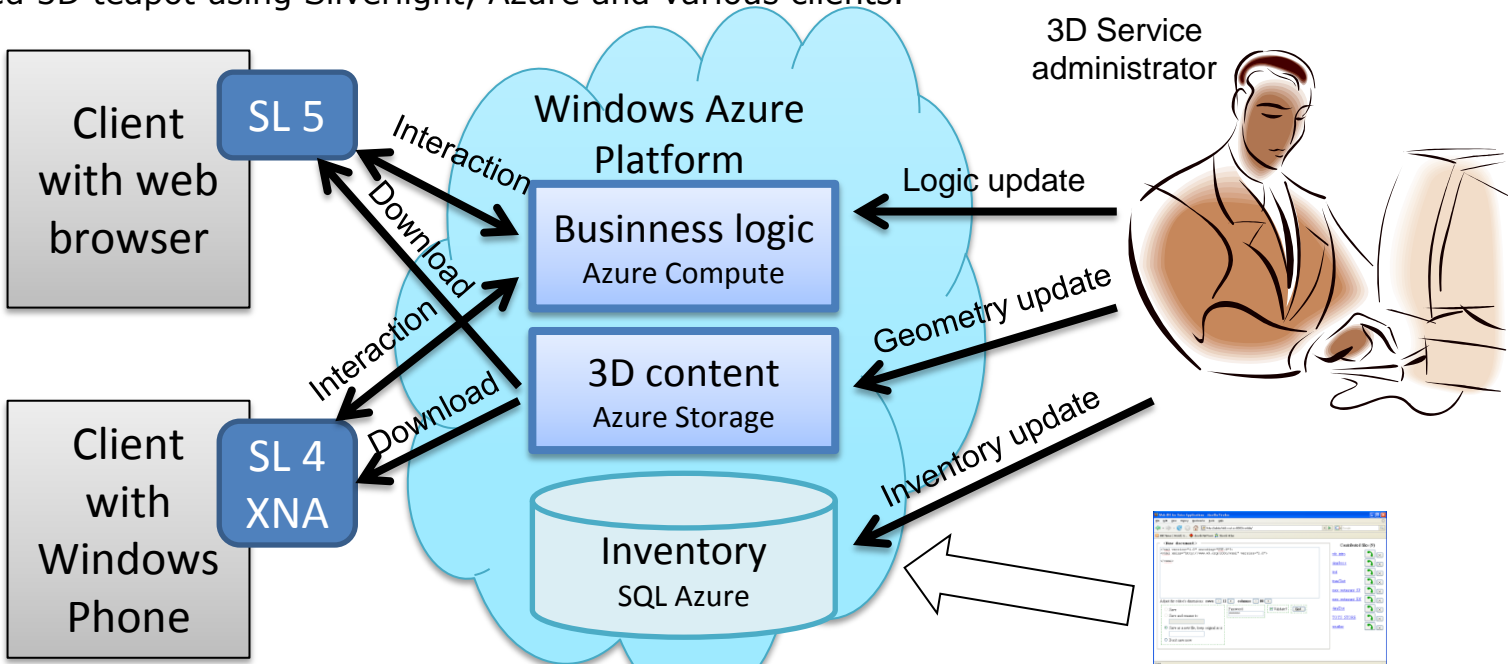


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Long-term project big picture: 3D Interactive Cloud Services

- Natural interaction: speech, 3D environment, real-time, multi-user
- Architecture: new graphics technologies together with cloud scalability & functions
- Fast creation & deployment of cloud-based 3D apps (e-Shops, Games, Education, etc)
- Early prototypes:
 - client-side rendering of a talking-head interface on desktop Windows using Silverlight;
 - client-cloud virtual shop with 3D content using Windows Azure;
 - Shared 3D teapot using Silverlight, Azure and various clients.



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Configuration Tools



Related work

- Second Life

closed server infrastructure



- RuneScape

cloud MMORPG (Amazon)



- Social games in Azure (turn based)



Tankster



Vampire Legacy

- Is Azure good for this?

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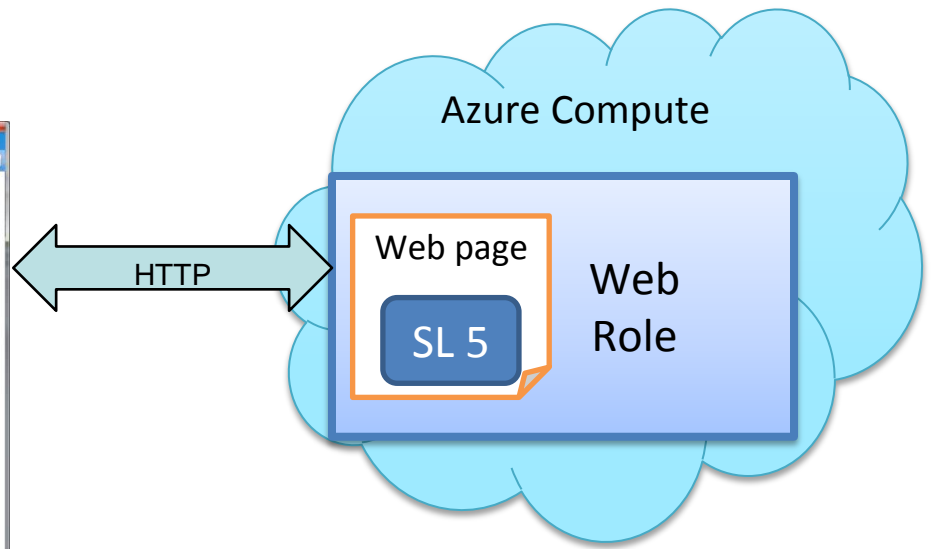
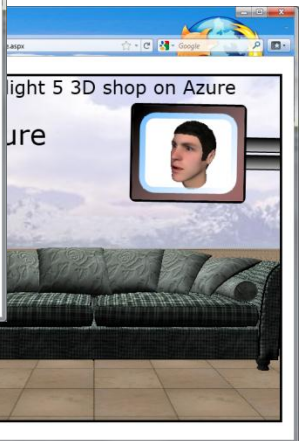
Prototype I: Single-user 3D shop with Talking Head on Azure

Client (MS Silverlight5 in browser)

- 3D Store content (3D models, textures)
- XNA drawing surface
- Virtual 3D Store app (.xap file)
- MS Silverlight runtime plugin 5
- Web browser (IE, Firefox, Chrome)
- Windows OS (later also Linux and Mac)
- Graphics accelerated hardware

Cloud (Windows Azure)

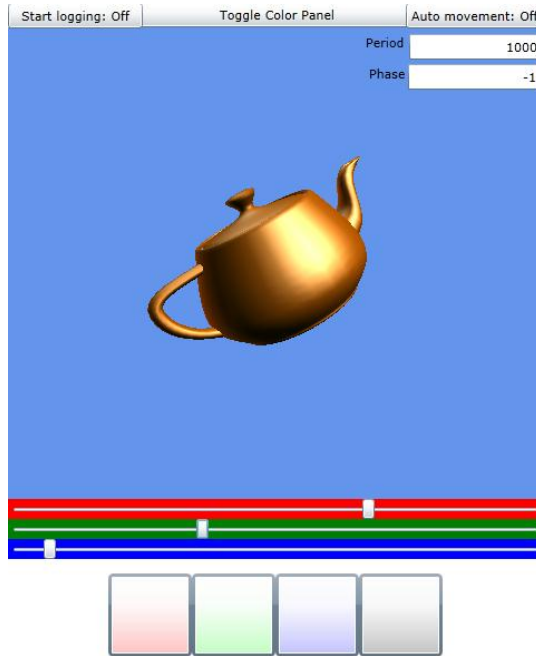
- Content data files
- Virtual 3D Store (.xap file)
- Azure Storage
- Windows Azure
- Microsoft datacenter



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Prototype II: 3D Teapot - Multi-user interaction with a shared 3D object



Silverlight browser client



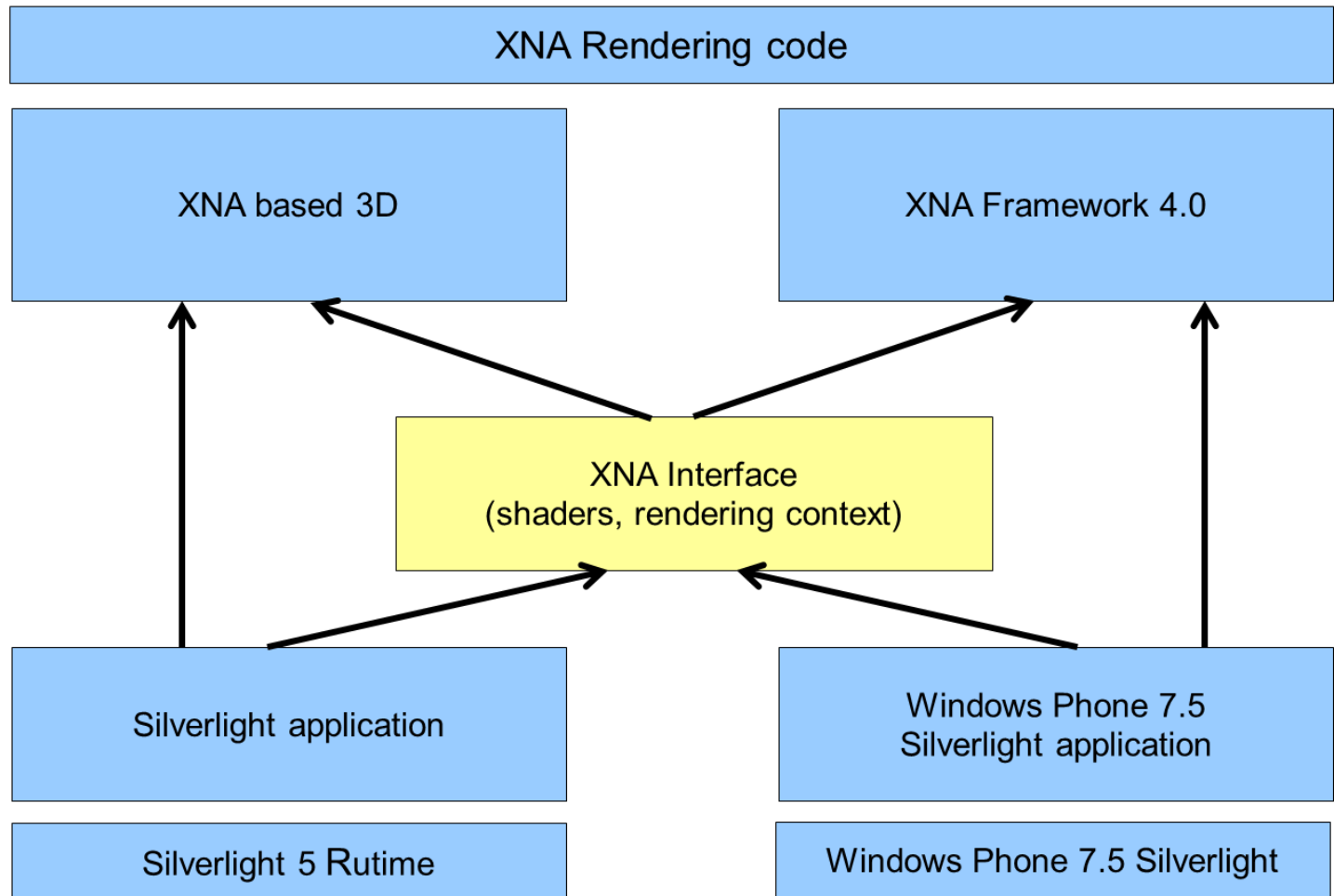
XNA mobile app

pitch	yaw	color
-30.5	34.5	#FFAC58

Represented by a simple, shared state

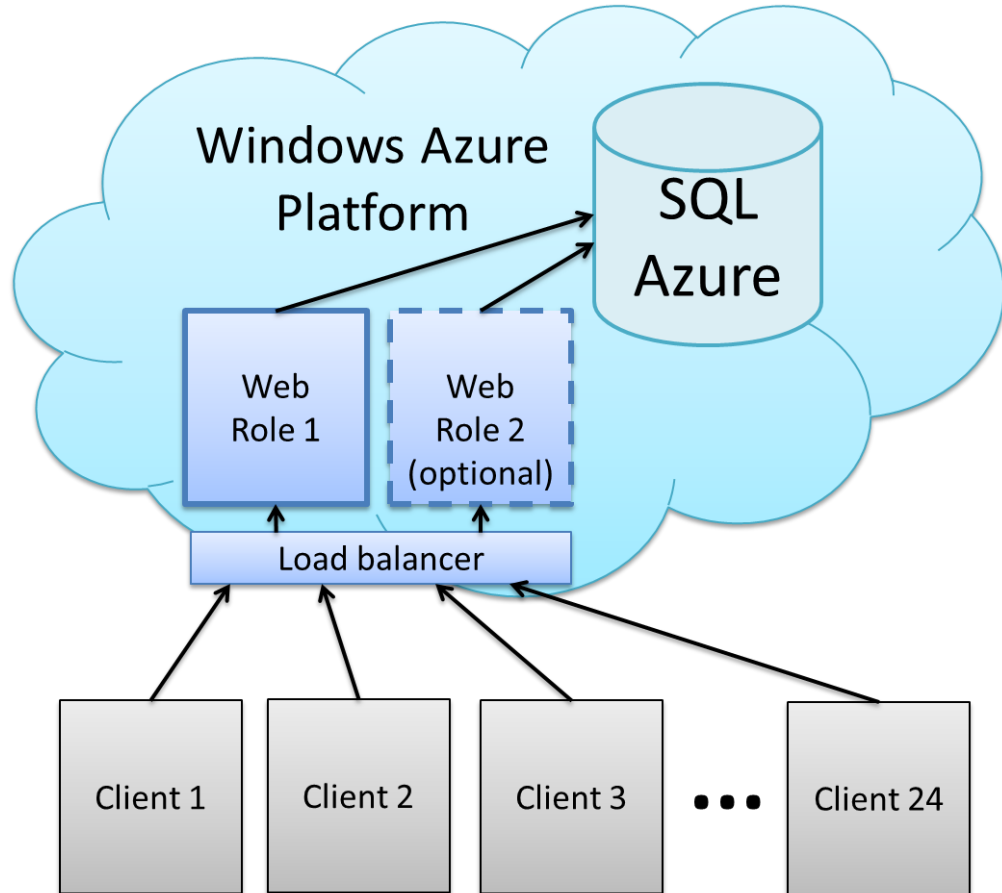


Client Software Architecture



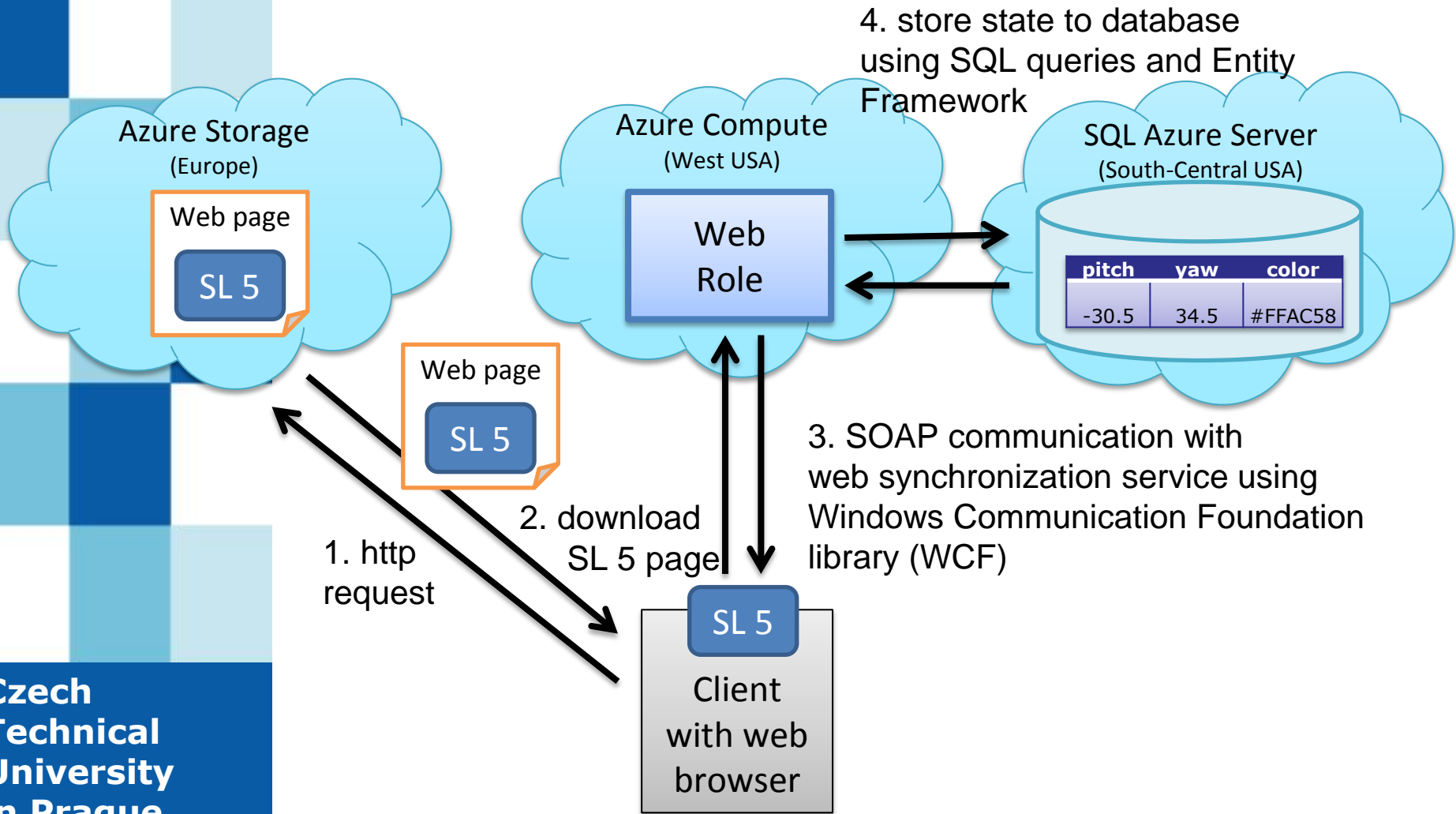


Azure Deployment Architecture



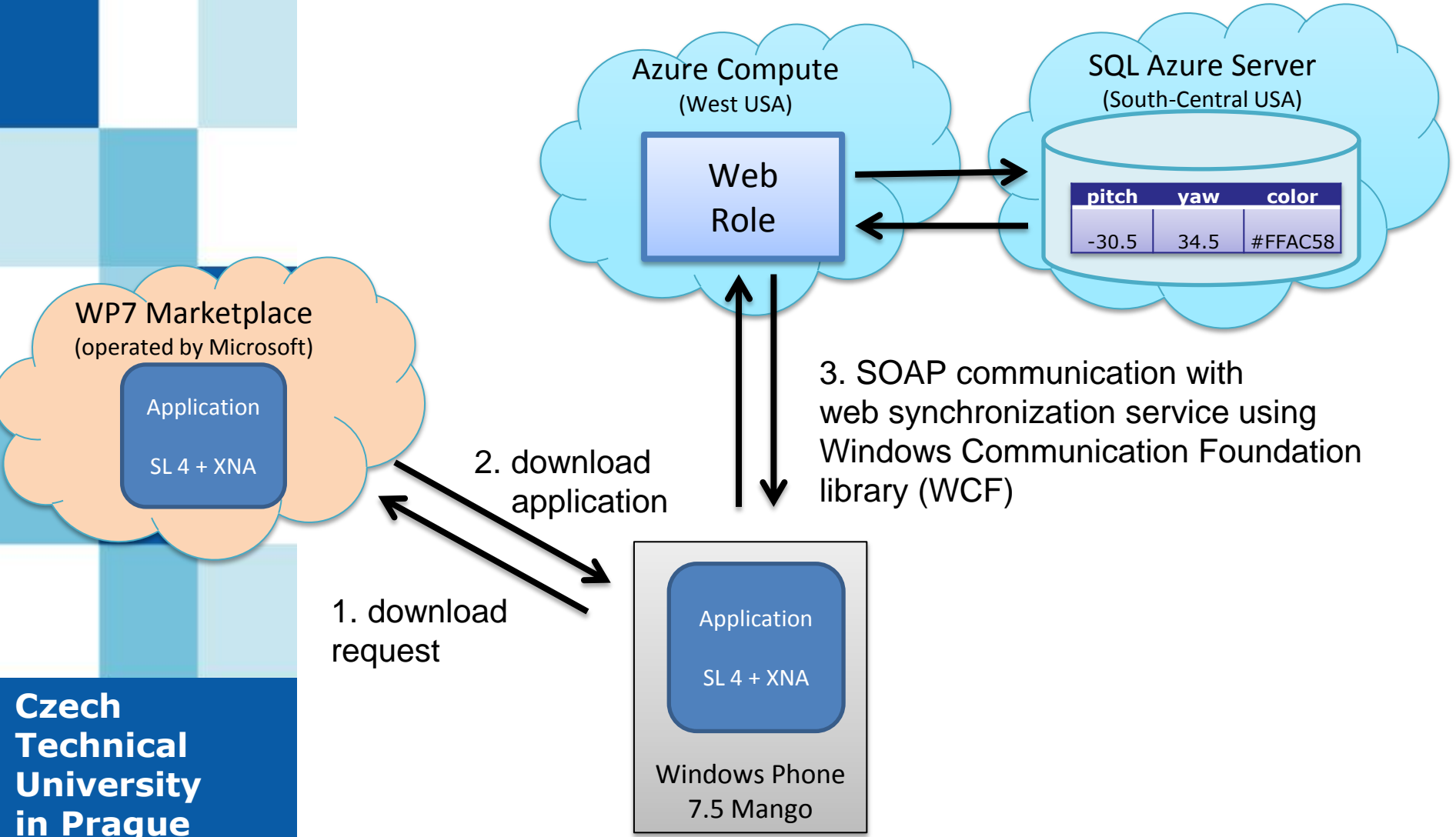


Detailed architecture – browser client





Detailed interconnection – mobile XNA client





Teapot state synchronization protocol

SL 5
– or –
SL 4 + XNA
application

GetState

- returns all fields of current state
- server does not maintain sessions

Pitch	Yaw	R	G	B
158	68	45	200	150



Web
Role

UpdateState

- sends relative change on client to server
- only changed fields sent
- client must track changes (maintain session)

Pitch delta	Yaw delta	R	G	B
+15	-7	null	null	null

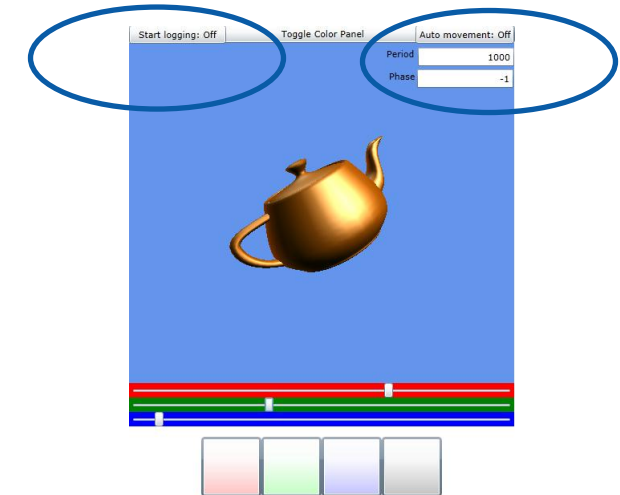


Measurement setup



Logging

Auto-movement

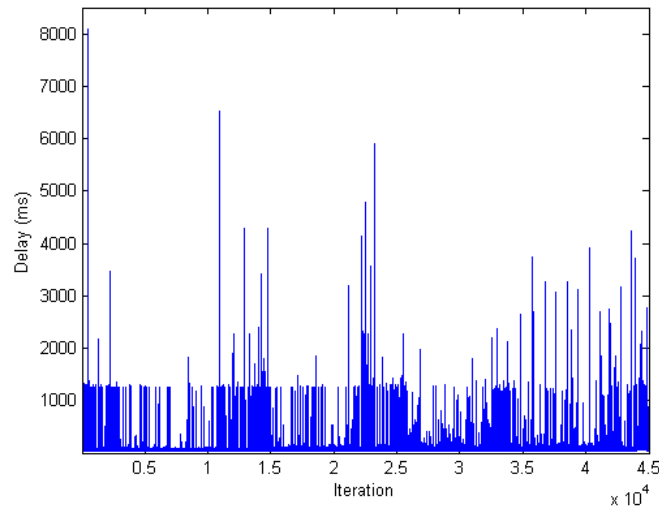


- Configurable auto-movement of teapot
- Logging latency of `GetState` & `UpdateState` operations
- 2 scenarios:
 - 24 simultaneous instances at university classroom
 - ▶ Incrementally increasing # of instances
 - ▶ Excellent network connectivity
 - ▶ 2 instances per machine
 - 2 simultaneous instances at a public café (Starbucks, Prague center)
 - ▶ Typical use case
 - ▶ WiFi connectivity

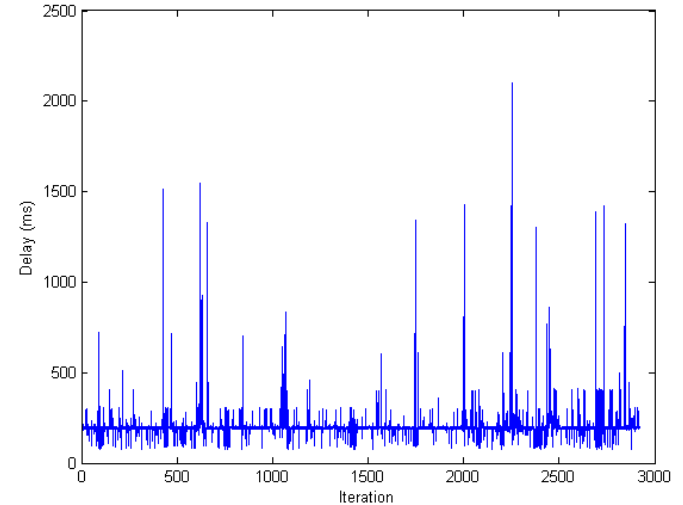


Measurements - Latency

Classroom
24 instances



Starbucks
2 instances

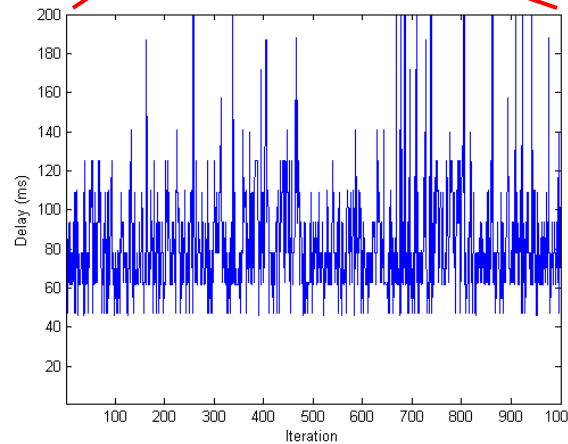
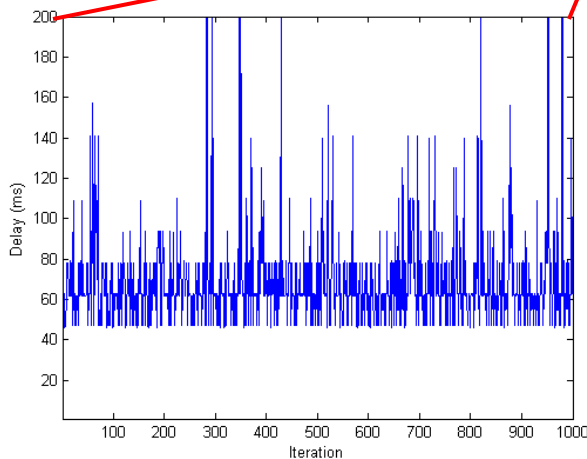
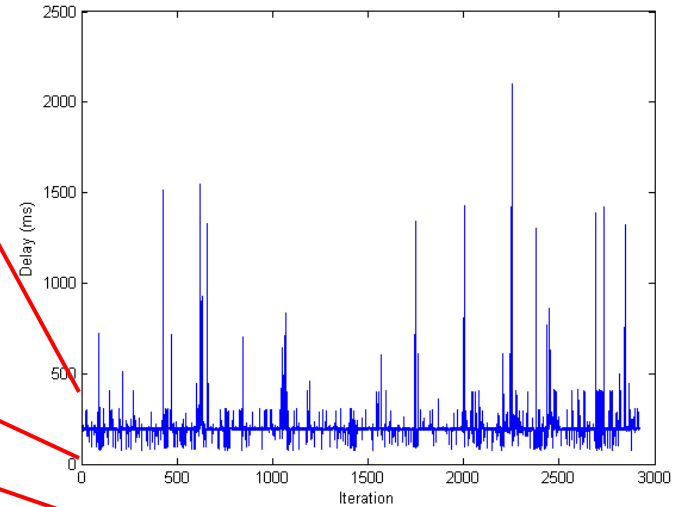
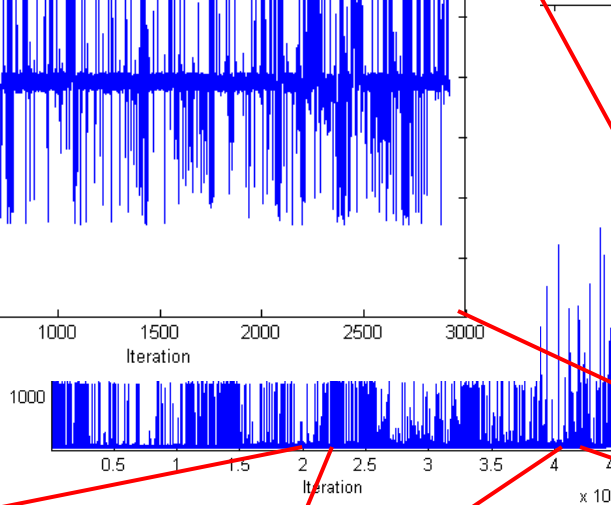
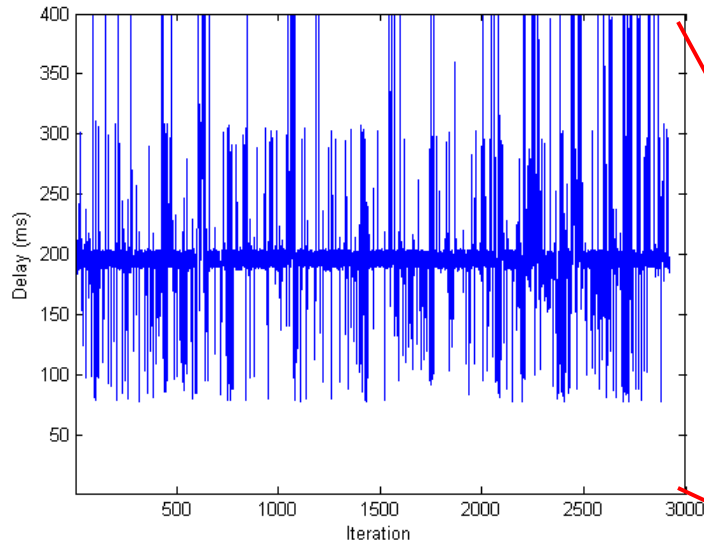


Latency (ms)	Classroom	Starbucks
Mean	91.40	204.38
St Dev	165.86	100.95
Median	63	195
Min	46	78
Max	8078	2101



Measurements - Latency

Starbucks
2 instances



Starbucks

204.38

100.95

195

78

2101



Lessons Learned & Future Work

- Azure lessons
 - Carefully consider data-center and geographic distribution
 - SQL processing elsewhere?
 - Atomicity of SQL operations would be nice
 - Shared state closer to web/worker roles
 - UDP vs TCP
 - Latency large – cloudlets or CDNs

- Further Work
 - Much more measurements
 - Sharing state by other means?
 - Prototype 3: Multi-user seeing each other
 - Integrate with speech recognition and synthesis
 - Open platform for rapid 3rd party configuration
 - Dynamic workload migration between client and cloud based on immediate conditions and context
 - Geographic distribution



Thank you! Q&A

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danihelka.blob.core.windows.net/sync/usa/index.html

danihelka.blob.core.windows.net/world//index.html



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IFIP Networking 2012 Conference @ CTU, Prague



- May 21-25, 2012
- networking2012.cvut.cz/
- Renowned networking research conference
- Network Architecture, Applications and Services, Wireless and Sensor Networks, Network Science
- 64 papers, 28% acceptance rate, ~120 worldwide attendees
- 2012: IFIP TC6 40-year anniversary
- Keynotes by Vint Cerf (Google), Jon Crowcroft (Cambridge University), Pablo Rodriguez (Director, Telefonica R&D), Dina Katabi (MIT) and many others
- MSR sponsored – thank you!



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