A Safety-Oriented Platform for Web Applications

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Agenda

- Motivation
- Design Goals
- Architecture
- Results/Evaluation
- Related Work
- Conclusions
- Pros and Cons

Motivation

- Browsers run lot of active untrusted code
- Web applications interfere with other applications and with browser itself
- Exposes users and web services to a lot of risk
  - Drive by download attacks
  - Cross-site scripting attacks
  - Content based attacks and Phishing attacks

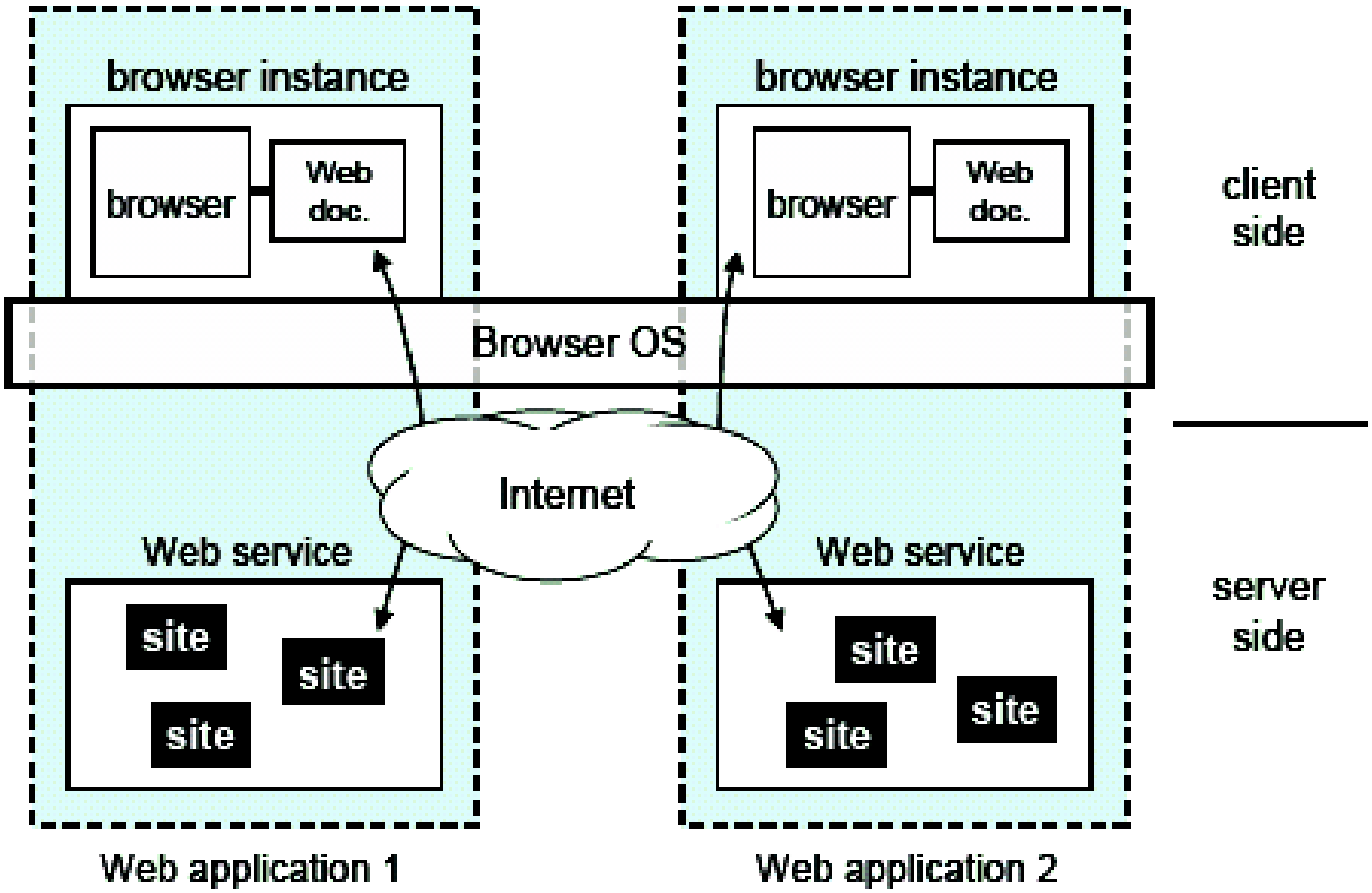
Design Goal

- Develop a new browser platform to improve safety and security for users and web services
  - New trusted layer on which web browsers execute

Tahoma Architecture

- Web applications should not be trusted
  - Web Application = Browser Instance + Web Service
  - Contain each browser instance in VM sandbox
- Web browsers should not be trusted
  - Isolate browsers from rest of the system
- Increase visibility and control over downloaded web applications
  - Web applications should be visible to users like desktop applications

Tahoma Architecture



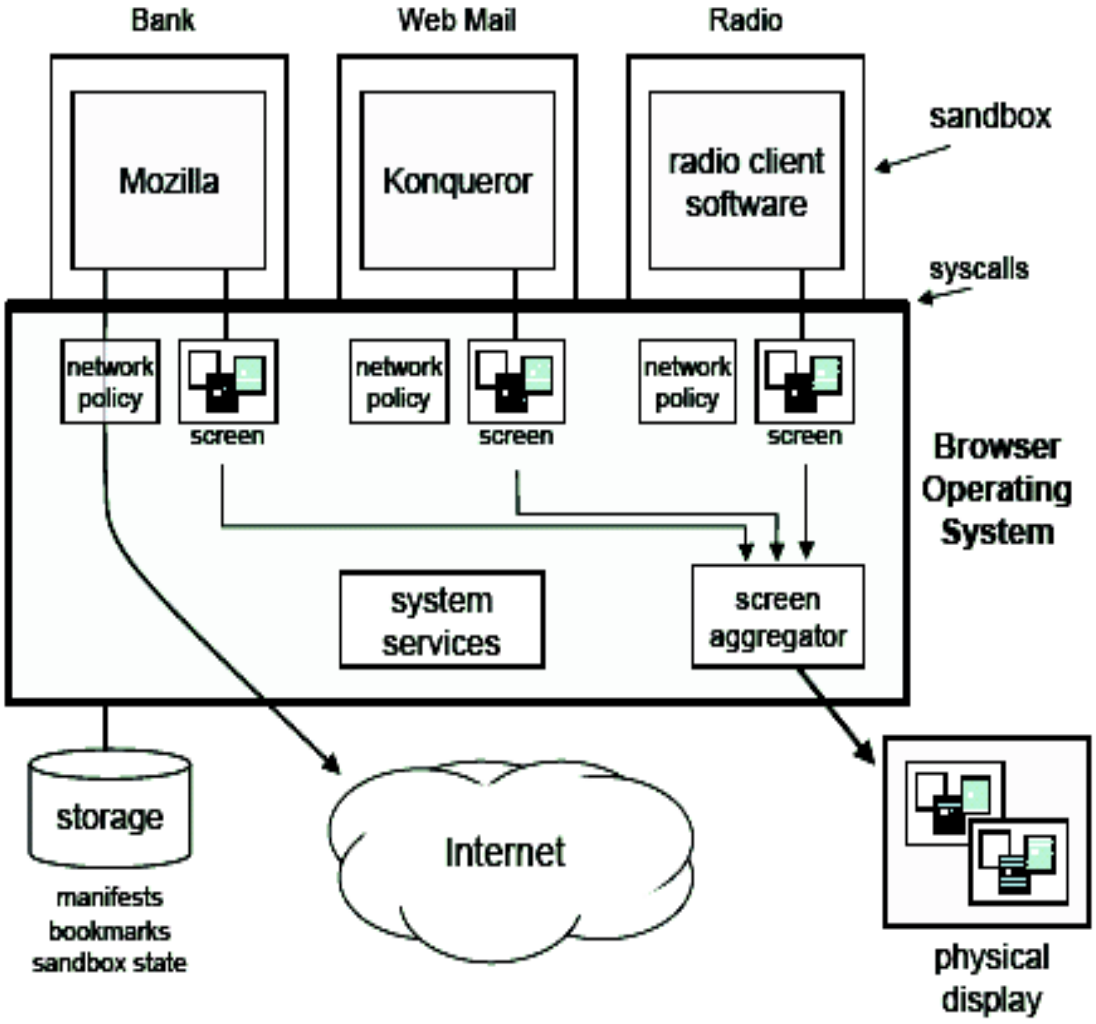
Web Application

- Tahoma browser instance associates with a single well circumscribed web application
- Web services specify manifests
- Manifest contains:
  - Digital signature authenticating web service
  - Browser policy: code to run in the browser instance
  - Network policy: Internet access policy to be enforced by reverse firewall
- User need to approve web application when web application is run for the first time

Browser Operating System(BOS)

- Trusted computing base for Tahoma browsing system
- Multiplexes the virtual screens of each browser instance into physical display
- Enforce network policies for each instance
- Store state for associated browser instances, bookmarks and manifests
- Also, stores pre-forked browser instances that can be cloned easily when installing web application

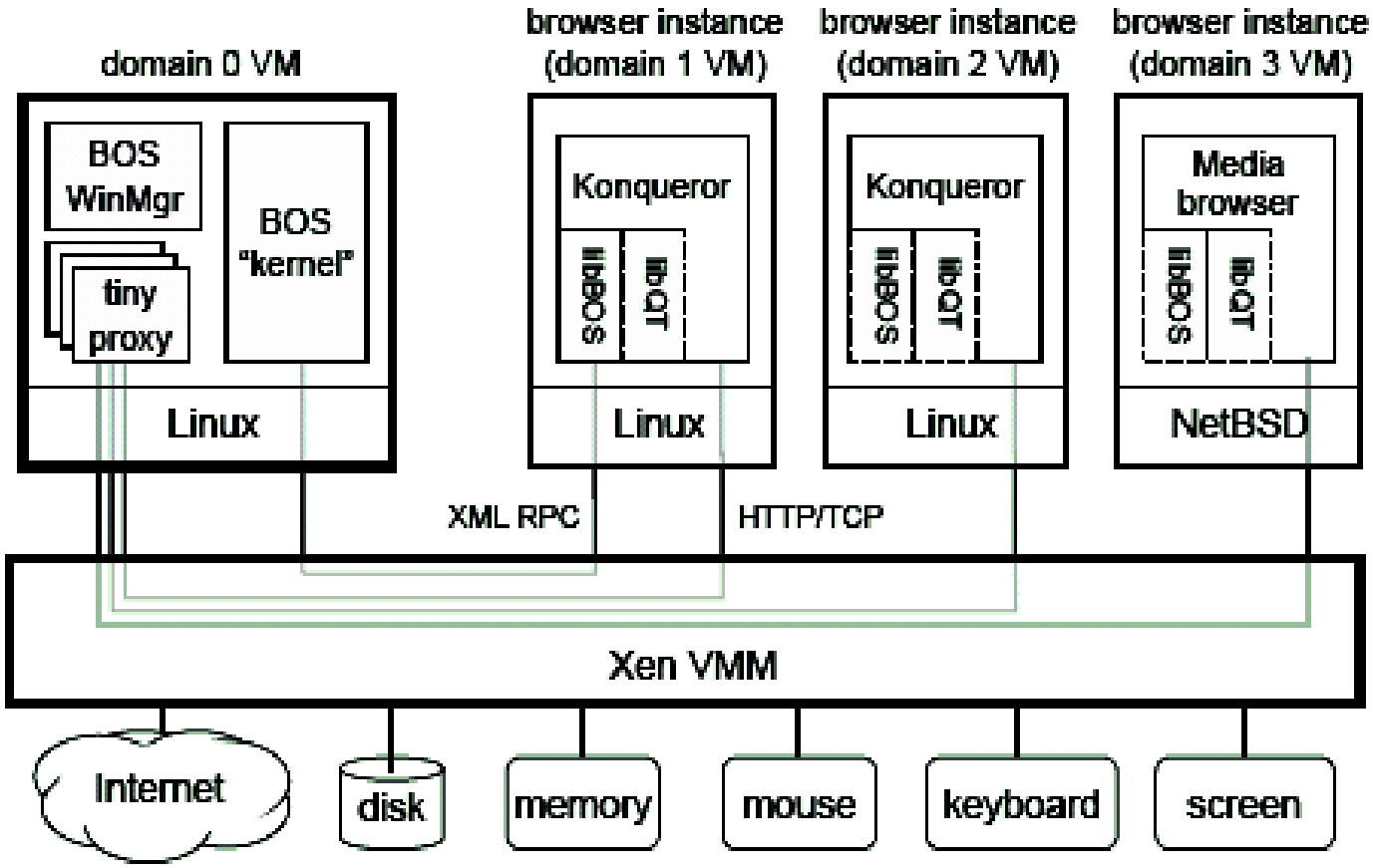
Tahoma Implementation



Implementation

- Tahoma prototype implemented on Xen virtual machine monitor in Linux
- BOS, BOS Kernel and tiny proxy implemented as domain0 VM
- User mode applications run on guest OS at lowest privilege level (domain-1 through domain-N)
- Manifests
- Window Manager aggregates virtual screens on the physical screen
- Browser instance is run on Xen Virtual MAchine

Tahoma Implementation on Xen



Tahoma Evaluation

- Safety and Effectiveness
  - Tahoma contained 95 out of 109 vulnerabilities in Mozilla (87% of the attacks)
- Performance overhead
  - Works well if pre-forked browser instance already exists
  - Cost of launching browser is high if no pre-forked instance

operation		average latency
Tahoma fork()	specialize a pre-forked browser instance	1.06 seconds
	clone a new VM, boot guest OS, launch browser program	9.26 seconds
native Konqueror open URL	load URL in running Konqueror	0.84 seconds
	warm-start Konqueror	1.32 seconds
	cold-start Konqueror	5.74 seconds

Related Work

- GreenBorder:
  - provides sandbox environment for IE and outlook
  - Virtualizes access to windows resources and redirect modifications to virtualized copies.
- Collective Project
  - Collections of applications within VMWare virtual machines
  - Ships above compute appliances over the network

Pros

- Novel approach – isolating web applications not only with user OS but also with other web applications
  - Better control for web services in defining policies through manifests
  - Prevents cross-site scripting attacks
- VM contain security vulnerabilities to one single browser instance
  - Even if the browser is compromised, it limits damage to one browser instance
  - E.g. Attack on SSL certificate management scheme

Pros

- Network policies protect web applications from compromised browsers
  - Protection against security holes in the browser
  - Prevents web application from sending information to a untrusted site (drive by download attacks – spyware infections)
- Secure sharing interface between web applications
  - Limit browser calls to Fork, BinStore, BinFetch
- Provides language independent safe execution environment for browser instances(VM)

Pros

- BOS kernel stores a set of VM checkpoints of freshly created stock browsers
  - Reduces the overhead in creating new browser instance
- Prevents phishing attacks to some extent using labelled borders

Cons of Implementation

- Increases complexity of web applications – More maintenance and required
- Manifest Issues:
  - Every web application will need a manifest created for them. Who will maintain them?
  - No mention of how manifests will be adopted
  - If manifest is incorrectly specified, web application will not work
  - Updating of manifest file may be problematic – Not dynamic

Cons of Implementation (contd)

- Does not prevent attacks from hi-jacked web applications:
  - Permissible browser unavailable, BOS relies on web service to supply URL of VM image
  - This VM image downloaded & executed- *This may be a hi-jacked phishing web application!*
- BinStore & BinFetch browser calls may be susceptible to format string vulnerabilities & buffer overflow attacks

Cons of Paper Content and Format

- Limited mention of the “trusted Tahoma tool” for transferring objects between the holding bin and the host OS
- Contradiction: “Most Apps will run on Tahoma with little or no modification. However, three kinds of modifications may be necessary …”

- Increases complexity of web applications – More maintenance and required

Cons of Paper Content and Format

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Q & A