Geoprocessing in the Web Browser

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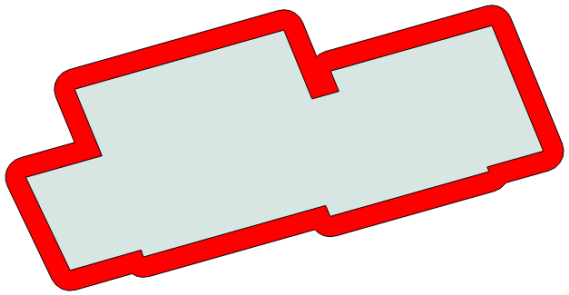
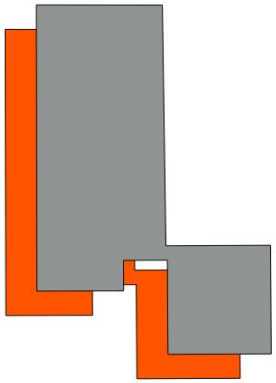
Introduction

Geoprocessing Operations

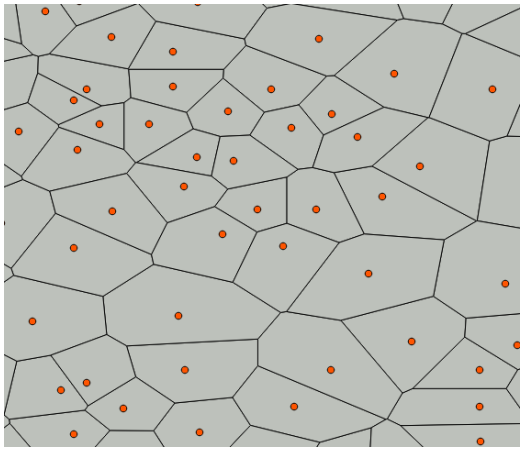
BUFFER



UNION

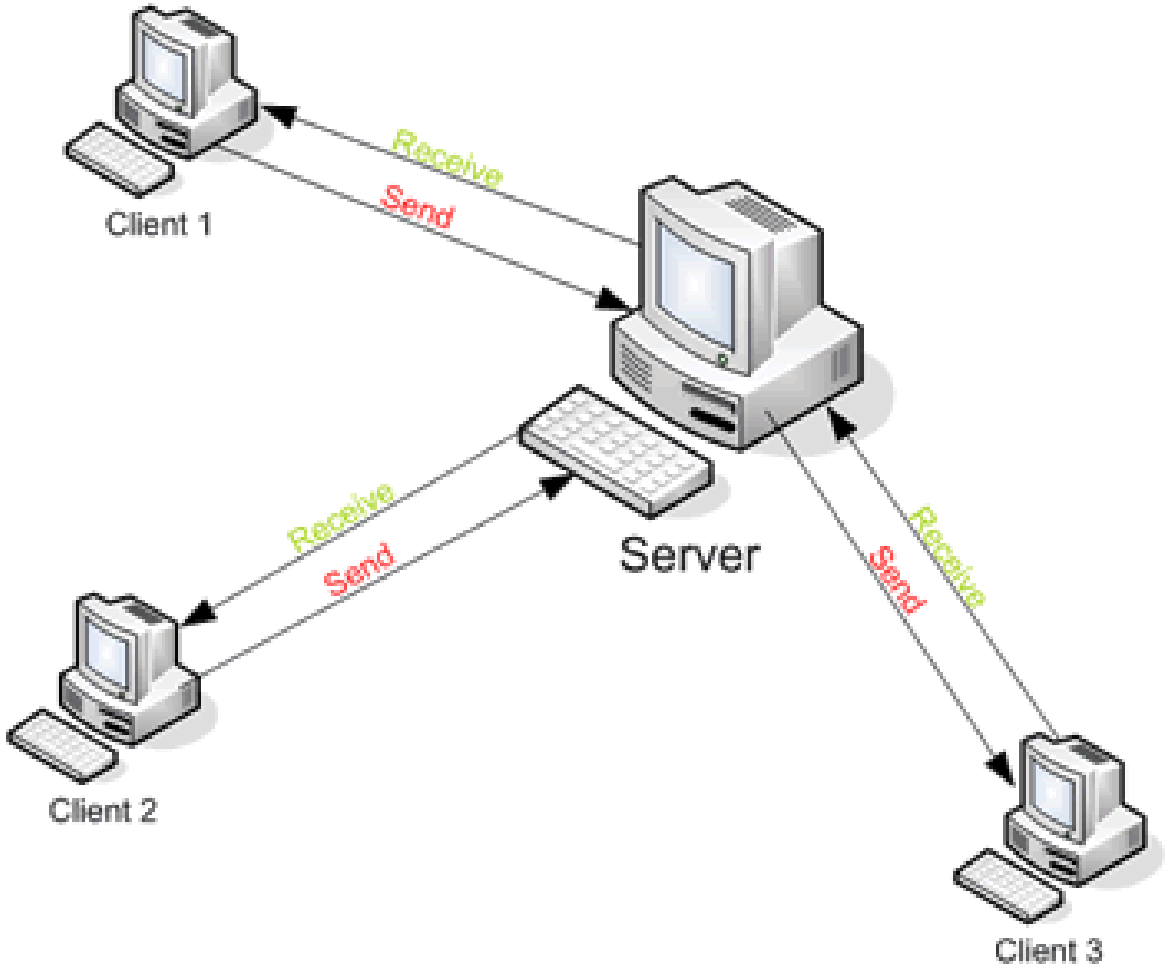


VORONOI DIAGRAMS

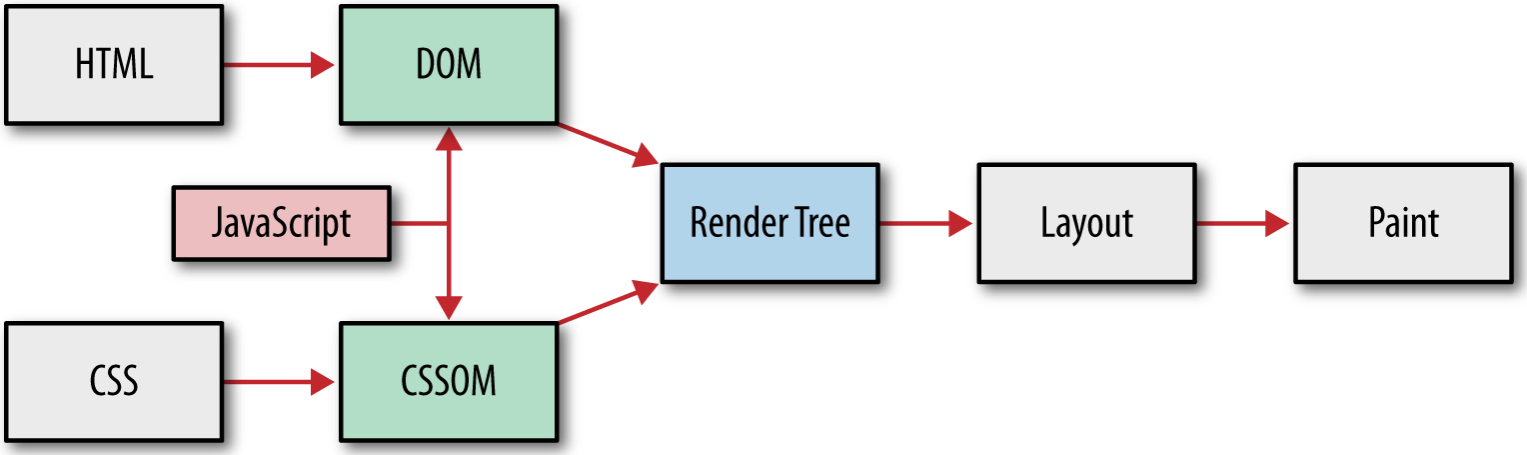


Michael Goodchild's *Towards an enumeration and classification of GIS functions* (1987), AAG's *GIS & Technology Body of Knowledge* (2006) and Jochen Albrecht's *Universal analytical GIS operations — a task-oriented systematization of data structure-independent GIS functionality* (1997).

Client-Server Model



A Tiny Bit about Browsers



High Performance Browser Network
http://chimera.labs.oreilly.com/books/1230000000545

http://www.html5rocks.com/en/tutorials/internals/howbrowserswork/

Web Browsers





Browser	Browser Version	JavaScript Engine	Developed By
Chrome	33	V8	Google
Opera	20	V8	Google
Firefox	27	SpiderMonkey	Mozilla
Internet Explorer	11	Chakra	Microsoft
Safari	6	SquirrelFish Extreme (SFX) aka Nitro	Webkit

JavaScript Mapping Libraries

Mapbox

JavaScript Geoprocessing

PUBLIC atlefren / **njord.js**

TURF
turf
a fast and fully featured open gis engine written in javascript

PUBLIC bjornharrtell / **jsts**

PUBLIC chelm / **shapely.js**

jQuery Geo
write less, map more

Geoprocessing Library

JTS Topology Suite → **JSTS Topology Suite**

Research Questions

1. How do the various web browsers compare in geoprocessing performance?

2. How do client computers with different operating systems, processors, and memory sizes compare in geoprocessing performance?

3. How do the various client test configurations compare to server-side geoprocessing performance?

4. Are client geoprocessing times in an acceptable range for incorporation into web applications?

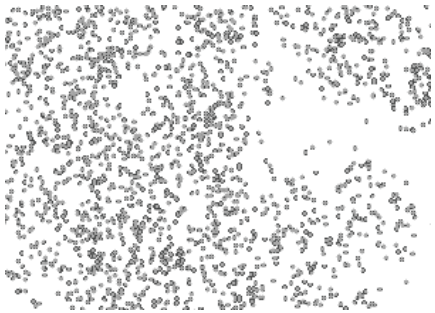
Methods

Testing Application Requirements

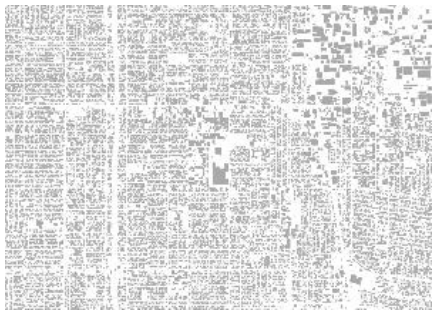
1. Common geoprocessing operations.
2. Suite of data sizes.
3. Common web browsers.
4. Various operating systems, processors, and memory sizes.
5. Same geoprocessing operations on a server for comparison.

Data – LA County GIS

ADDRESS POINTS



BUILDING FOOTPRINTS



ROAD CENTERLINES

10 Vertices – 100,000 Vertices

444 Bytes – 3.8 Megabytes

Natural Earth

Large scale data, 1:10m

Cultural | Physical | Raster

The most detailed. Suitable for making zoomed-in maps of countries and regions. Show the world on a large wall poster.

1:10,000,000
1″ = 158 miles
1 cm = 100 km

50,000+ vertices

Medium scale data, 1:50m

Cultural | Physical | Raster

Suitable for making zoomed-out maps of countries and regions. Show the world on a tabloid size page.

1:50,000,000
1″ = 790 miles
1 cm = 500 km

10,000 - 50,000 vertices

Small scale data, 1:110m

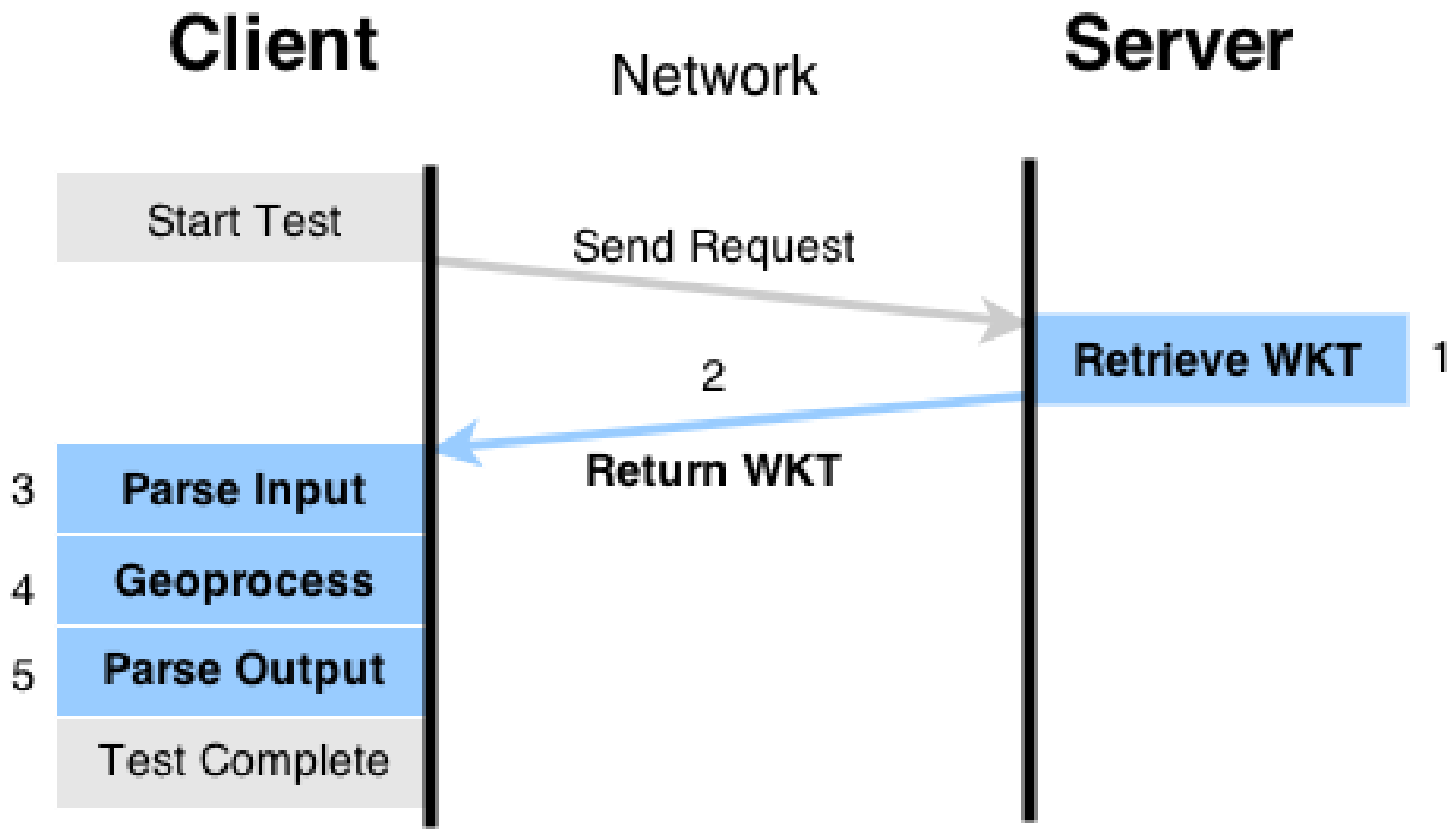
Cultural | Physical

Suitable for schematic maps of the world on a postcard or as a small locator globe.

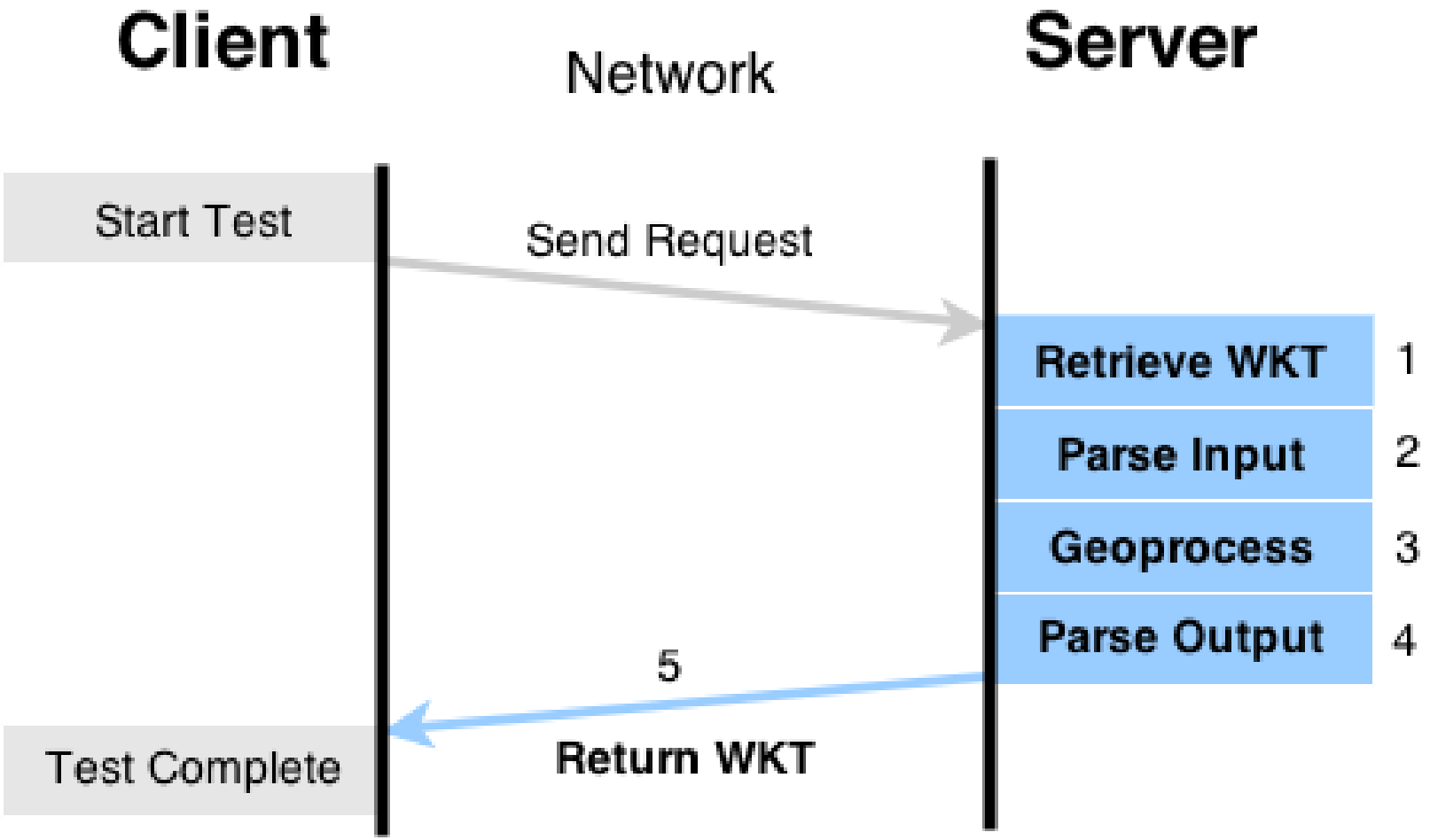
1:110,000,000
1″ = 1,736 miles
1 cm = 1,100 km

10 - 10,000 vertices

Client – JavaScript Libraries


Client
Network
Server
Start Test
Send Request
Retrieve WKT
1
2
Return WKT
3
Parse Input
4
Geoprocess
5
Parse Output
Test Complete

Server – Amazon EC2 Linux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Web Browsers





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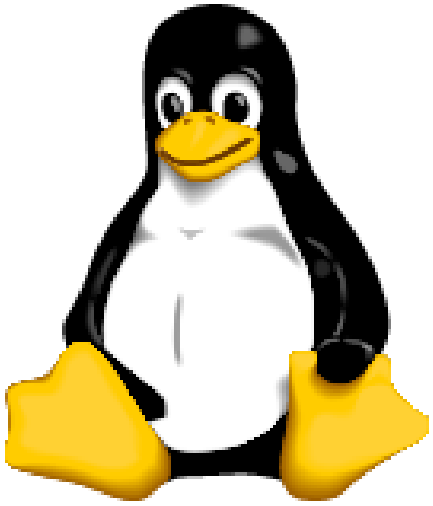
Safari	6	SquirrelFish Extreme (SFX) aka Nitro	Webkit

Client – Testing Platforms



Performance Measure

Faster processing times (milliseconds) == better performance

Browser unresponsive scripts, timeouts, crashing.

Performance determined by web usability metric:

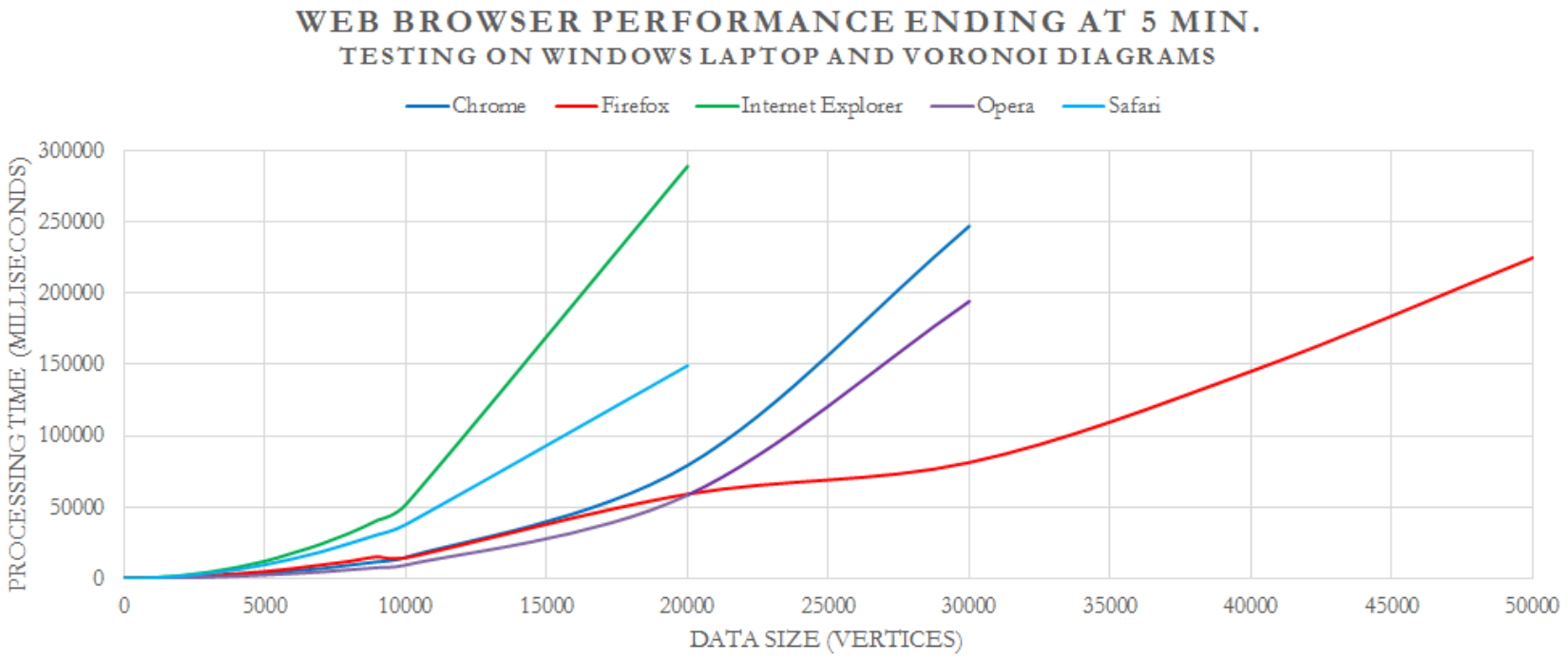
1,000 Milliseconds
10,000 Milliseconds*

*Grigorik, Ilya. *High-performance Browser Networking*. Sebastopol, CA: O'Reilly Media, Inc., 2013.

Results & Discussion

How do various web browsers compare in geoprocessing performance?

Web Browsers



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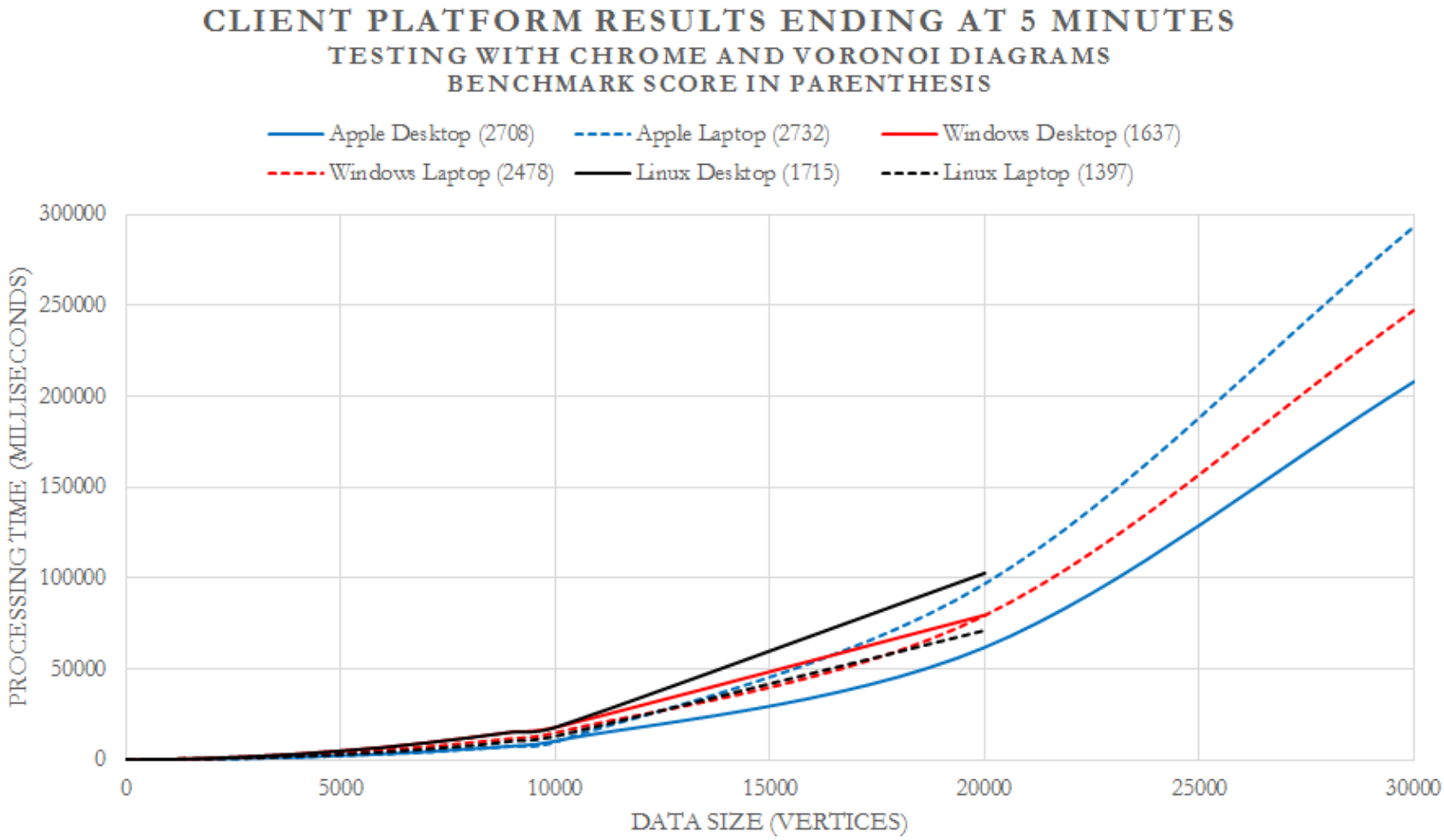
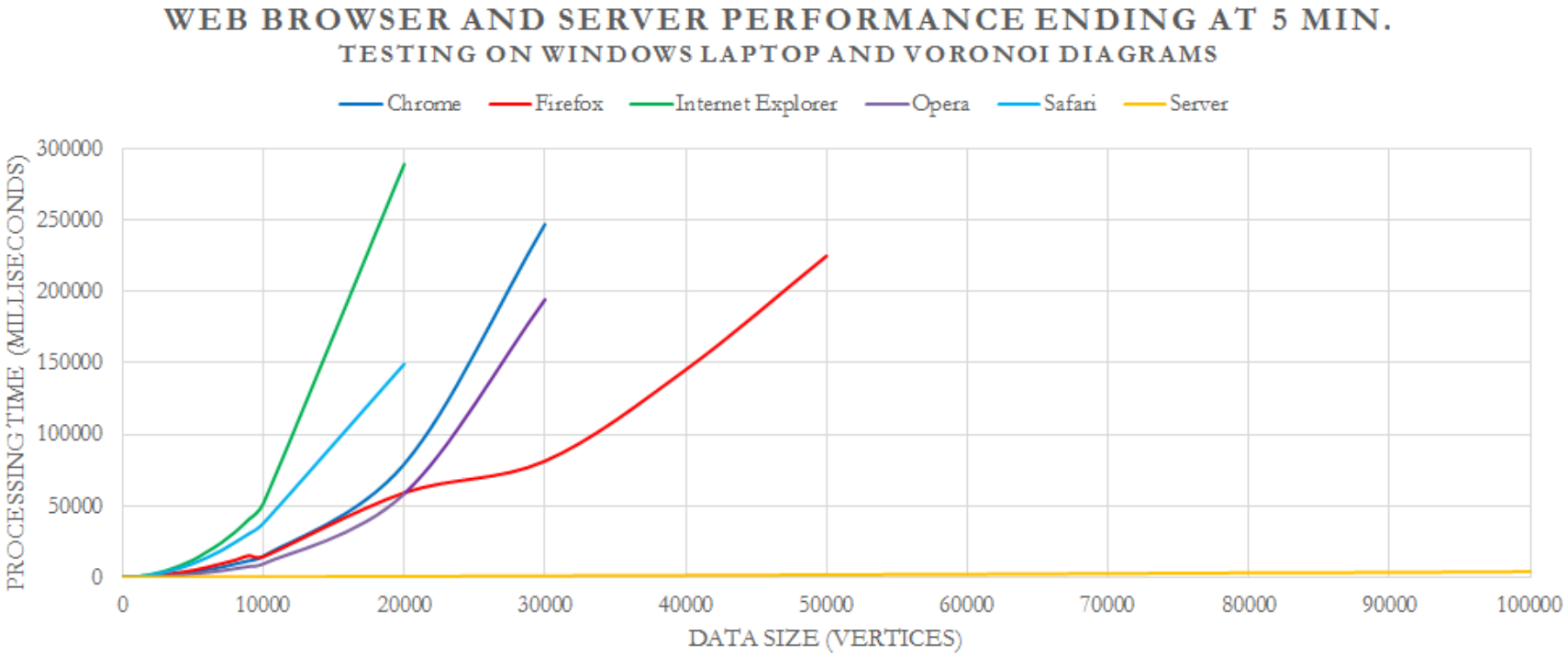
Client Platforms

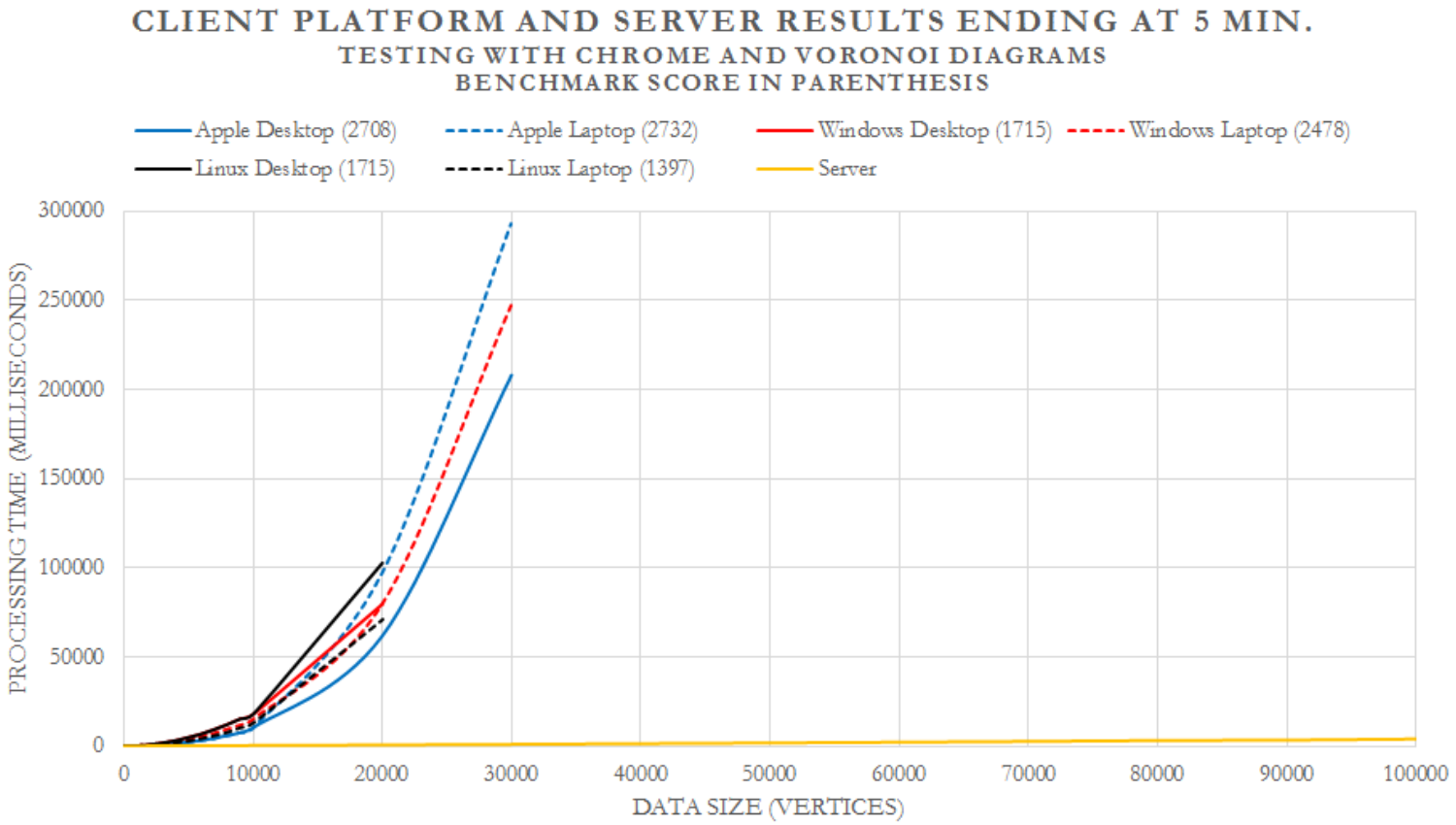


How do the various client test configurations compare to server-side geoprocessing performance?

Browsers vs Server

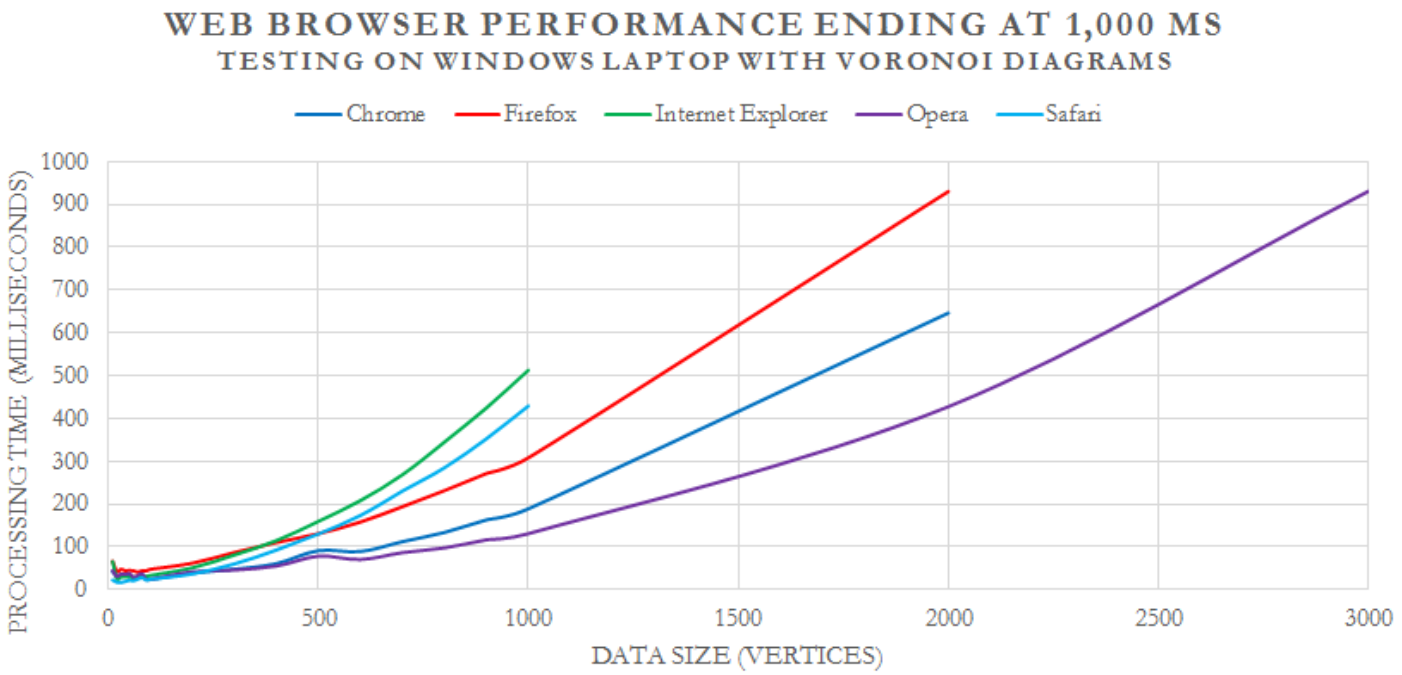


Client Platforms vs Server



Are client geoprocessing times in an acceptable range for incorporation into web applications?

Web Browsers



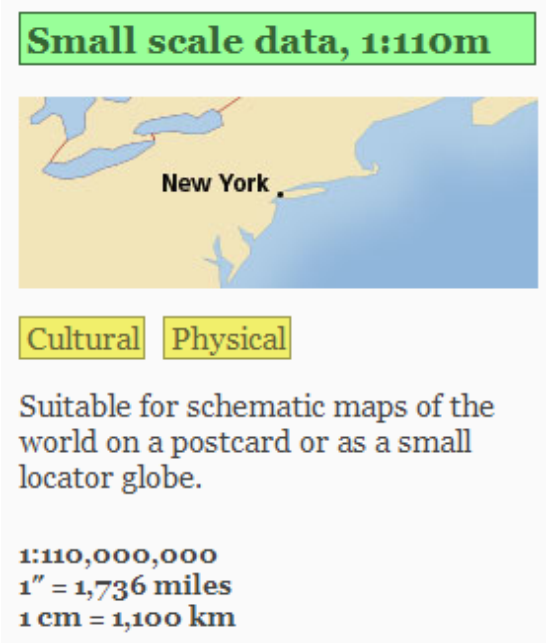
Browser	1 sec (vertices)	1 sec (kb)	10 sec (vertices)	10 sec (kb)
Chrome	2000	80	8000	318
Opera	3000	119	10000	398
Firefox	1000	40	7000	278
Internet Explorer	1000	40	4000	159
Safari	1000	40	5000	199

Conclusion

The server was faster than the client in all testing scenarios. *

*Single User

Web browsers limited to data about 7,000 to 10,000 vertices



Thank you!

Special thanks to the Trewartha Research Grant

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Appendix

Client – Testing Platforms

Brand	Operating System (OS)	OS Version	Processor	CPU (GHz)	Memory (GB)
Lenovo Y480	Windows	7 Home Premium Service Pack 1 (64-bit)	Intel(R) Core(TM) i7-3610QM	2.3	8
Lenovo T61	Linux Mint	16 "Petra" Cinnamon (32-bit)	Intel Centrino Core 2 Duo CPU	2.5	6
MacBook Pro	Mac OS X	10.7.5	Intel Core i7	2.8	8
MacMini	Mac OS X	10.9.1	Intel Core i7	2.3	4
Custom Built	Linux Mint	13 "Maya"	2x Intel(R) Core(TM)2 Duo CPU	3.0	8