the Availability Digest

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The Big One - Are You Ready?

September 2015

Is it safe to build a datacenter on the Ring of Fire, that line of earthquakes and volcanos that surrounds the Pacific Ocean? So far, this has not been a problem. But that is about to change. We are well overdue for the mother of all earthquakes. The culprit? - the Cascadia Subduction Zone. If you have a data center in this area, it may be time to prepare for its extinction.

The Ring of Fire

The Ring of Fire, shown in Figure 1, is a 25,000-mile horseshoe-shaped line stretching from the southwestern tip of South America up along the western coast of North America, then along eastern Asia, curling east of Australia, and terminating in New Zealand. It is home to over 75% of the earth's volcanos. It accounts for about 90% of the world's earthquakes and 81% of the world's worst earthquakes: Japan, 2011, magnitude 9.0; Indonesia, 2004, magnitude 9.1; Alaska, 1964, magnitude 9.2; Chile, 1960, magnitude 9.5.

Ring of Fire
Figure 1

The Ring of Fire is a ring of subduction zones. A subduction zone is a region of the planet where one tectonic plate is sliding underneath another ("subduction"). Tectonic plates are those slabs of mantle and crust that, in their epochs-long drift, rearrange the earth's continents and oceans. Most of the time, their movement is slow, harmless, and all but undetectable. Occasionally, at the borders where they meet, it is not. Nearly all the earthquakes in the region are caused by continental plates getting stuck on oceanic plates and then getting abruptly unstuck.

The Richter Scale

The Richter scale is a measurement of the power of an earthquake. It is a logarithmic scale. An earthquake that is 7.0 on the Richter scale is ten times more powerful than a 6.0 earthquake and one hundred times more powerful than a 5.0 earthquake. A 5.0 earthquake can be felt and will rattle the dishes in a cupboard. An 8.0 earthquake can cause major damage, but most modern buildings in earthquake-prone zones are built to withstand an earthquake of this magnitude. A 9.0 earthquake is

highly devastating and will cause significant damage, no matter what steps have been taken to mitigate earthquake damage.

Equally destructive are the tsunamis that often accompanies earthquakes that have occurred in the ocean floor. Tsunamis can wash ashore with waves over one hundred feet tall, destroying everything in their path.

In 2011, Japan suffered a 9.0 earthquake. The resulting tsunami washed across northern Japan and killed more than eighteen thousand people. It triggered the meltdown at the Fukushima power plant

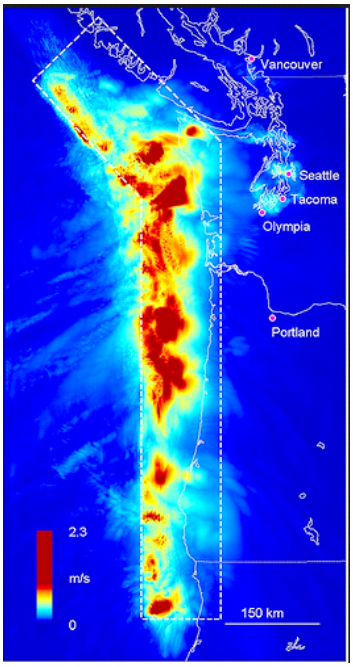
The San Andreas Fault

Most people in the United States are very aware of the San Andreas Fault, the most active subduction zone in the U.S. It extends roughly 800 miles through California and is formed by the tectonic boundary between the Pacific Plate and the North American Plate. Over the years, it has spawned many large earthquakes in the 6.0 to 7.0+ range (with the largest ones in recent history being the 7.9 earthquake in 1857 and the famous 7.8 San Francisco earthquake in 1906).

Many worry that the San Andreas fault is on the verge of unleashing the "big one." However, seismologists do not believe that this will happen. Every fault line has an upper limit to its potency as determined by its length and width and by how far it can slip. For the San Andreas fault, that limit is roughly an 8.2 earthquake, only six percent as strong as the 2011 9.0 Japanese earthquake (due to the logarithmic nature of the Richter scale).

The Cascadia Fault

Though the San Andreas fault may not be the source of the "big one," seismologists deem that the Cascadia fault is deemed likely to be. Looking at Figure 1, which shows the location of major earthquakes along the Ring of Fire, you may note that the Pacific Northwest of North America seems to have been spared. Should we then conclude that this is an area that is immune to large earthquakes? No, quite the contrary.



The Cascadia Subduction Zone
Figure 2

This is the Cascadia Subduction Zone. It runs for seven hundred miles off the coast of the Pacific Northwest, beginning near Cape Mendocino, California, continuing along Oregon and Washington, and terminating around Vancouver Island, Canada (Figure 2). Its "Cascadia" name comes from the Cascade Range, a chain of volcanic mountains that follow the same course a hundred or so miles inland. The Cascadia fault is caused by the subduction of the Jaun de Fuca plate under the North American plate. Yet not once in recorded history has the Cascadia fault spawned a major earthquake – or for that matter, any quake to speak of.

This is not because there is no plate movement in the Cascadia Subduction Zone. It is because the plates are *really* stuck, pushing against each other, with neither moving. When they do finally let loose, that is when the "big one" will happen.

We seem to be well overdue for the Cascadia "big one." Based on deep-soil research, we now know that the Cascadia fault has unleashed forty-one massive earthquakes in the last 10,000 years. That is an average of one every 244 years.

The last Cascadia earthquake was in 1700, long before the U.S. expanded to the west coast (Canada wasn't even a nation then). No one was around to document its devastation. It has been over 300 years

since this last earthquake. At an average time between earthquakes of 244 years, we are overdue for the "big one."

Will the "big one" happen a hundred years from now? Will it happen tomorrow? Seismologists give odds of a big Cascadia earthquake happening in the next fifty years as roughly one in three. The odds of a very big one are roughly one in ten.

The Big One

Seismologists describe the effects of the "big one" in a very terrifying way. The first sign that the Cascadia earthquake has begun will be compressional waves radiating out from the fault line. These are high-frequency waves audible to dogs but not to humans. The result will be a cacophony of barking dogs. Then the shaking will begin. The northwest edge of the continent, from California to Canada, will drop as much as six feet, losing within minutes all the elevation it has gained over the last many centuries.

A Tsunami
Figure 3

Some of that shift will take place under the ocean, displacing a massive quantity of seawater. The resulting one-hundred foot tsunami will reach the Northwest coast about fifteen minutes later. By the time the shaking has stopped and the water has receded, the region will be unrecognizable. FEMA, the U.S. Federal Emergency Management Agency, predicts that everything west of Interstate 5 will be gone.

The Oregon Seismic Safety Policy Advisory Commission (OSSPAC) estimates that it will take between one to three months to restore electricity to the Interstate-5 corridor. It will take one month to a year to restore drinking water and sewer service, six months to restore major highways, and eighteen months to restore health-care facilities. These estimates do not apply to the tsunami-inundation zone, which will remain uninhabitable for years.

Where Is Your Data Center?

If your organization has a data center in the Cascadia Subduction Zone, now is the time to plan for its extinction. You have several options. The obvious one is to back it up with one or more other data centers – most large organizations probably already do this. However, in this case, keep your disaster recovery plan updated and well tested. You will probably have to fail over all processing from the failed data center to other surviving data centers, and mission-critical applications may require that this be done in minutes.

If you have only one data center, plan on moving it out of the subduction zone and to high ground – several hundred feet above sea level, at least.

You may not need these precautions for the next hundred years. On the other hand, you may need them tomorrow.

Summary

The Pacific Northwest of North America has seen little in the way of earthquake activity over the two-hundred years or so that it has been settled. This can lull us into a sense of security that it is an earthquake-safe area. Nothing can be further from the truth.

The area has seen little earthquake activity because the tectonic plates in the Cascadia Subduction Zone upon which it rests are pushing harder and harder against each other without moving. At some point, this

pressure will release; and the tectonic plates will rush into new positions. This will generate an earthquake that may well represent the worst disaster in North American history.

A wide swath of the upper Northwest coast will be demolished, including any data centers that may be located there. Now is the time for your organization to plan how it will handle this disaster. Otherwise, once the “big one” hits, your organization may simply disappear.

Acknowledgements

Unlocking the Cascadia Subduction Zone's secrets: Peering into recent research and findings, *Earth*; July 20, 2014.
The Really Big One, *New Yorker*; July 20, 2015.
Cascadia Subduction Zone: Mega Earthquake Predictions for 2015 are Megaquake Crazy?, *Inquistr*; July 23, 2015.