

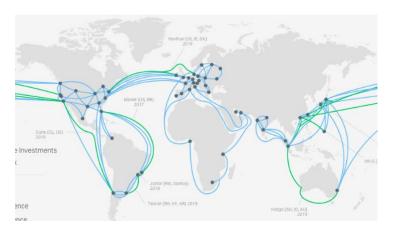
EdgeNet: A Lightweight, Scalable Edge Cloud

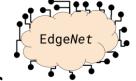
Rick McGeer April 16, 2019









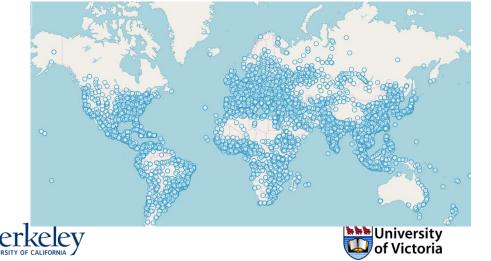


The Cloud as it is

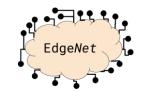


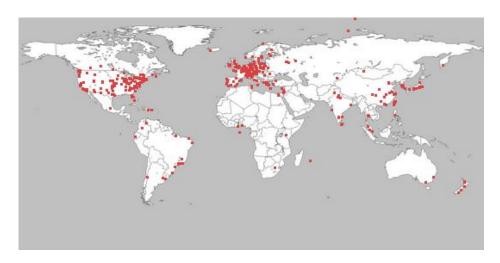
EdgeNet: the Cloud as it will be





PlanetLab: The First Edge Cloud





- Peak: 1353 nodes at 717 sites worldwide
- Invented the concepts of a "slice" and "sliver"
- Over 150 publications at top-5 venues in 5 years!

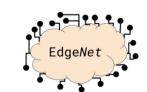
- Container-based infrastructure
- Sliver: standard container at site
- Slice: network of containers









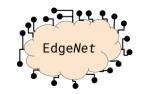








What Killed It?



- Hardware cost: \$800K/year just to maintain PL hardware
- Lack of central support
 - Maintaining distributed hardware infrastructures is expensive
 - \$5K-\$15K/site/year
- Lack of onsite support
 - Research boxes aren't a local admin's day job
 - Hardware replacement/installation are slow, networks reassigned...
- Custom software/control stack
 - Maintenance, documentation, training burden without value-add

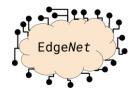
Bottom Line: \$10,000 site/year (PlanetLab); \$50,000 site/year (GENI)







Four Big Takeaways



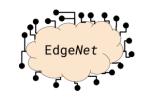
- CS Funding Agencies don't do maintenance
 - Set up to fund 3-5 year projects, grad students
- Hardware is heinous
 - Breaks and needs fixing
 - Bulk of the cost of both onsite and centralized support
 - PlanetLab reached its maintenance limit
- Don't write software unless you're actually adding value
 - If industry-standard stuff works, use it
 - Free maintenance
 - Free tutorials/answers/educational material
- Be as cheap and easy as possible for local sites







Successful Infrastructures Live Off The Land

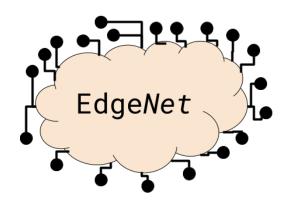


- Use local resources
- Spread by local action: software download and configuration
- Ex: Internet used existing computers, phone lines
- Ex: Web used *existing* Internet and services
 - FTP
 - Nine-line shell script was first web server!









"Hello, World" around the world in 5 minutes



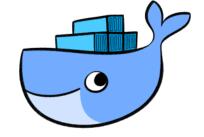
~\$0 per-site maintenance



zero-touch install

Third-party tools
Copious documentation





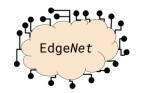


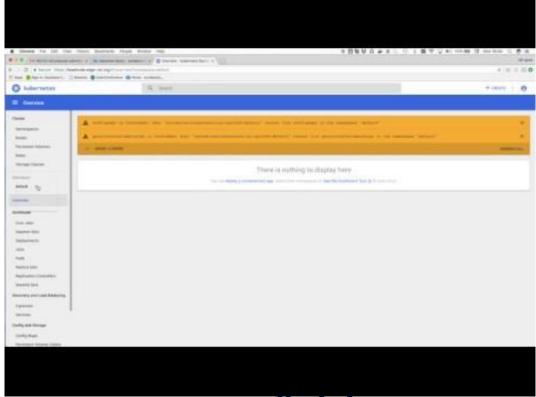






Hello, World, Around The World!



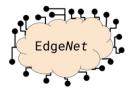








Add A Node in 1 Minute!



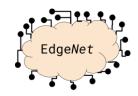
```
ug to unpack .../kubelet 1.10,5-00 amd64.deb ...
g kubelet (1.10.5-00) ...
g previously unselected package kubectl.
 to unpack .../kubectl 1.10.5-00 and64.deb ...
g kubectl (1.10.5-00) ...
 previously unselected package kubeads.
g to unpack .../kubeadm 1.10.5-00 and64.deb ...
g kubeadm (1.18.5-00) ...
ng triggers for man-db (2.7.5-1) ...
ng triggers for ureadahead (0.180.0-19) ...
ng triggers for systemd (229-4ubuntu21.1) ...
up docker.io (17.03.2-Oubuntu2-16.04.1) ...
up kubernetes-cni (0.6.0-00) ...
up kubelet (1.10.5-00) ...
up kubectl (1.10.5-00) ...
up kubeadn (1.10.5-00) ...
te name (site.edge-net.io): cornell
   % Received % Xford Average Speed Time
                                                          Time Current
                                   0 0:00:03 0:00:03 --:--:--
 join 142.104.71.105:6443 --token xe6tfh.lwmgngte0g9gogku --discovery-token-ca-cert-hash sha256:0ce6le6e0443ae255c9f7
kip-preflight-checks has been deprecated, it is now equivalent to --ignore-preflight-errors-all
ht] Running pre-flight checks.
 [MARNING Hostname]: hostname "cornell.edge-net.io" could not be reached
 WARNING Hostname1: hostname "cornell.edge-net.io" lookup cornell.edge-net.io on 192.122.236.68:53: no such host
 WARNING FileExisting-crictl]: crictl not found in system path
on: go get github.com/kubernetes-incubator/cri-tools/cmd/crictl
ry] Trying to connect to API Server "142.104.71.105:6443"
ry] Created cluster-info discovery client, requesting info from "https://142.184.71.185:6443"
```







EdgeNet Today



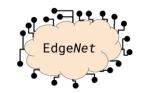








What's Left to Build?



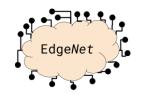
- Everything!
 - 150+ papers in top-five conferences in first five years of PlanetLab
 - Almost all about building services and utilities on/for PlanetLab
- We need the same thing!
 - Tons of things to do...







Clouds, CloudLab, EdgeNet



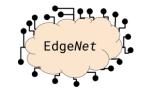
	Familiar UI	High Scalability	Deep Access	Laboratory Conditions	Wide-Area Deployment
Commercial Cloud	~		×	×	×
CloudLab	×	×	✓	~	×
EdgeNet	✓	×	×	×	✓







Thanks to Collaborators







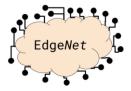


Eric Allman, Hadi Bannazadeh, Ilya Baldin, Andy Bavier, Andi Bergen, Mark Berman, Ketan Bhardwaj, Sushil Bhojwani, Marshall Brinn, Justin Cappos, Yvonne Coady, Chip Elliott, Timur Friedman, Sudhakar Ganthi, Ada Gavrilovska, Jim Griffoen, Matt Hemmings, John Kubiatowicz, Al Leon-Garcia, Thomas Lin, Ken Lutz, Sean McGeer, Nitesh Mor, Hausi Muller, Aki Nakao, Pat O'Connell, Riz Panjwani, Tom Mitchell, Larry Peterson, Albert Rafetseder, Glenn Ricart, Rob Ricci, Ciro Scognagmiglio, Robert Taylor, Ulrike Stege, Vic Thomas







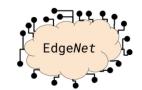


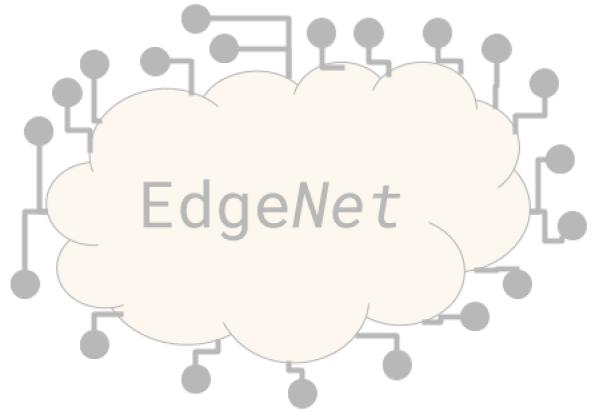
https://www.edge-net.org

















"Any opinions, findings, conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the Networking and Information Technology Research and Development Program."

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