

Towards Real-World Deployment of Cloudlets

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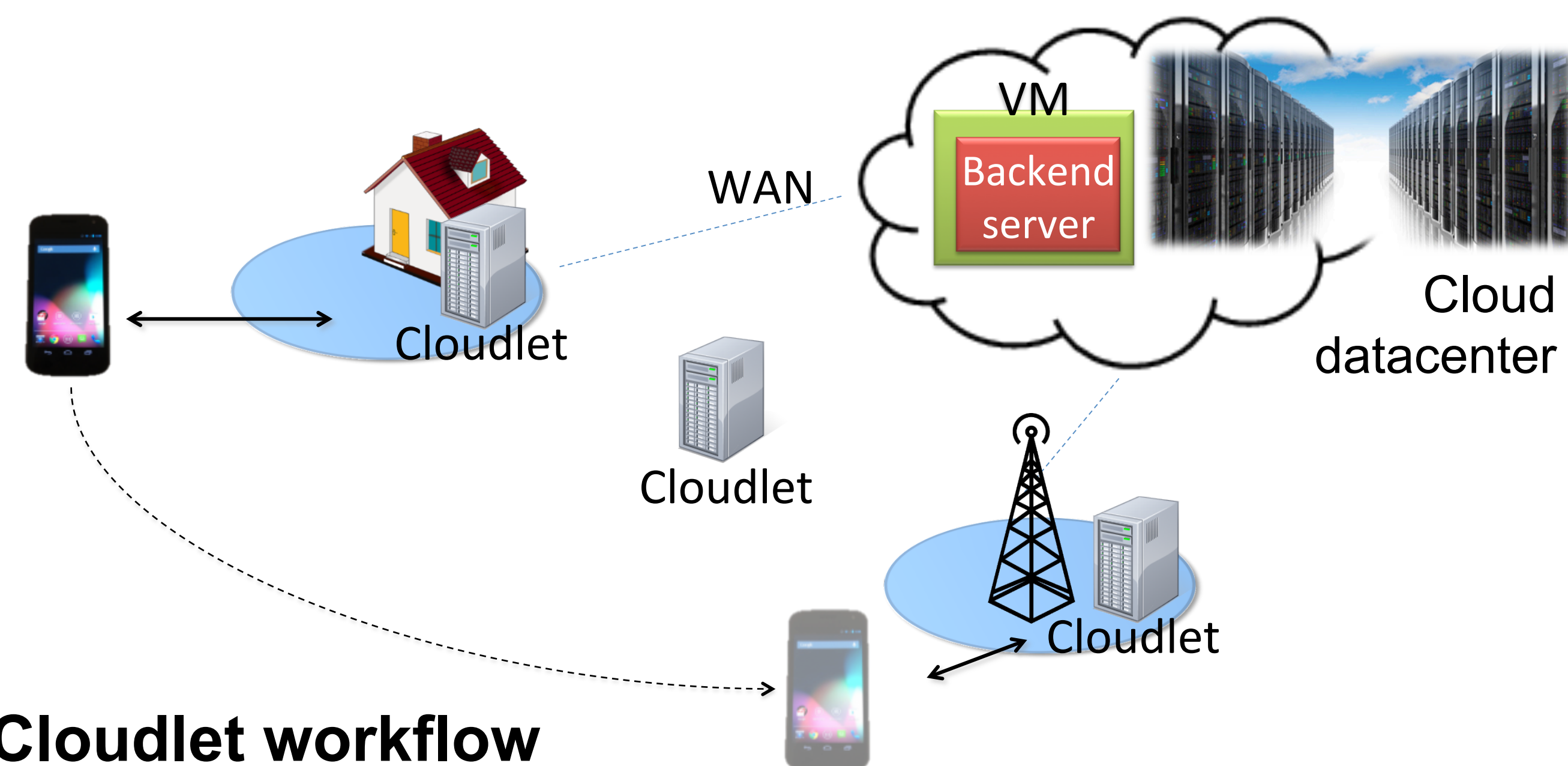
Motivation

- Conventional Cloud is not enough for rich/interactive applications due to high latency and low bandwidth
- Cloudlets provide Cloud-like capabilities near the mobile users

Cloudlets bring the Cloud closer to the user



Cloudlet-specific Features



Cloudlet workflow

- Cloudlet Discovery:**
Cloudlets by definition are dispersed at the edge of the Internet. Need a mechanism to find a nearby cloudlet.
- Rapid Just-in-Time Provisioning:**
Not practical & scalable to pre-provision every cloudlet with every software. Need to provision on demand.
- VM Handoff across WAN:**
What if a mobile user wanders away from the cloudlet?

Discover! Provision! Handoff!

Increasing Cloudlet Mindshare

Academic Research

- Citation count is rapidly increasing
- Papers at MobiSys, IEEE Pervasive Computing, HotMobile, etc.
- Not just our own papers!
- New Symposium on Edge Computing

The case for vm-based cloudlets
M Satyanarayanan, P Bahl, R Caceres... - F
OCTOBER–DECEMBER 2009 PERSVASIVE
hardware. 1 At any given cost and level of te
battery life, ergonomics, and heat dissipatio
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MOBILE EDGE COMPUTING



Industry influence

- Mobile Edge Computing
 - Industry initiative to standardization edge computing (hardware) for cellular networks
 - MEC congress: <http://meccongress.com>
 - Intel, Huawei, Vodafone, Nokia, IBM, NTT DoCoMo, ...
- Open Edge Computing (OEC): New Industry + Academy initiative for open-source Cloudlet software

Cloudlet concept gaining acceptance from academia and industry

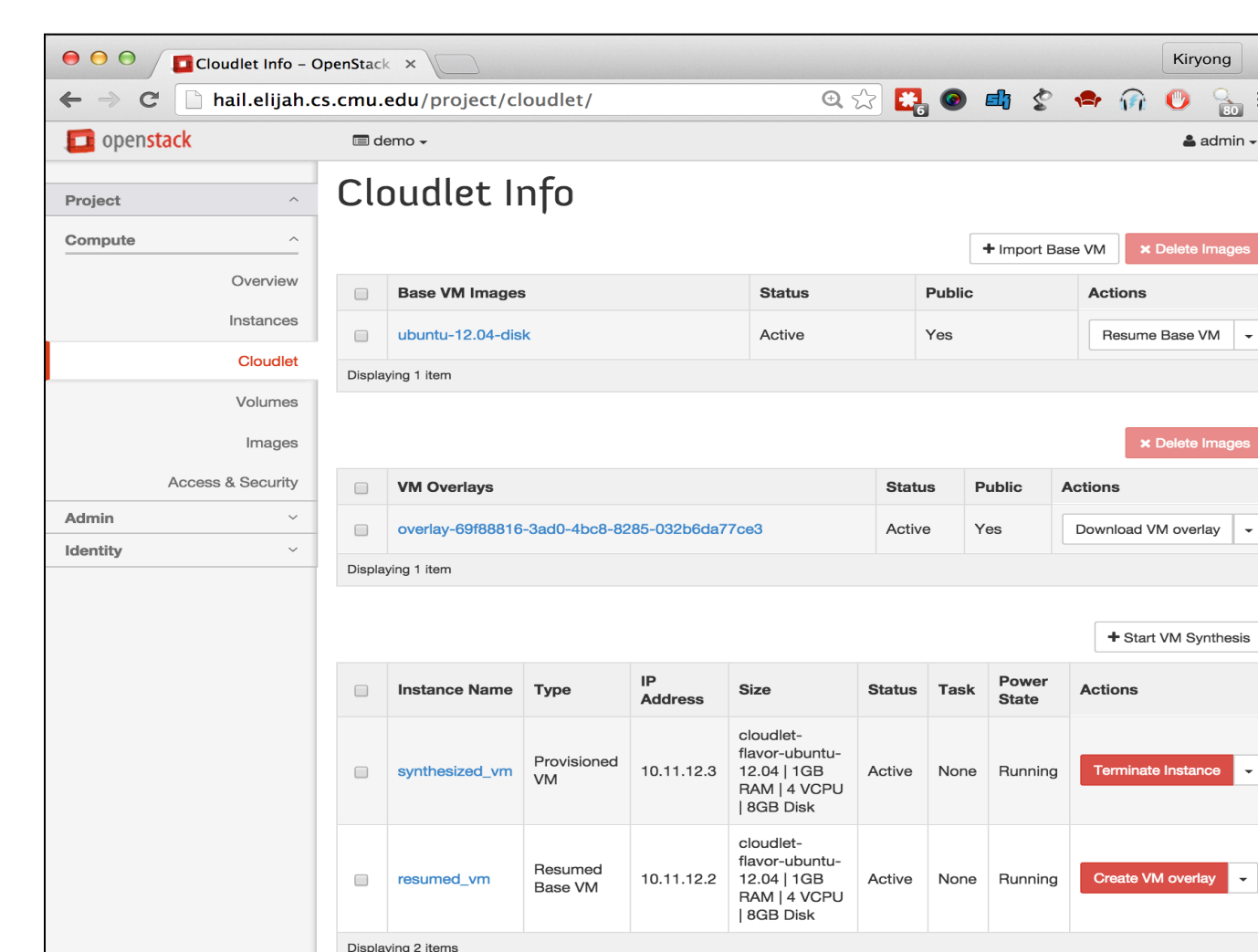
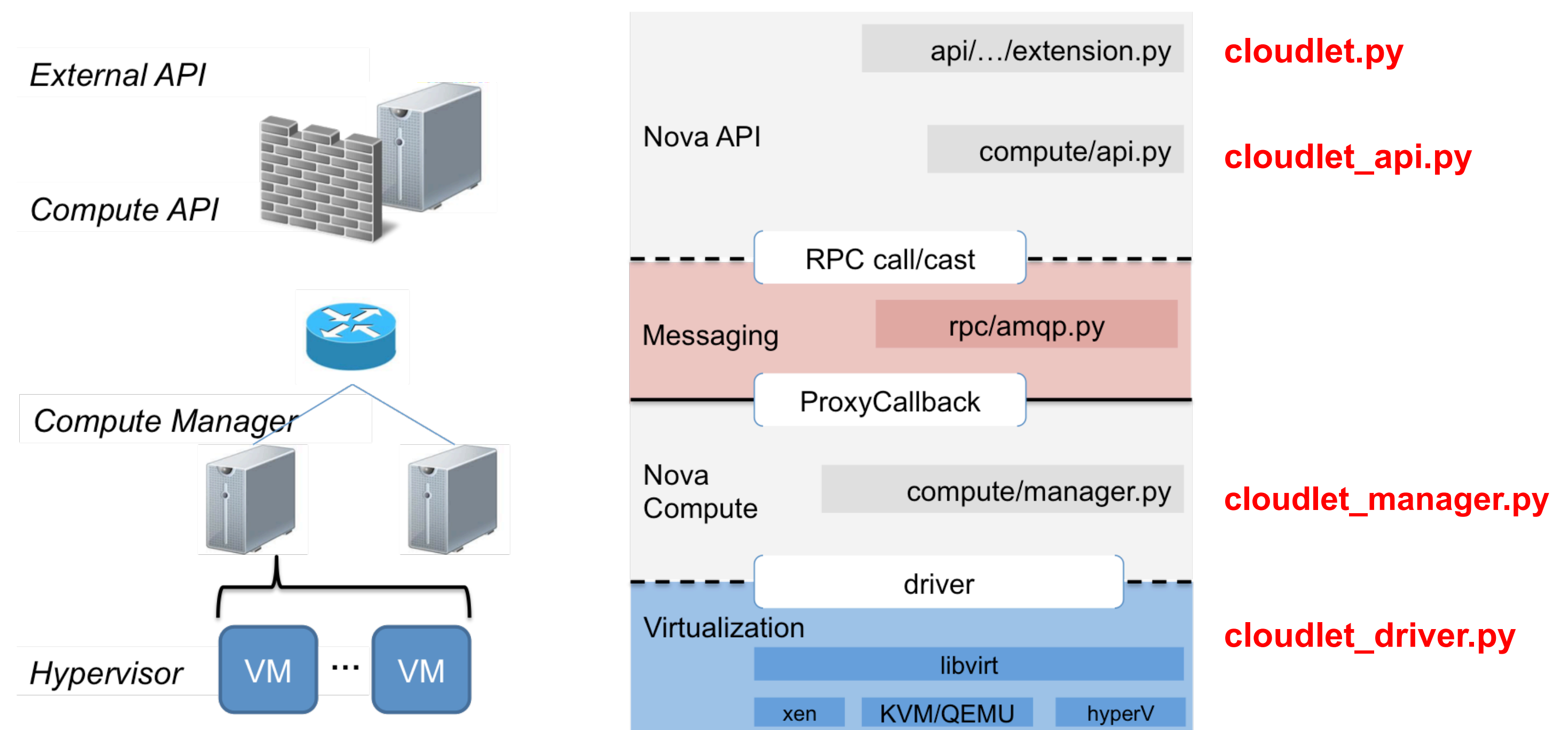
Bootstrapping Deployment

- Classic bootstrapping problem
 - Need practical applications to incentivize cloudlet deployment
 - Developers cannot rely on a cloudlet infrastructure
- OpenStack++: Cloudlet-extended OpenStack
 - Leveraging an open ecosystem for cloud computing
 - Anyone who uses OpenStack for cloud can easily use cloudlets
 - Systematic way to expedite cloudlet deployment

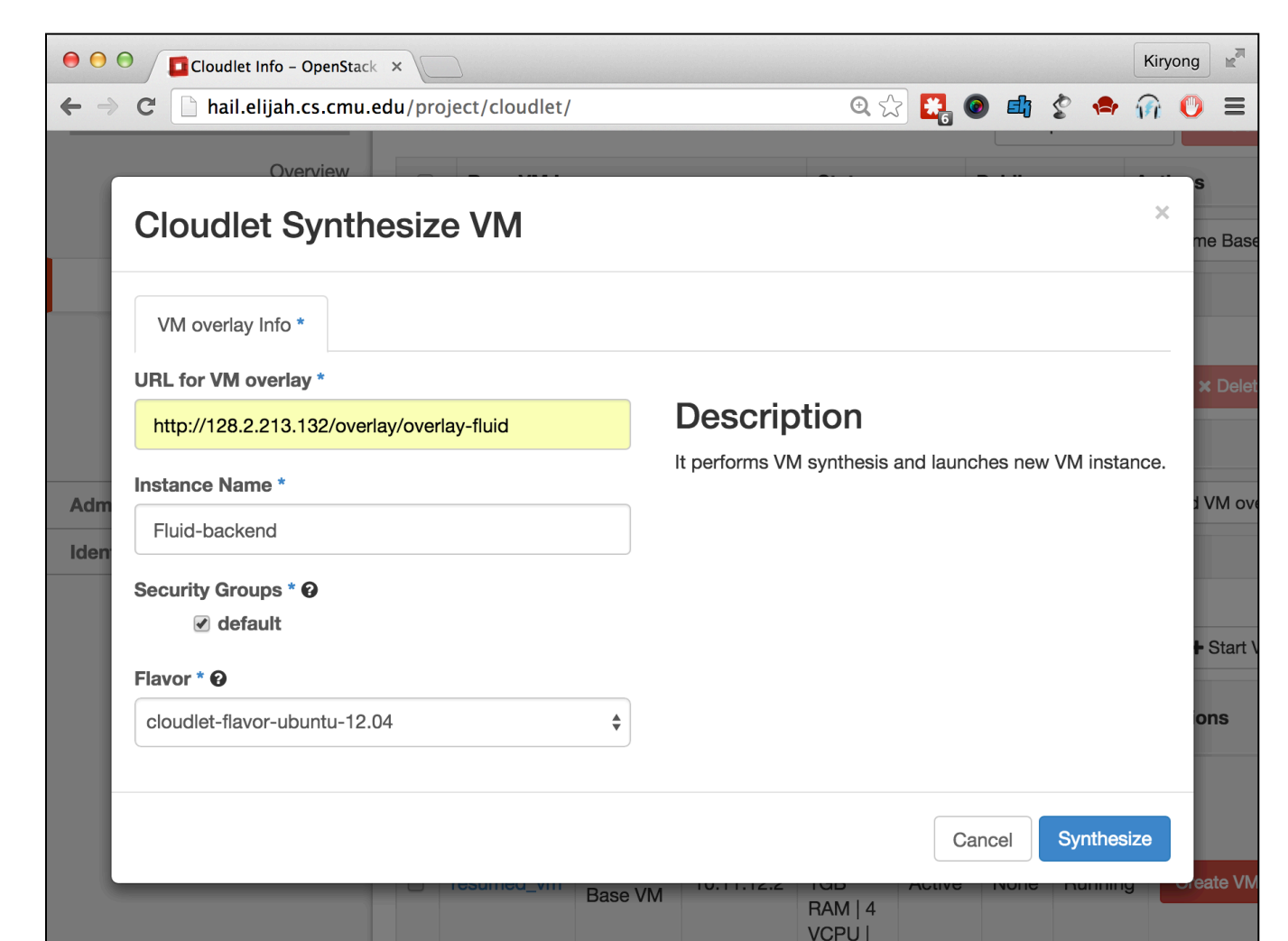
Leverage OpenStack to expedite Cloudlet deployment

OpenStack++: Cloudlet Extension

- New features: 1) Rapid Provisioning 2) Adaptive handoff
- Design Principles
 - Modular Approach using Extension mechanism
Minimize maintenance despite the rapid OpenStack release cycle
 - Support both OpenStack++ and standalone version
For accurate performance measurement and easy debugging



Cloudlet Panel in Dashboard



UI for VM Provisioning

Successfully integrated Cloudlet capability into OpenStack Kilo

Future Plans

- Distribute to early adopters. Code is available at: <https://github.com/cmusatyalab/elijah-openstack>
- Intel-supplied Wi-Fi cloudlets for CMU class projects (Fall 2015)
- Merge into OpenStack upstream