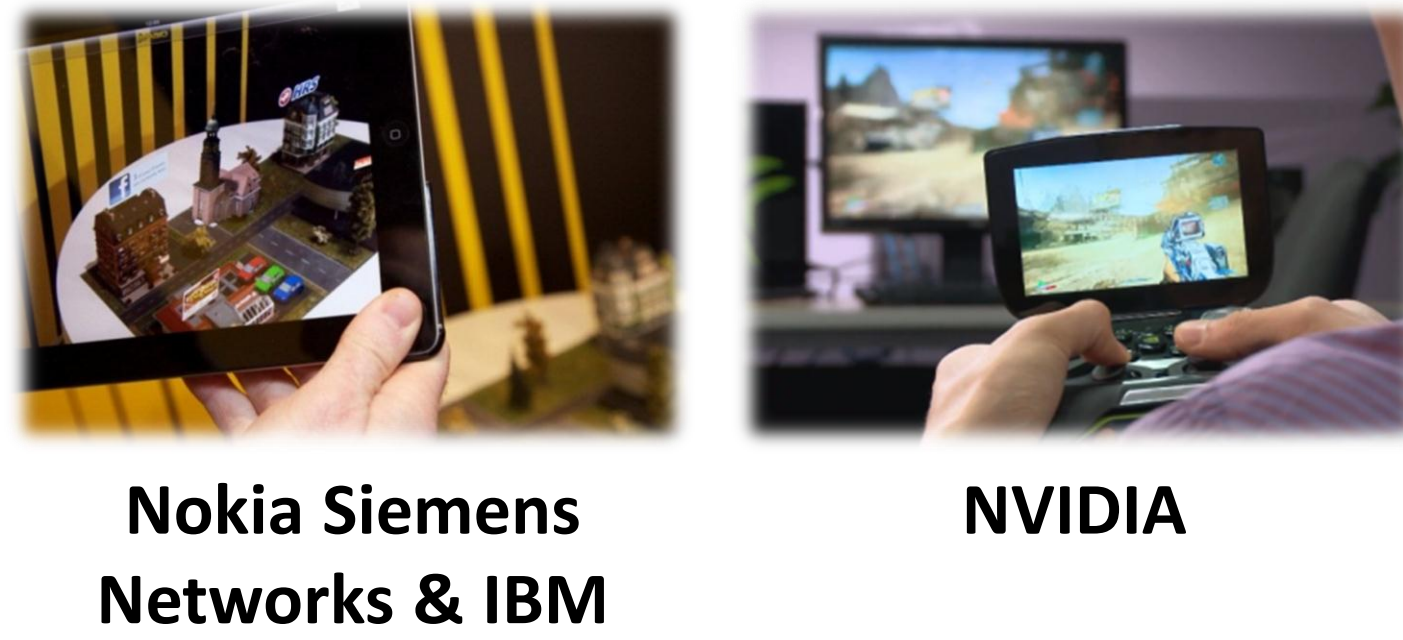# OpenStack++ for Cloudlets

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MOTIVATION

- Today's cloud is a suboptimal offloading place for rich/interactive applications due to high latency low bandwidth

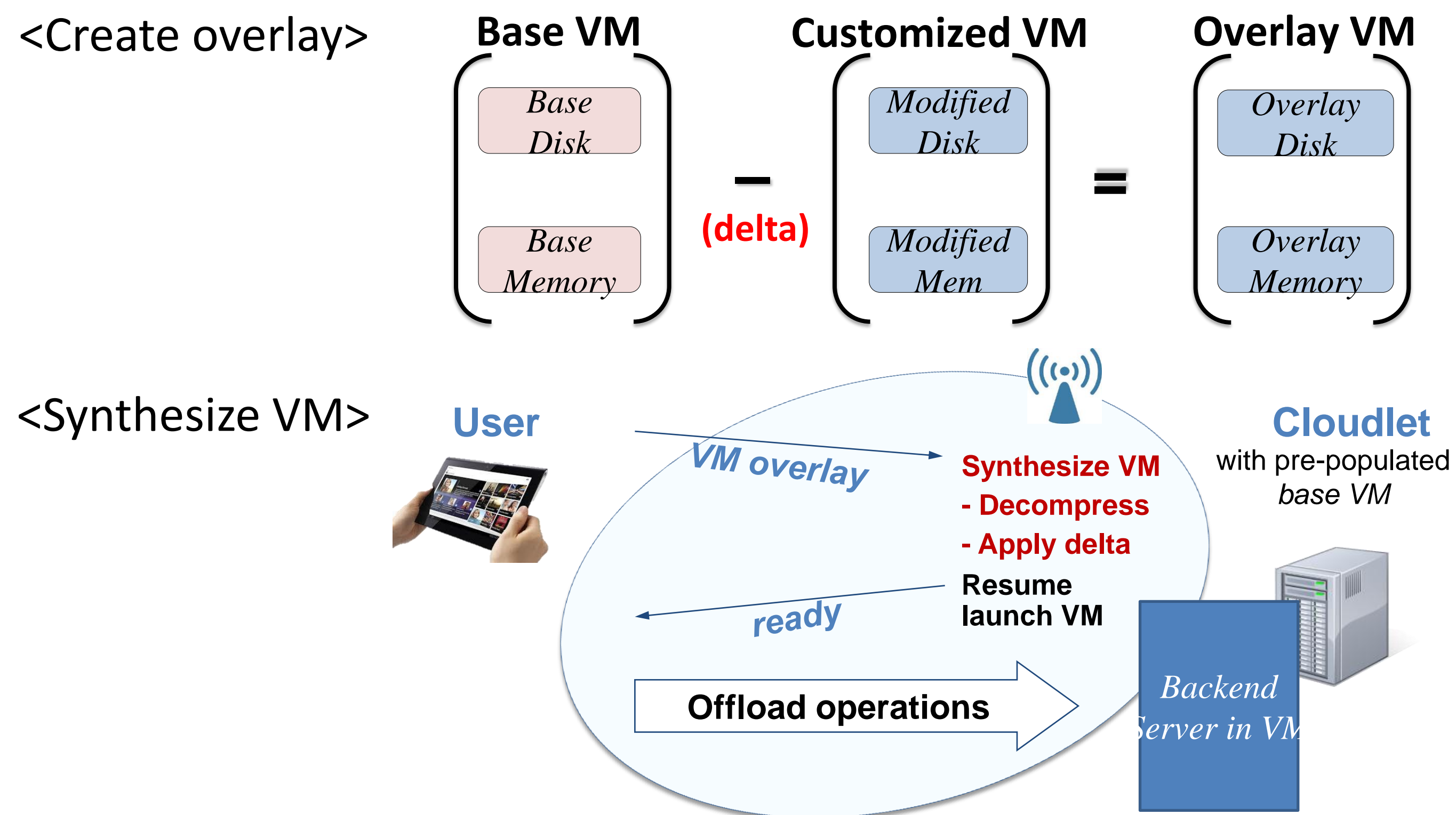--> Cloudlet: Bring the cloud closer to The mobile users!

Nokia Siemens Networks & IBM

NVIDIA

- ***How to launch your custom server at an arbitrary place?***

CLOUDLET & VM SYNTHESIS

VM Synthesis

- Base VM: Vanilla OS that contains kernel and basic library
- Overlay VM: A binary patch that contains customized part

<Create overlay>

<Synthesize VM>

Application

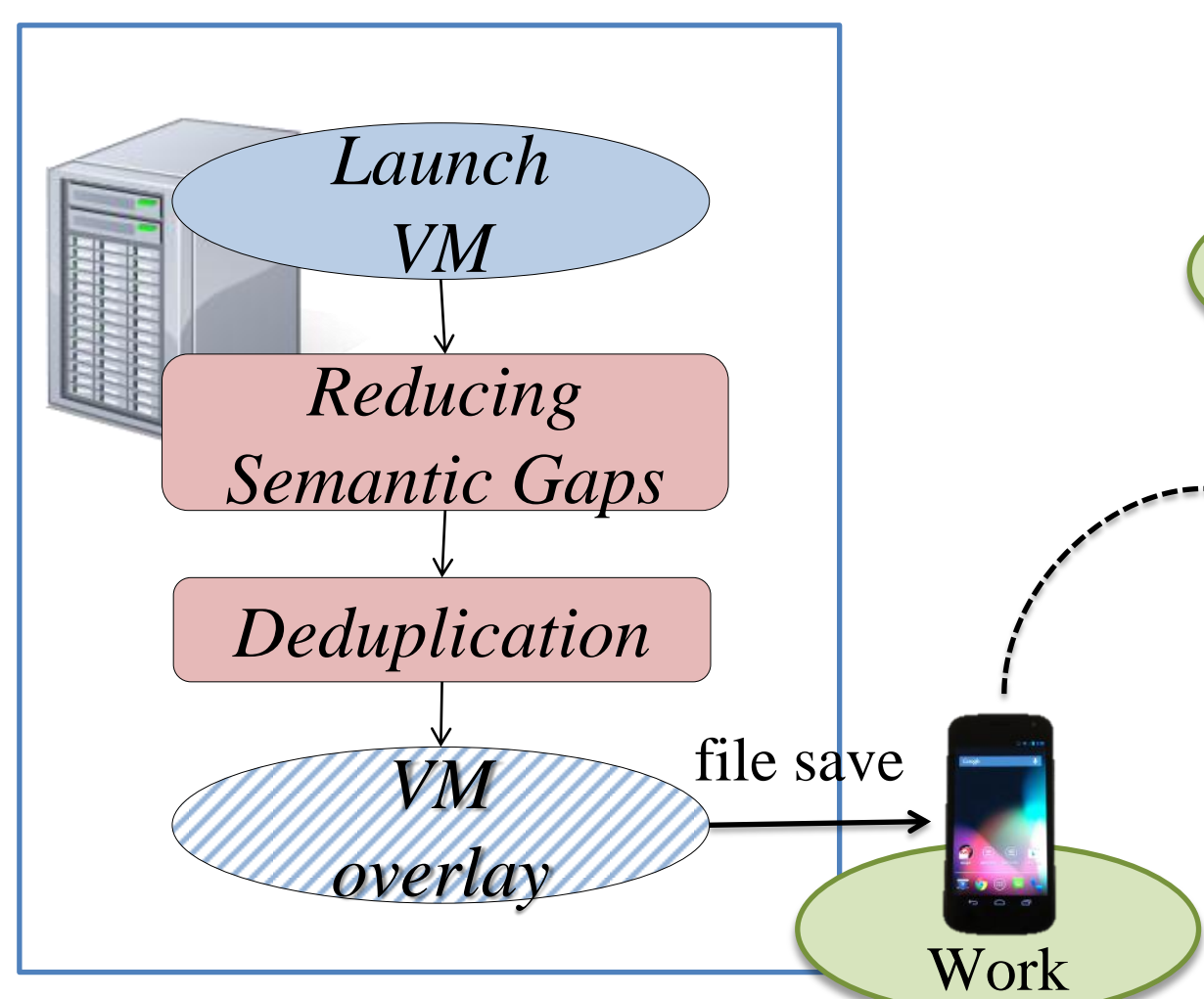- Face/Object/Speech recognition, AR, Fluid simulation

Initial prototype using simple binary delta

- Face Recognition : 101 MB overlay size, 43s for synthesis
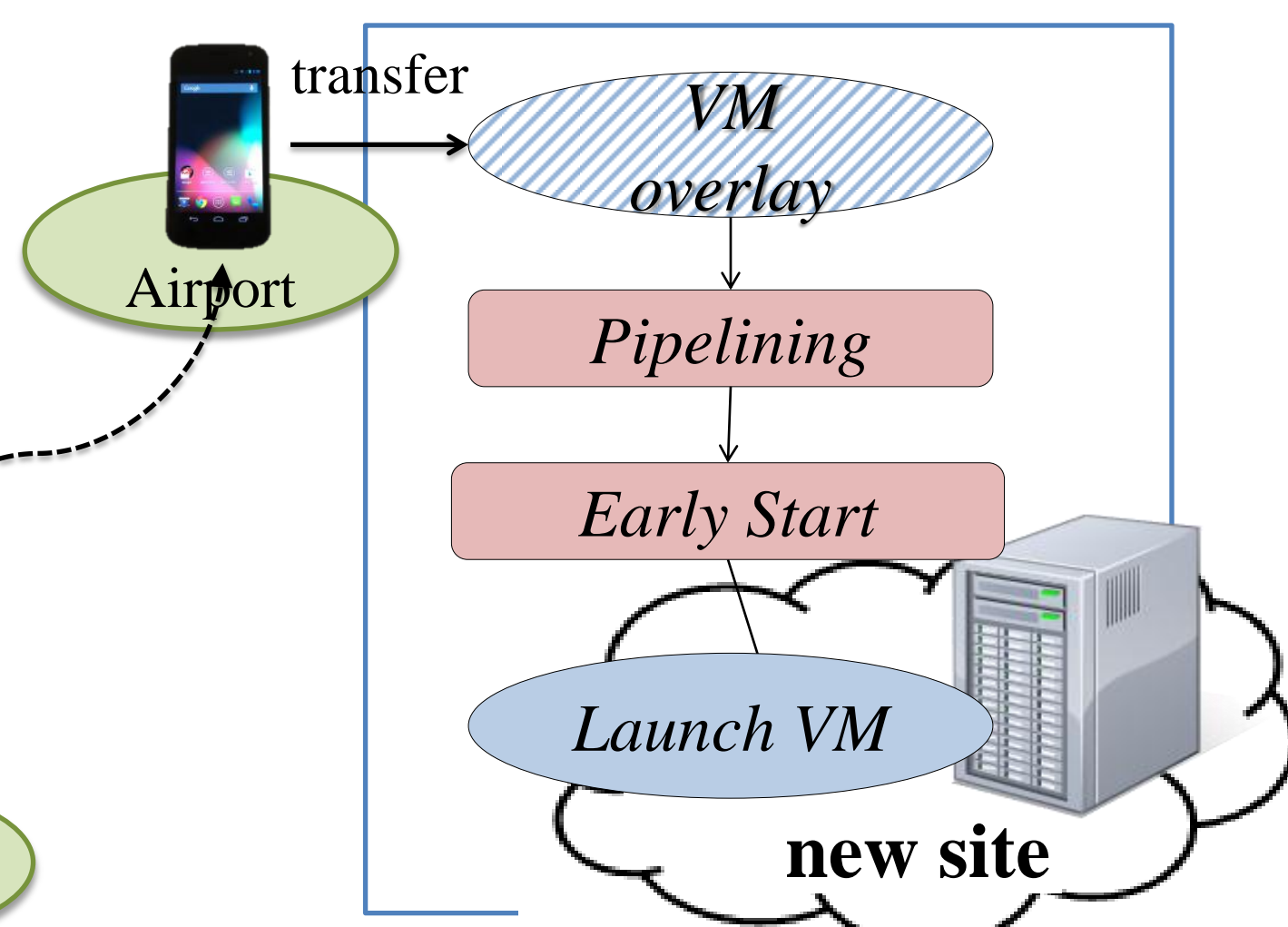- Object Recognition : 153 MB overlay size, 63s for synthesis

- **1~2 minutes is too long for mobile user to wait !**

OPTIMIZATIONS

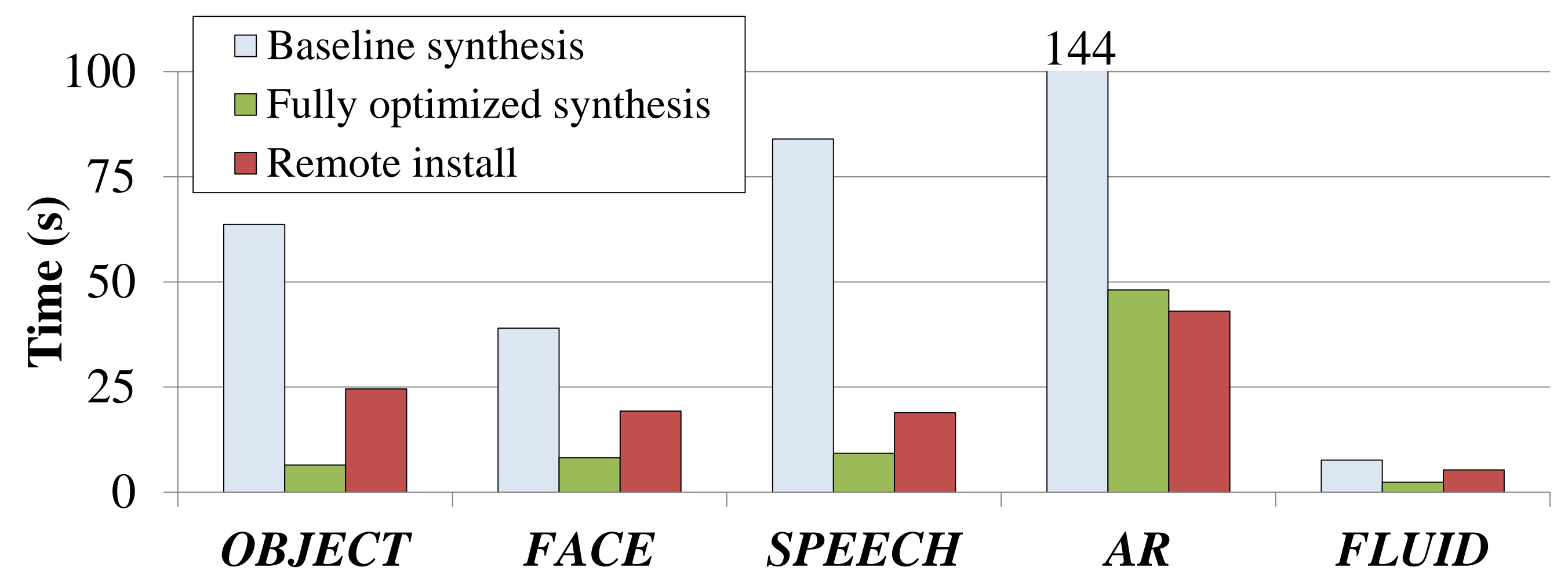**1. Creating VM overlay (offline)**

2. VM synthesis (runtime)

Optimization details at "Just-in-Time Provisioning for Cyber Foraging."
In MobiSys. ACM, 2013

RESULTS

- First response time (of the offloading request)

- *Up to 8x performance improvement (get result within 10s)*
- The code is available under Apache v2.0 license at
  https://github.com/cmusatyalab/elijah-cloudlet

OPENSTACK++

OpenStack

- Cloud computing platform to provide IaaS (i.e. Amazon EC2)
- More than 150 companies joined the project including IBM, Dell, redhat, CISCO, EMB, VMWare, KVM, ..

OpenStack++

- OpenStack with cloudlet features (VM Synthesis, discovery)
- Steps toward open standard implementation of cloudlet

Implementation

- Implemented as Extension!
- No modification on existing code – introduce new computing manager and virtual driver (inherited from the existing one)