Rapid VM Synthesis for Cloudlet

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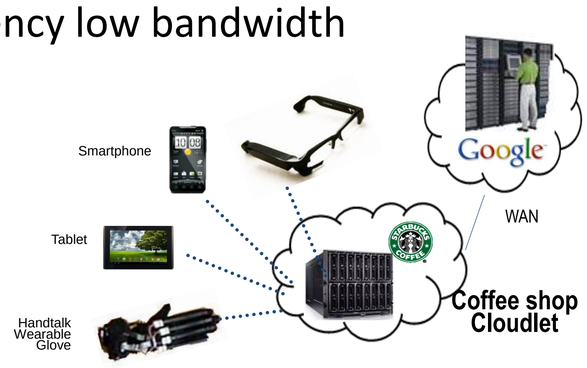
MOTIVATION

- Conventional Cloud is not enough for rich/interactive applications due to high latency low bandwidth

--> Cloudlet: Launch the Cloud near the mobile users!



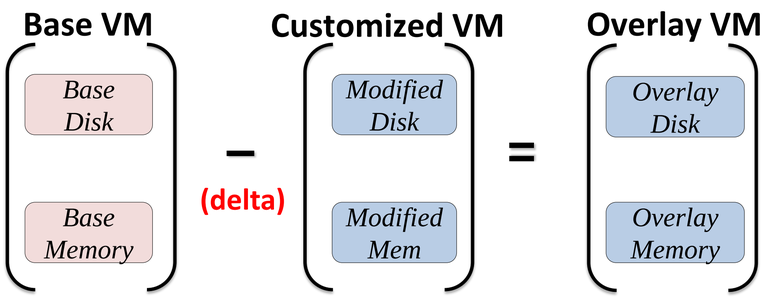
- *How to launch your custom server at an arbitrary place?*

CLOUDLET & VM SYNTHESIS

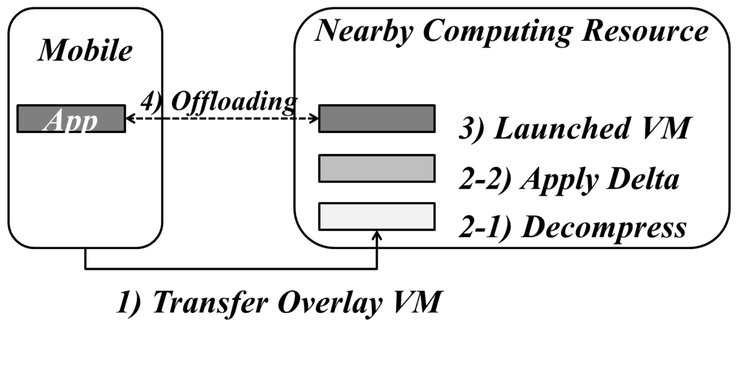
VM Synthesis

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

<Create overlay>



<Synthesize VM>



Tested Application

- Face recognition, Object recognition, Speech recognition, Augmented Reality, 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 !**

DEDUPLICATION

Use context information for better deduplication

- memory operation unit is a page (4K Bytes)
- disk operation unit is a sector (512 Bytes)

(In practice, it is same as memory page size due to DMA)

→ Use 4K-size chunk as a deduplication unit

REDUCE VMM'S SEMANTIC GAP

Semantic Gap

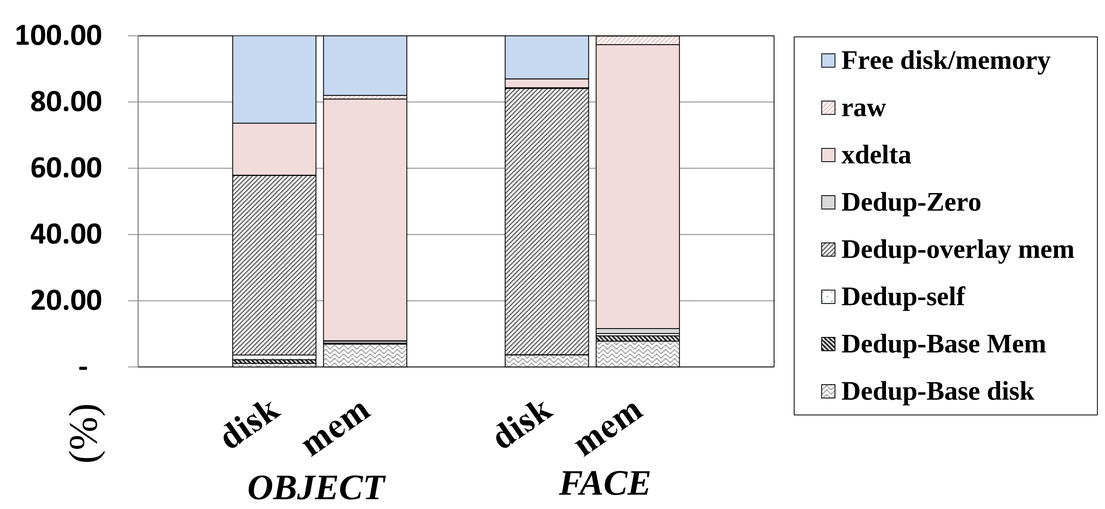
- Free memory: OS moves them to free list without deleting
- File deletion: Block Device VS File system

Reducing gap for disk – TRIM Support

- Inform SSD the blocks that are no longer in use
- Guest OS agnostic – works for Window, Linux, MAC

Reducing gap for memory – Guest information

- Get a little help from guest to know the address of free memory list



Final overlay size: 1) *OBJECT* 61 MB, 2) *FACE* 36 MB

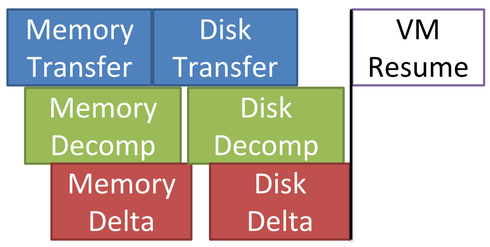
PIPELINING & PARALLELISM

Synthesis Steps

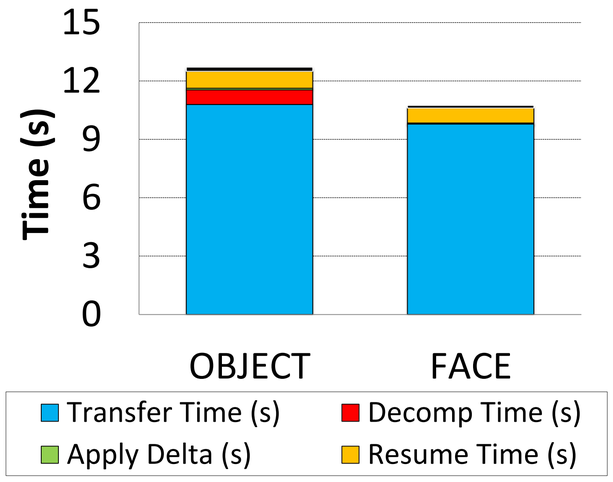
- 1) Overlay transfer 2) Decompression, 3) Applying Delta

Sequential synthesis

Pipelined Synthesis



- **Now it's 10 seconds!**



CONCLUSION

- Rapid VM synthesis significantly reduces overhead of using VM by minimizing overlay size and provisioning time.
- We can provision new cloudlet in as little as 10 seconds with a complete copy of a new VM image.

Intel Science & Technology Center for Cloud Computing

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