COSMOS: Computation Offloading as a Service for Mobile Devices

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Offload Computation to the Cloud*

BG Chun, et al., CloneCloud: elastic execution between device and cloud, EuroSys’11
1- Long Setup Time
2- Long Lease Quantum
3- Connectivity Agnostic
Mobile Device Computation Requirements

1- Quick Response
2- Infrequent
3- Variable connectivity
COSMOS Bridges Gap

Cloud Provider

COSMOS

Mobile Device
Computation Requirements
COSMOS Architecture

Cloud

Resource Management

COSMOS Client

COSMOS Servers

Application Tracker
Execution Predictor
Offloading Controller
Connectivity Predictor
Connectivity Manager

Task Scheduler
Task Tracker
Server Tracker
Server Scheduler

Workers

Application Tracker
Execution Predictor
Offloading Controller
Connectivity Manager

Workers
COSMOS Architecture

Resource Management

Risk Controlled Computation Offloading
COSMOS Design Goal

➢ COSMOS as an optimization problem
  - Min usage cost of cloud resources
  - s.t. sub-optimal offloading performance

➢ A divide-and-conquer method
  - Cloud resource management
  - Task allocation
  - Offloading decision
Resource Management

➢ Capacity Management
  ▪ Cloud Server Choice ("Cost", Power)
  ▪ Adding/Removing Servers

➢ Task Allocation
  ▪ Which active COSMOS server to use
Offloading Decision

CloneCloud: Executing on phone
Cloud: Wait for contact Offload to Cloud

$t_2 < t_3$?

Connectivity

Time

$\text{t}_0 \quad \text{t}_1 \quad \text{t}_2 \quad \text{t}_3$
Offloading Decision

➢ Based on
  ▪ Execution prediction
  ▪ Connectivity prediction
  ▪ Calculating “offloading gain”

➢ Risk Control
  ▪ Use variance in execution and connectivity statistics
Prototyping and Experiments

➢ Servers: Amazon EC2 running Android x86
➢ Client: Android mobile device
➢ COSMOS Master: Linux running in EC2
Evaluation

➢ Wireless environments
  ▪ Stable WiFi, Indoor WiFi, Outdoor WiFi, Outdoor 3G

➢ Applications
  ▪ FaceDetect, VoiceRecog, DroidFish(Chess)

➢ Metrics
  ▪ Speedup, Cost

➢ Baseline: CloneCloud, COSMOS(OP)
Stable WiFi

One-day in the life of COSMOS
Speedup and Cost

The diagram on the left shows the cumulative distribution function (CDF) of speedup for different systems: CloneCloud, COSMOS(OP), and COSMOS. The x-axis represents speedup, and the y-axis represents the CDF.

The bar chart on the right compares the total cost for each system: CloneCloud, COSMOS(OP), and COSMOS. The bars indicate the cost in dollars.
Outdoor Wireless: Intermittent Connectivity on Campus Shuttle
Speedup for Outdoor Wireless

![Graph showing speedup for outdoor wireless with CDF on the y-axis and speedup on the x-axis. The graph compares Oracle, CloneCloud, and COSMOS.](image-url)
Questions?

Thank you!