

# Operating Systems for Modern Applications

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1. Introduction

2. Re-thinking the OS

3. Research Projects

# Once upon a time, applications were..



single user, single platform, and single node.

# Operating systems provided important services.

- Execution environment & hardware abstractions (e.g., process model).
- Protection & isolation (e.g., access control policy and enforcement).
- Managed storage & caching (e.g., the file system).

# Today, applications are ...



multi-user, multi-platform and multi-node

# Operating systems provide fewer services for modern applications.

Applications are now responsible for:

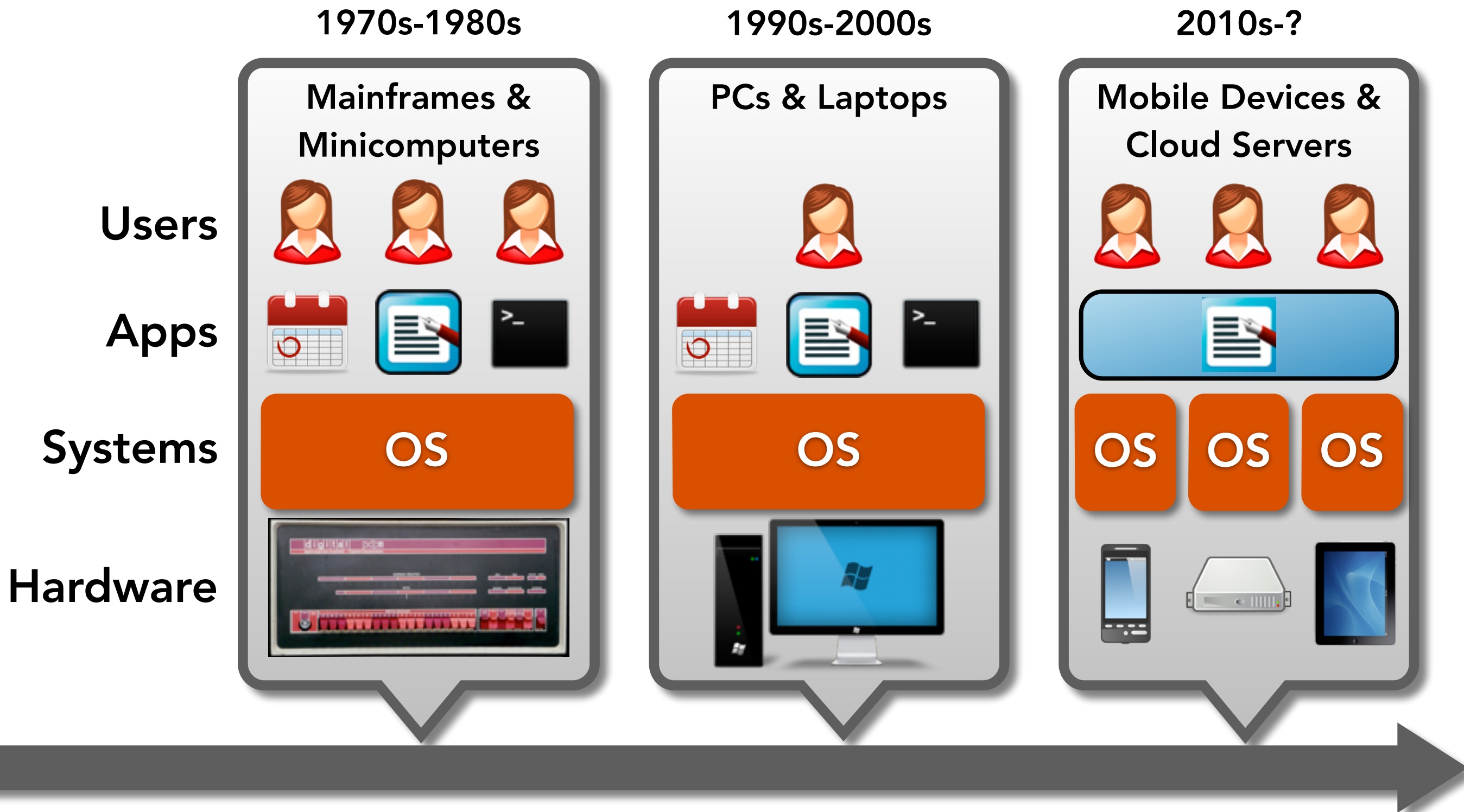
- Executing in many heterogeneous execution environments.
- Protecting shared user data.
- Coordinating distributed storage & caches.

1. Introduction

2. Re-thinking the OS

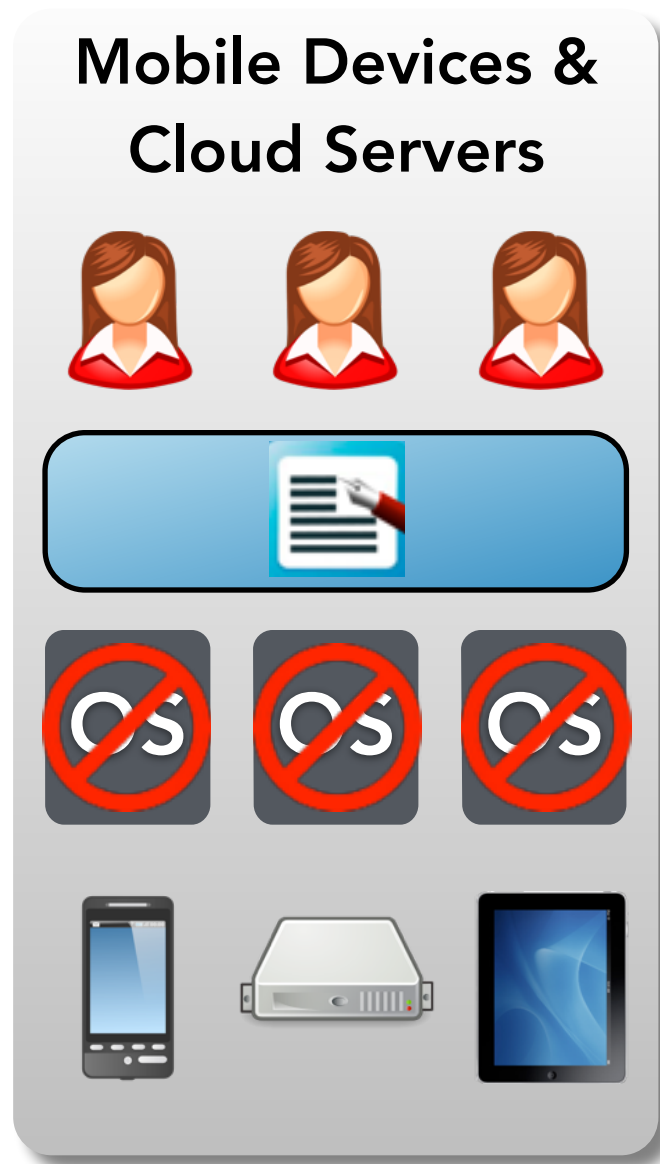
3. Research Projects

# Evolution of Application Architecture





# Are operating systems obsolete?



- Programmers must learn a different interface & process model for each platform.
- OS becomes a performance bottleneck, providing services that application doesn't need.
- Application still must manage users, sharing, and cross-platform coordination.

# No! But the OS must now be...



distributed   flexible   customizable

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# Rethinking the OS

**Distribution  
&  
Deployment**

**Sapphire**

**Protection  
&  
Privacy**

**Coordination  
&  
Consistency**

# Sapphire

A new distributed execution environment that allows applications to control performance trade-offs.

# Sapphire Architecture



App



Sapphire Runtime System



OS



OS



OS



# Rethinking the OS

**Distribution  
&  
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Privacy**

**Agate**

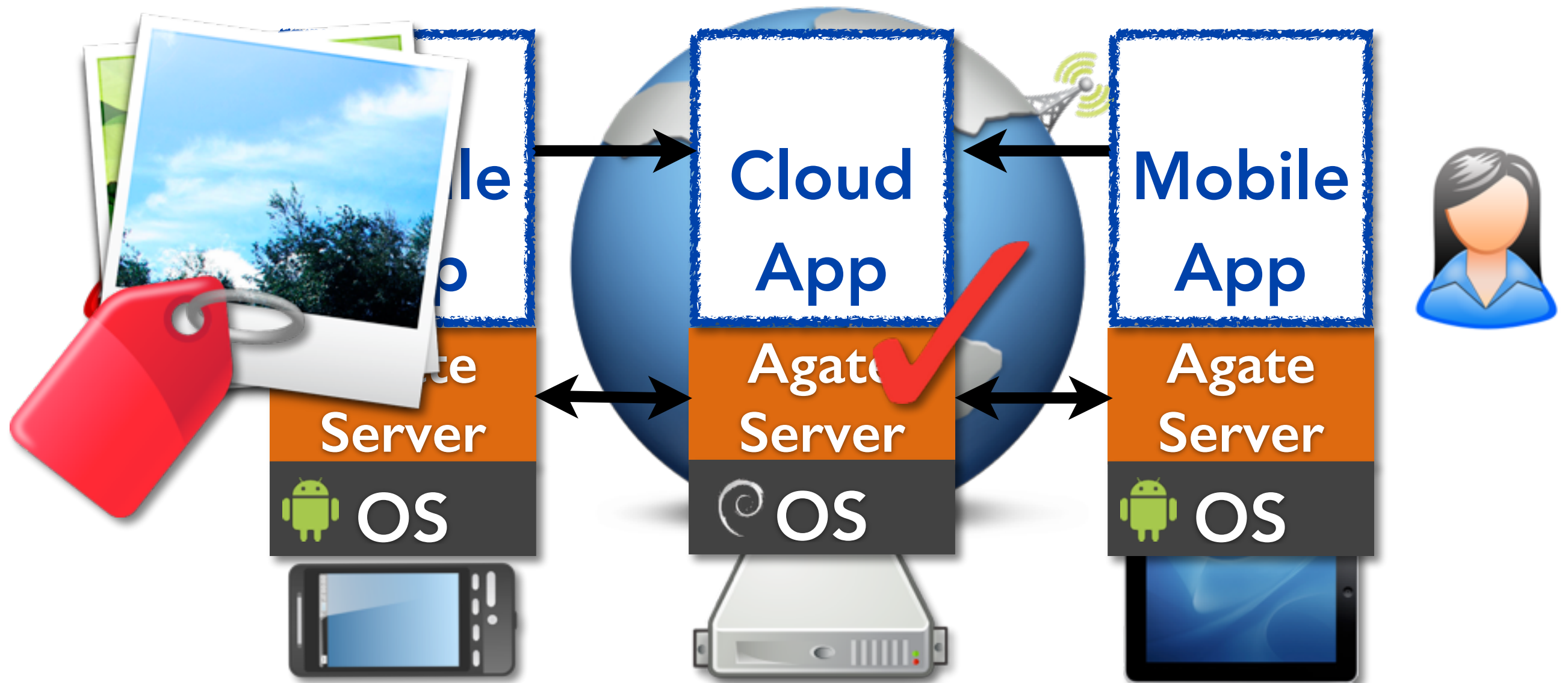
**Coordination  
&  
Consistency**

# Agate

A new secure distributed OS for  
protecting shared user data.



# Agate Architecture



# Rethinking the OS

**Distribution  
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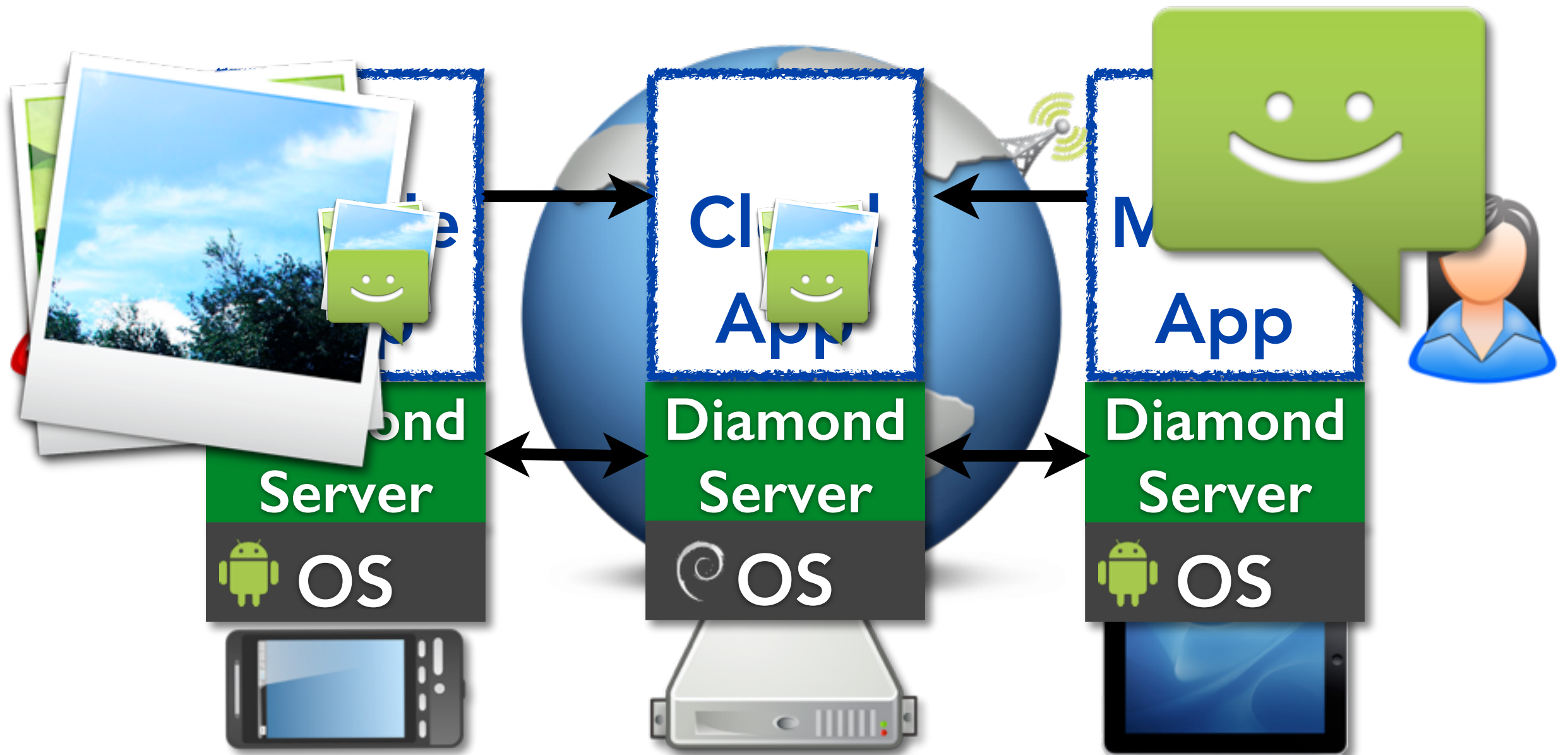
**Coordination  
&  
Consistency**

**Diamond**

# Diamond

A new coordination layer for  
tracking & synchronizing  
distributed application state.

# Diamond Architecture



# Summary

- Traditional OSes do not provide the services that modern applications need.
- We must rethink the OS for the new requirements of modern applications.
- We are working on projects to provide new OS services for modern applications.