ASM: A Programmable Interface for Extending Android Security

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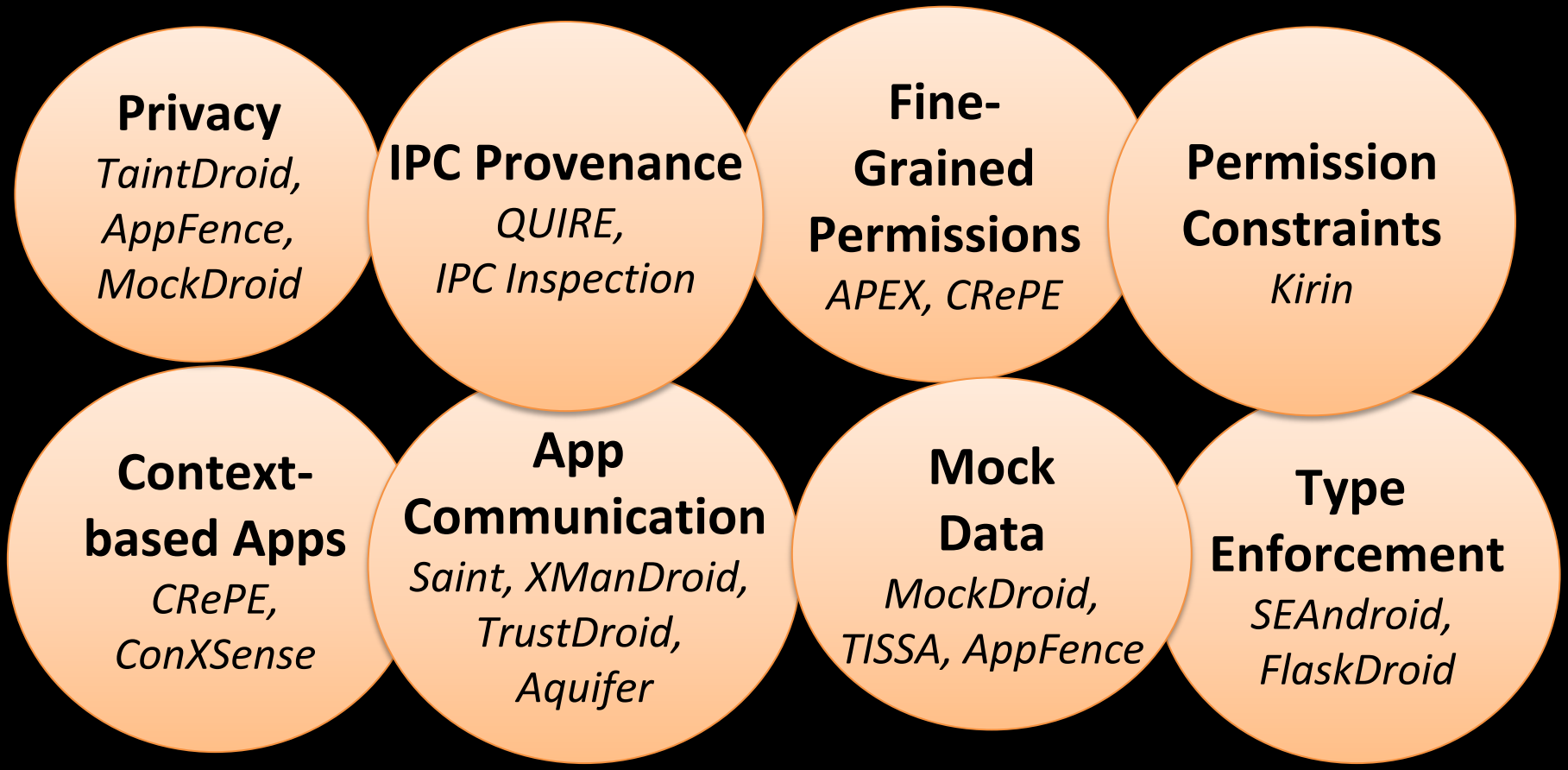
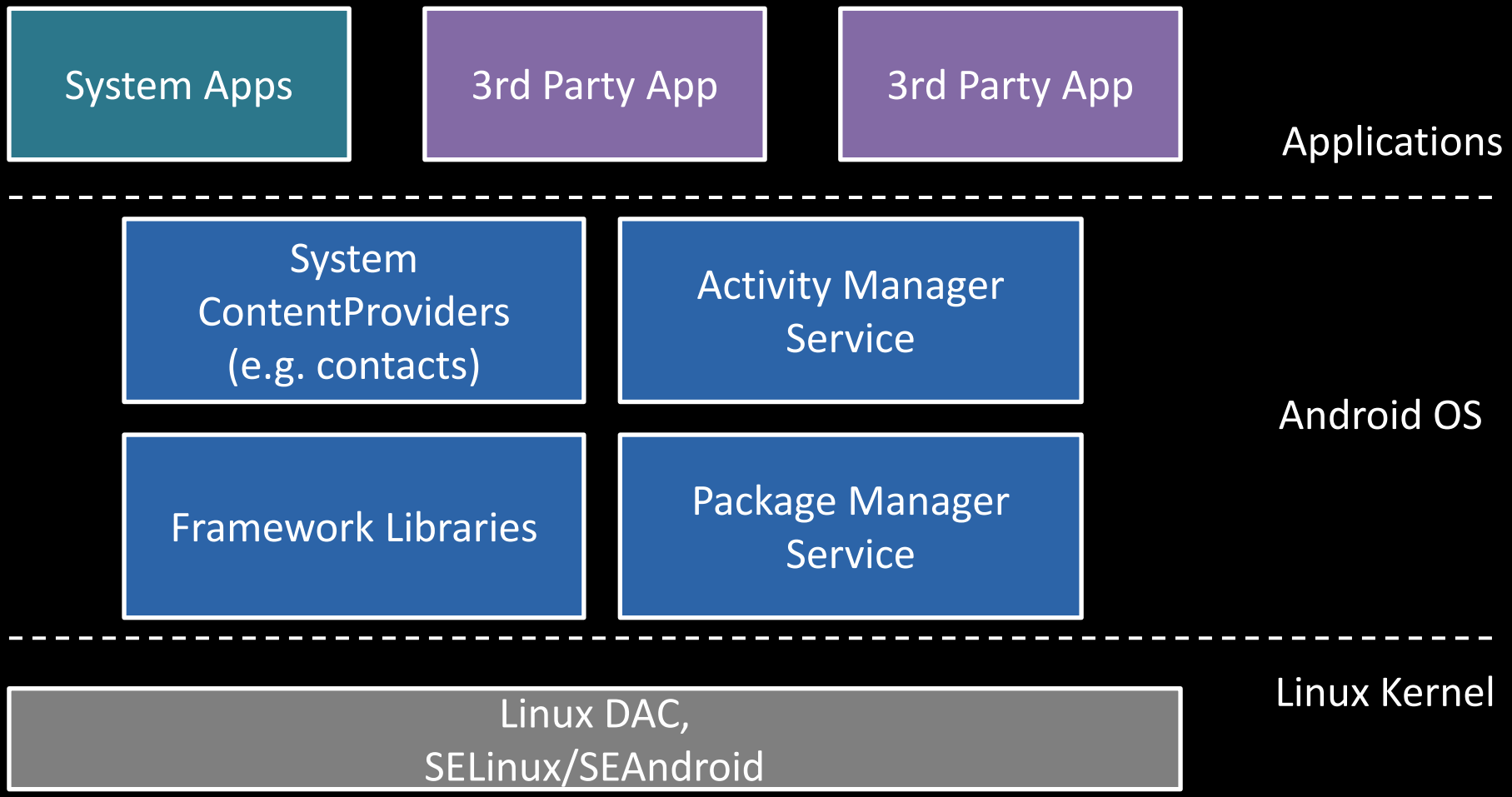
Android Security Extensions (selected)

Security extensions focus on
specific use cases and/or *security and privacy models*



Android Security Extensions

Access control (hooks) are embedded in sensitive components



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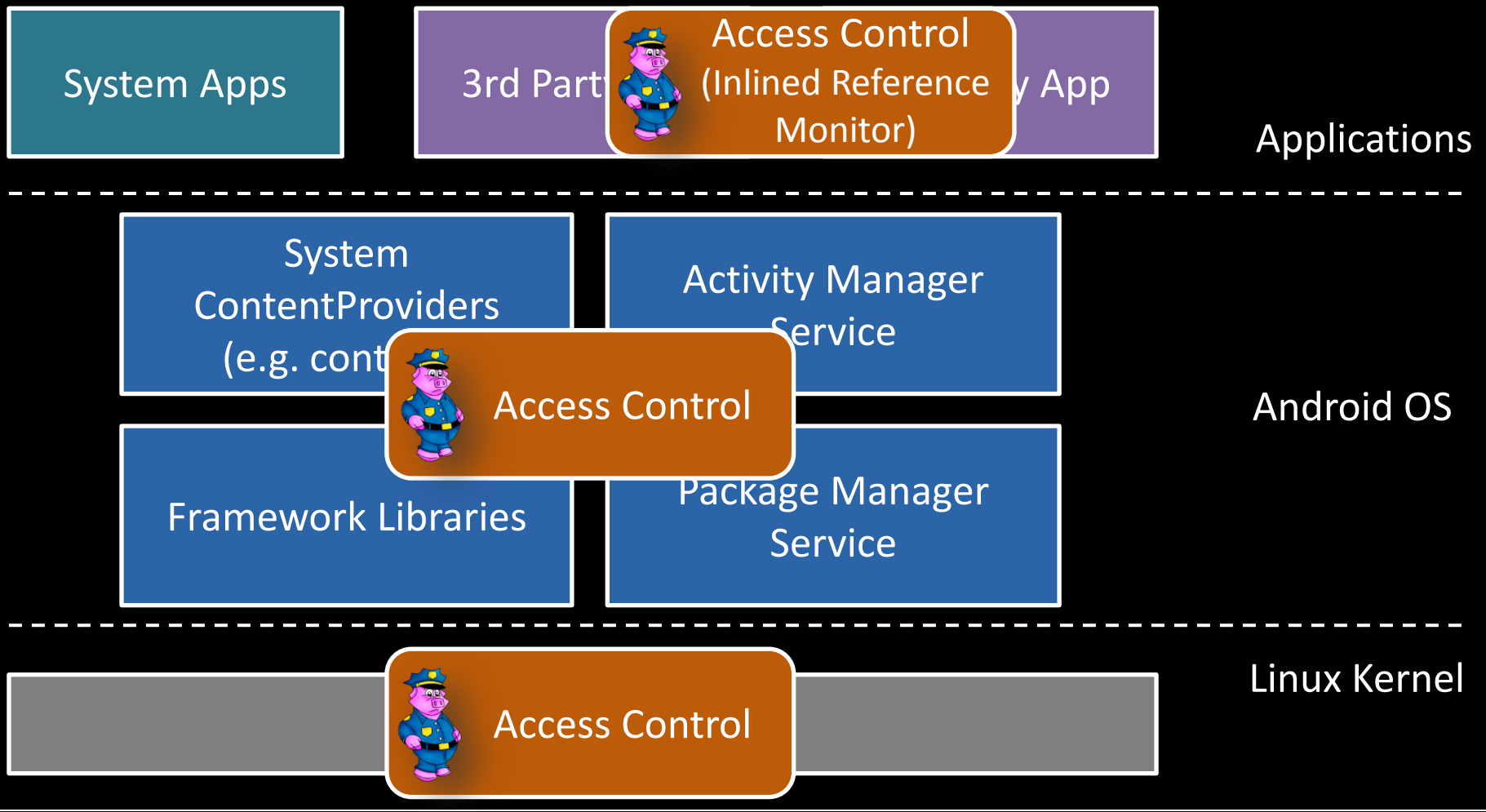

Research Question

Is it possible to provide a *programmable* and *generic* security architecture on top of which many of these solutions can be instantiated?

Observations

Diverse Goals, but use similar security hooks and mechanisms

System	Android ICC	Package Manager	Sensors / Phone Info	Fake Data	System Content Providers	File Access	Network Access	3rd Party Hooks
MockDroid		✓	✓	✓	✓		✓	
XManDroid	✓	✓	✓			✓	✓	
TrustDroid	✓	✓			✓	✓	✓	
FlaskDroid	✓	✓	✓	✓	✓	✓	✓	✓
CRePE	✓		✓					
Quire	✓	✓						
TaintDroid	✓		✓			✓	✓	
Kirin		✓						
IPC Inspection	✓	✓						
AppFence	✓	✓	✓	✓	✓	✓	✓	
Aquifer	✓					✓	✓	
APEX	✓	✓	✓					
Saint	✓	✓						✓
SEAndroid	✓	✓				✓	✓	
TISSA			✓	✓	✓			

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CRePE	✓		✓					
Quire	✓	✓						
TaintDroid	✓		✓			✓	✓	
Kirin		✓						
IPC Inspection	✓	✓						
AppFence	✓	✓	✓	✓	✓	✓	✓	
Aquifer	✓					✓	✓	
APEX	✓	✓	✓					
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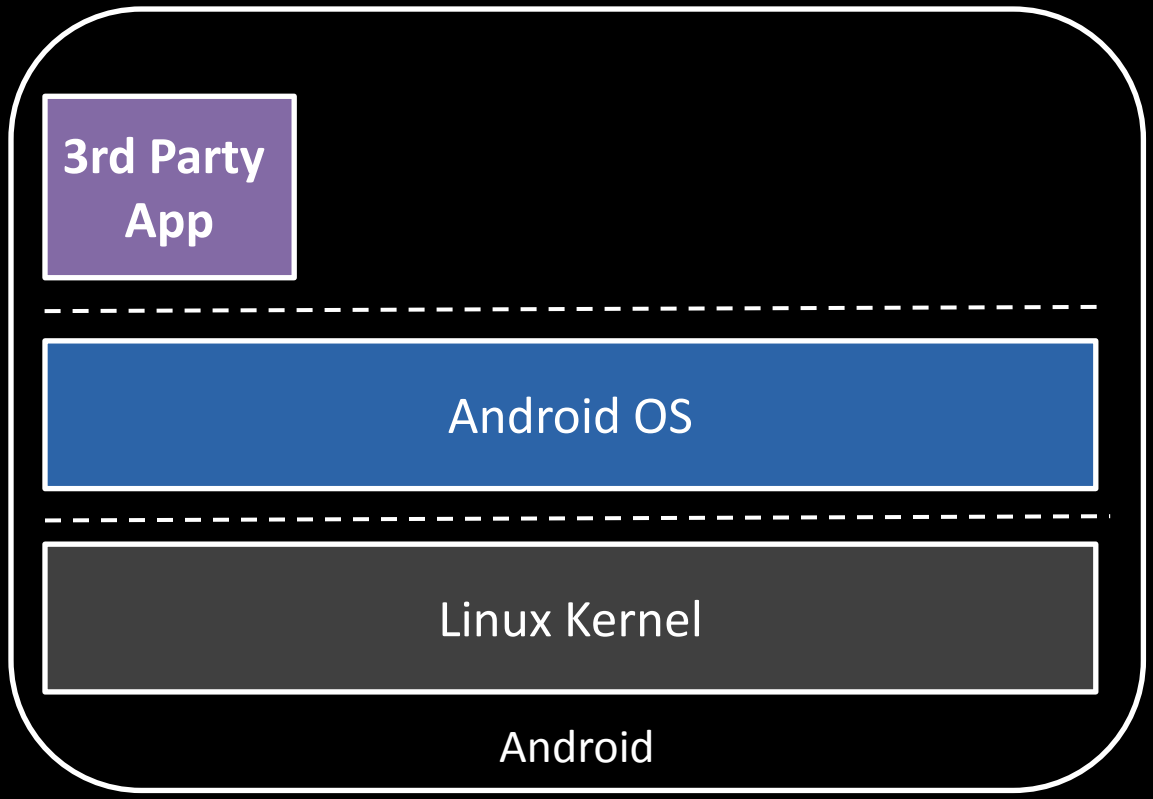
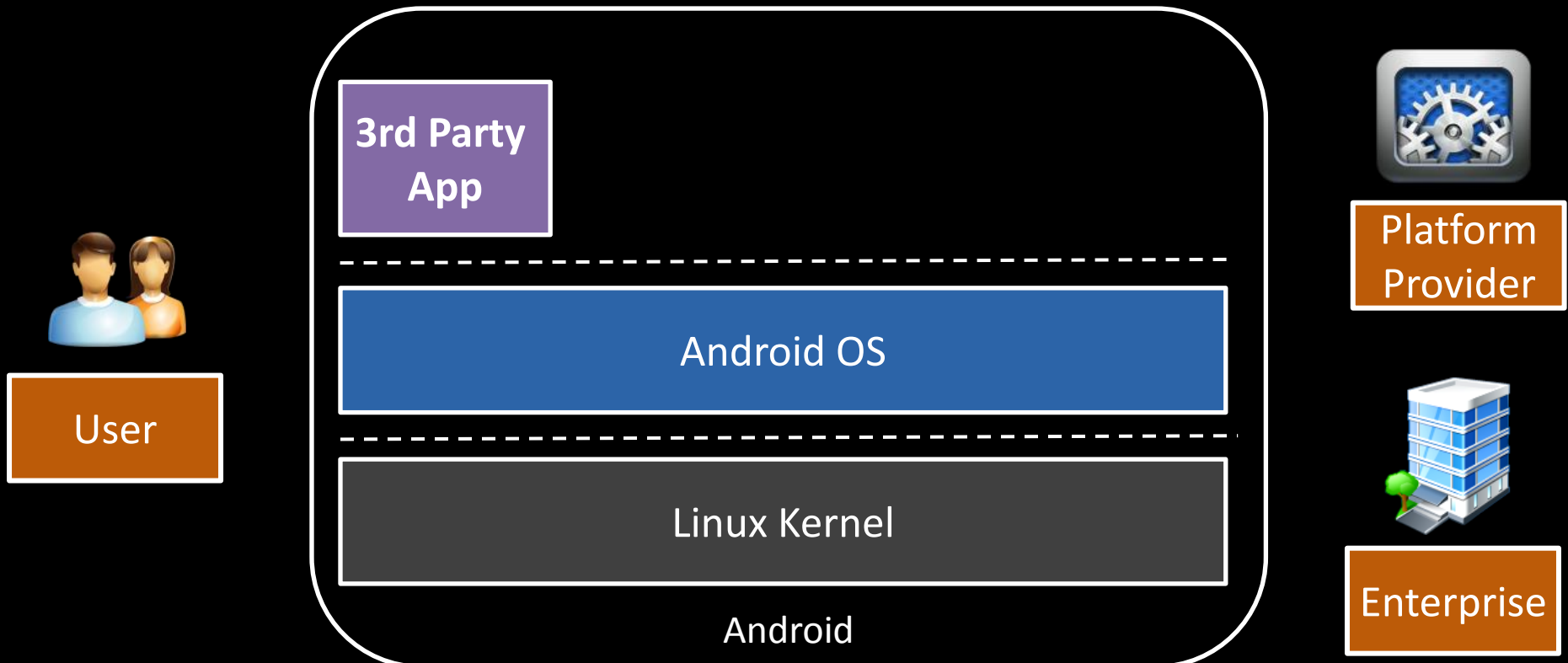
SEAndroid	✓	✓				✓	✓	
TISSA			✓	✓	✓			

High-level Idea of ASM



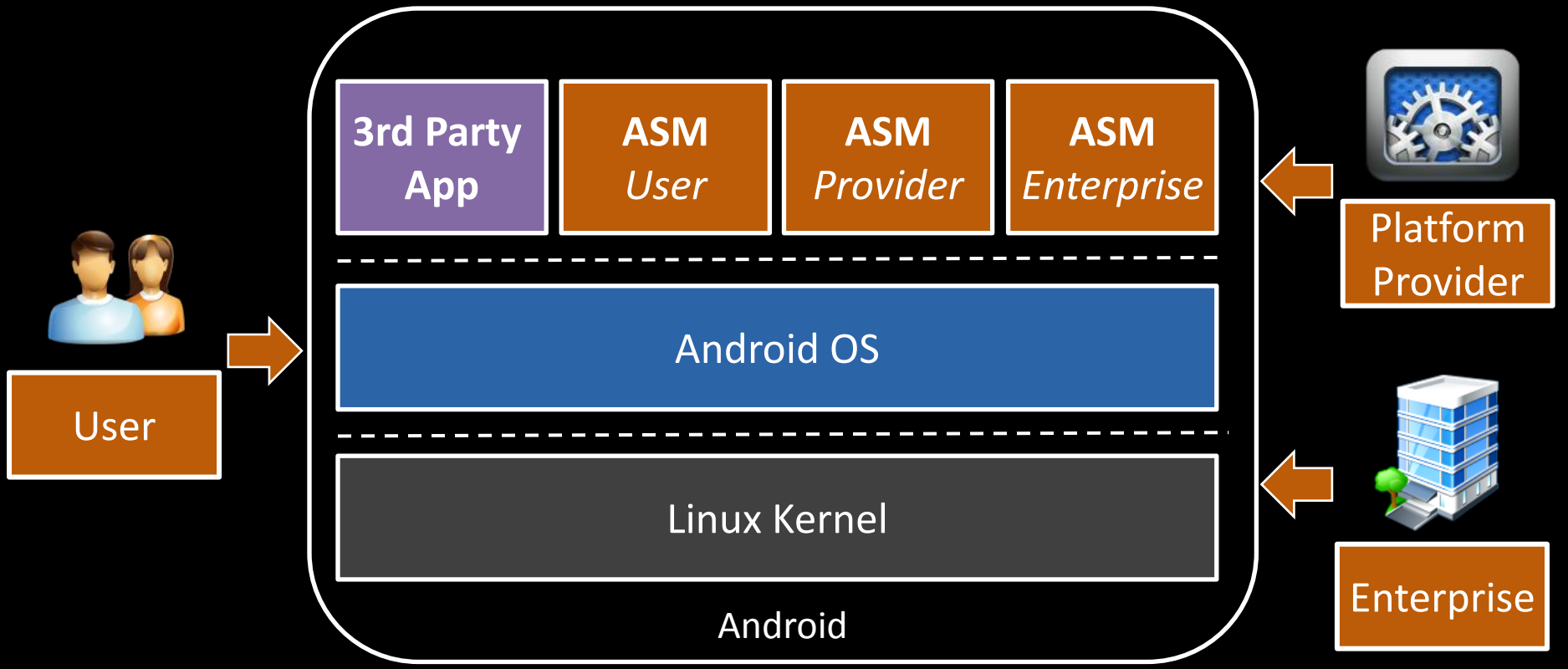
High-level Idea of ASM

- A *modular* access control architecture supporting *multiple stakeholders*



High-level Idea of ASM

- A *modular* access control architecture supporting *multiple stakeholders*
- Deploy *Android Security Modules (ASMs) as apps*



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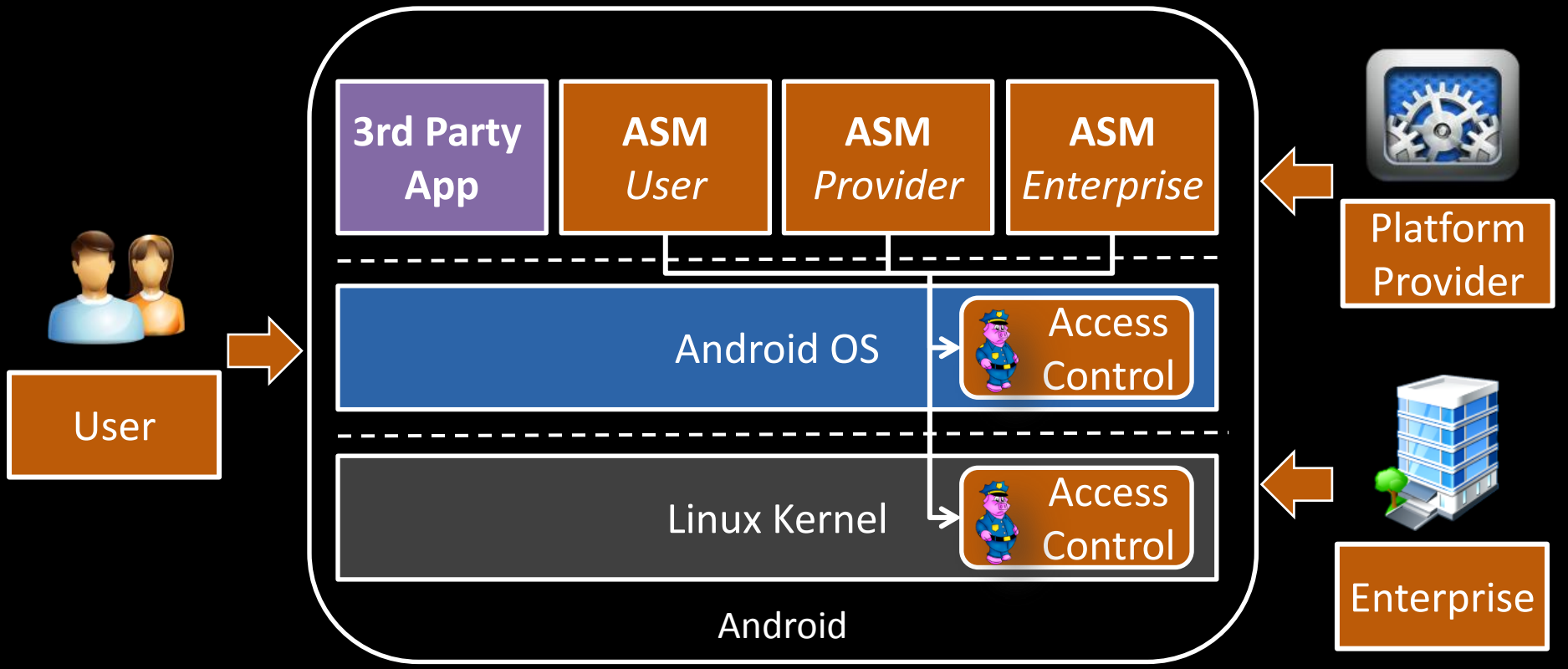
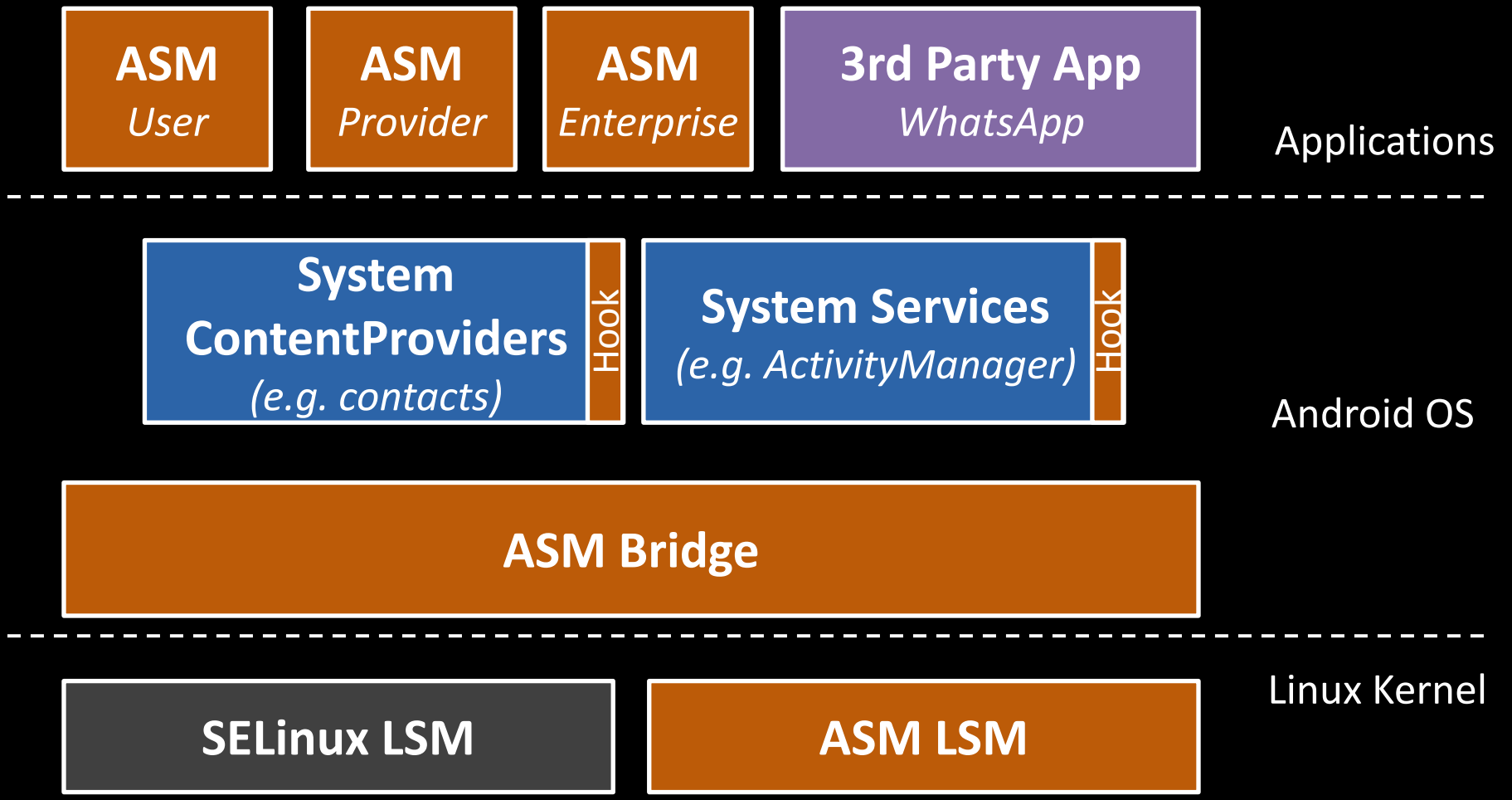


Challenges

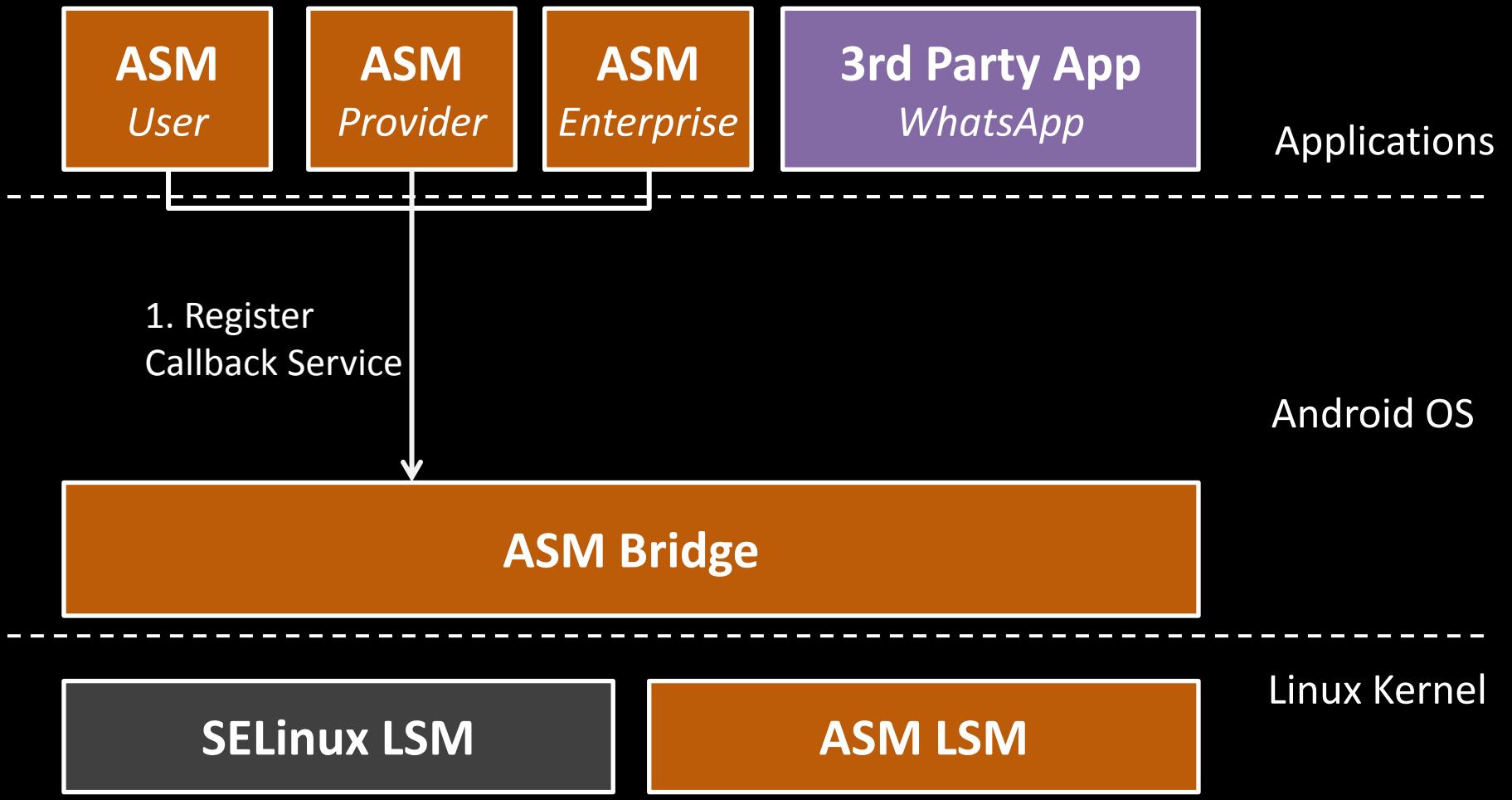
- **Fine-grained access control on all abstraction layers**
  - Handle the *semantics and pecularities* of each layer
- **Preserve existing security invariants**
  - Don‘t overrule *denials* by *default Android access control*
  - Data modification by ASMs only in *well-defined bounds*
- **Efficiency**
  - Only activate hooks when they are *required*
  - Whitelisting for *root processes* and *system apps*
- **Policy Reconcilliation**
  - Handle *decision conflicts* (currently consensus strategy)

Design

ASM Framework



ASM Framework



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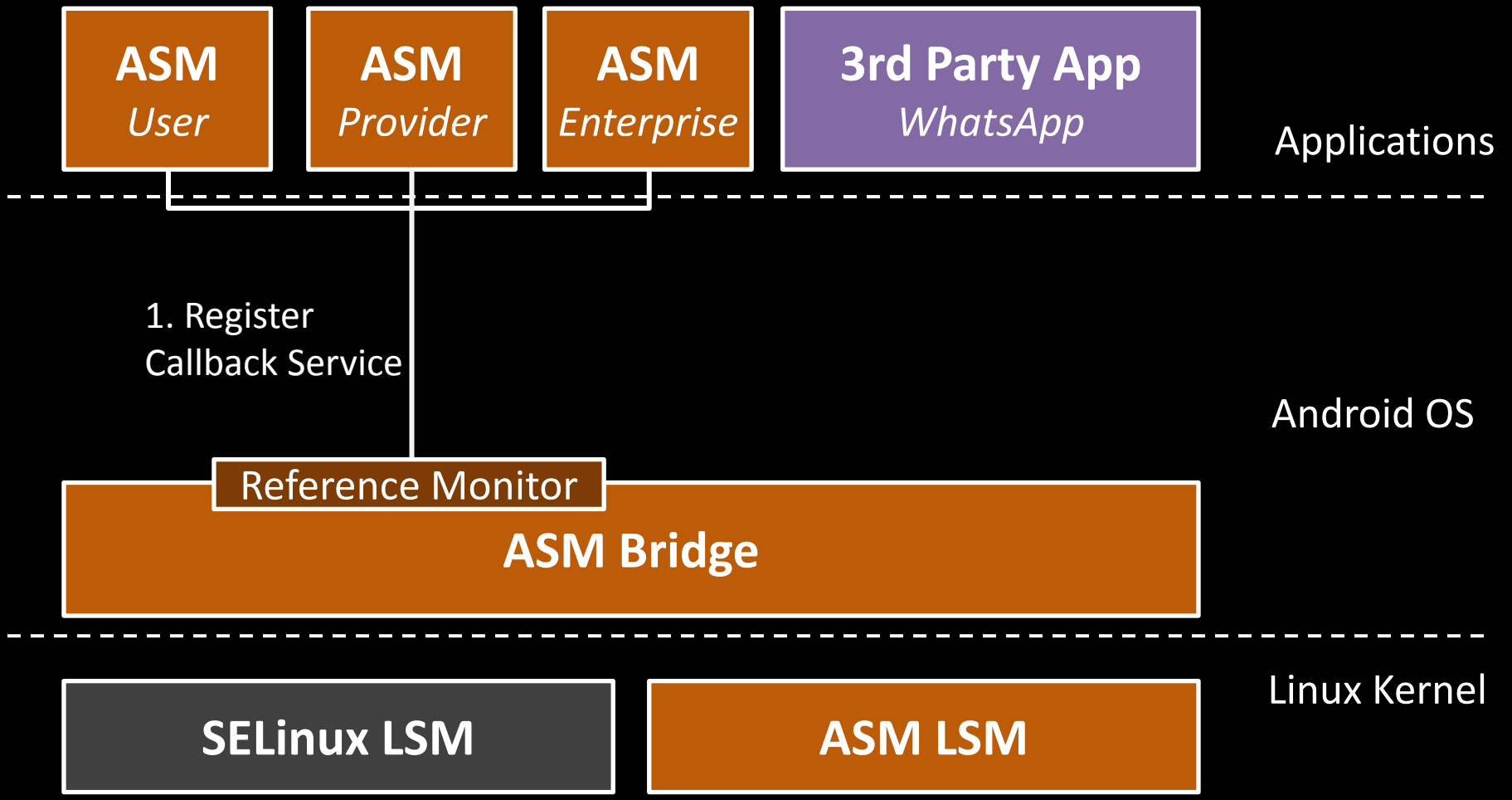

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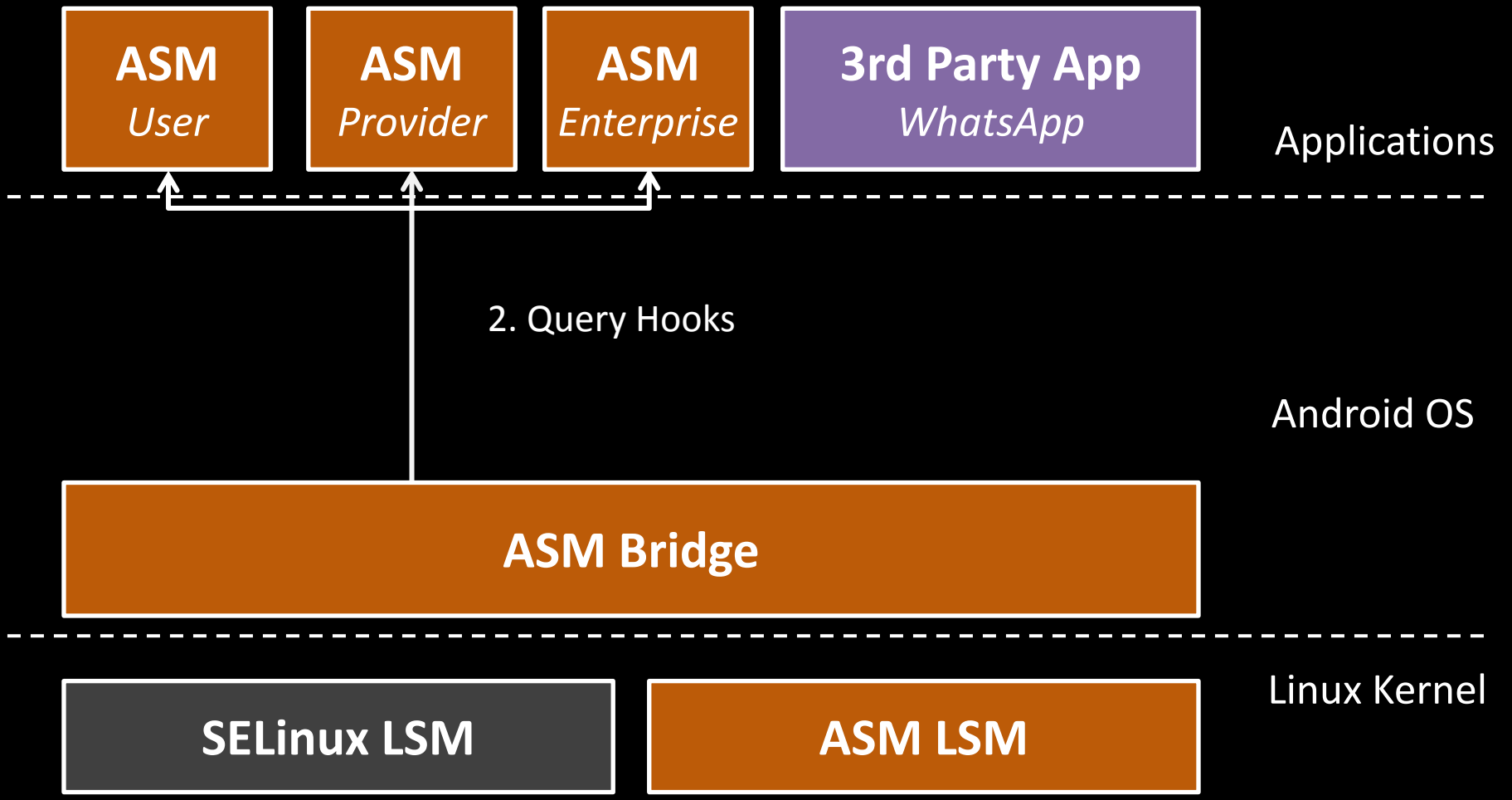
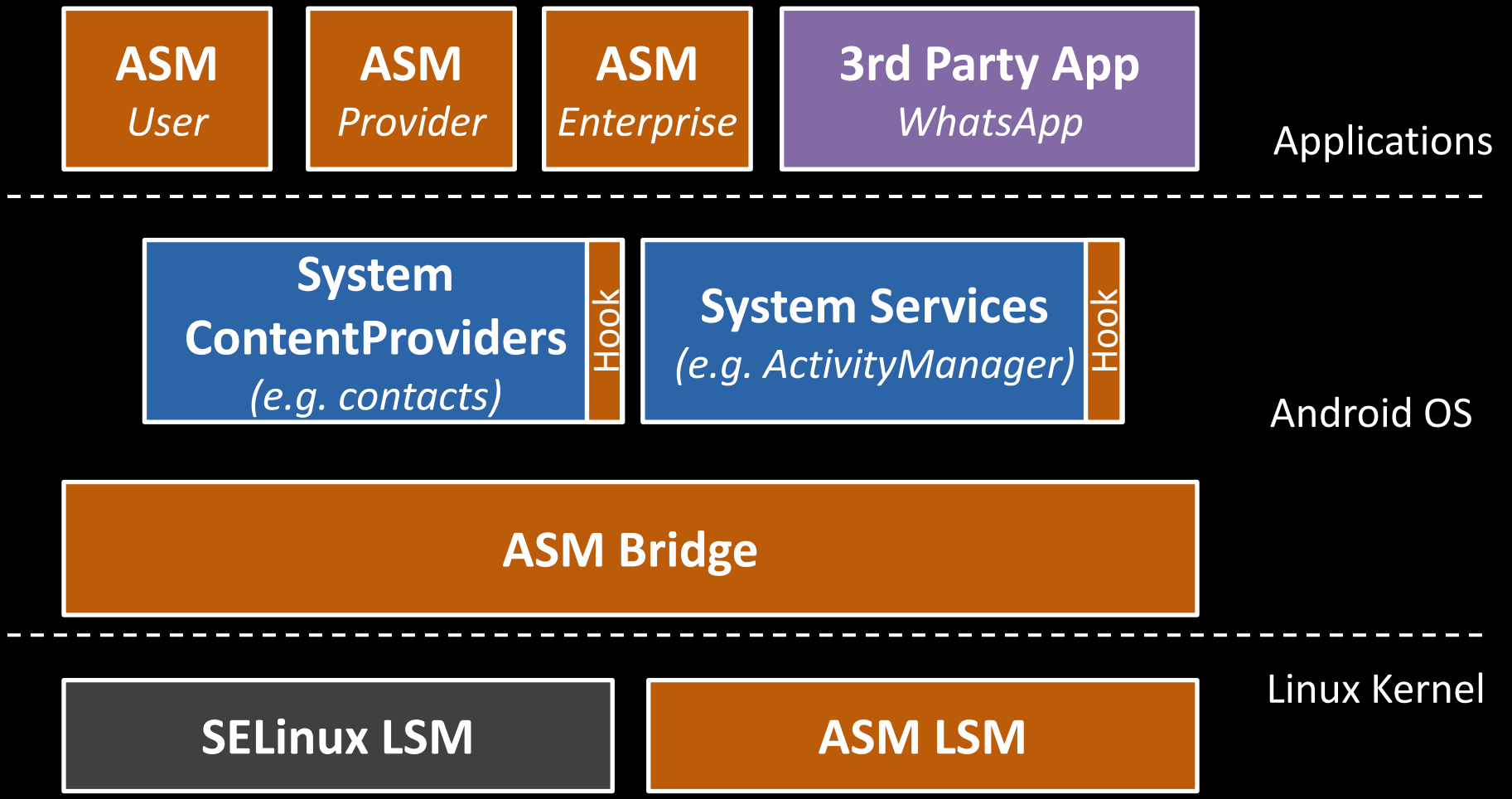


Hook Invocation



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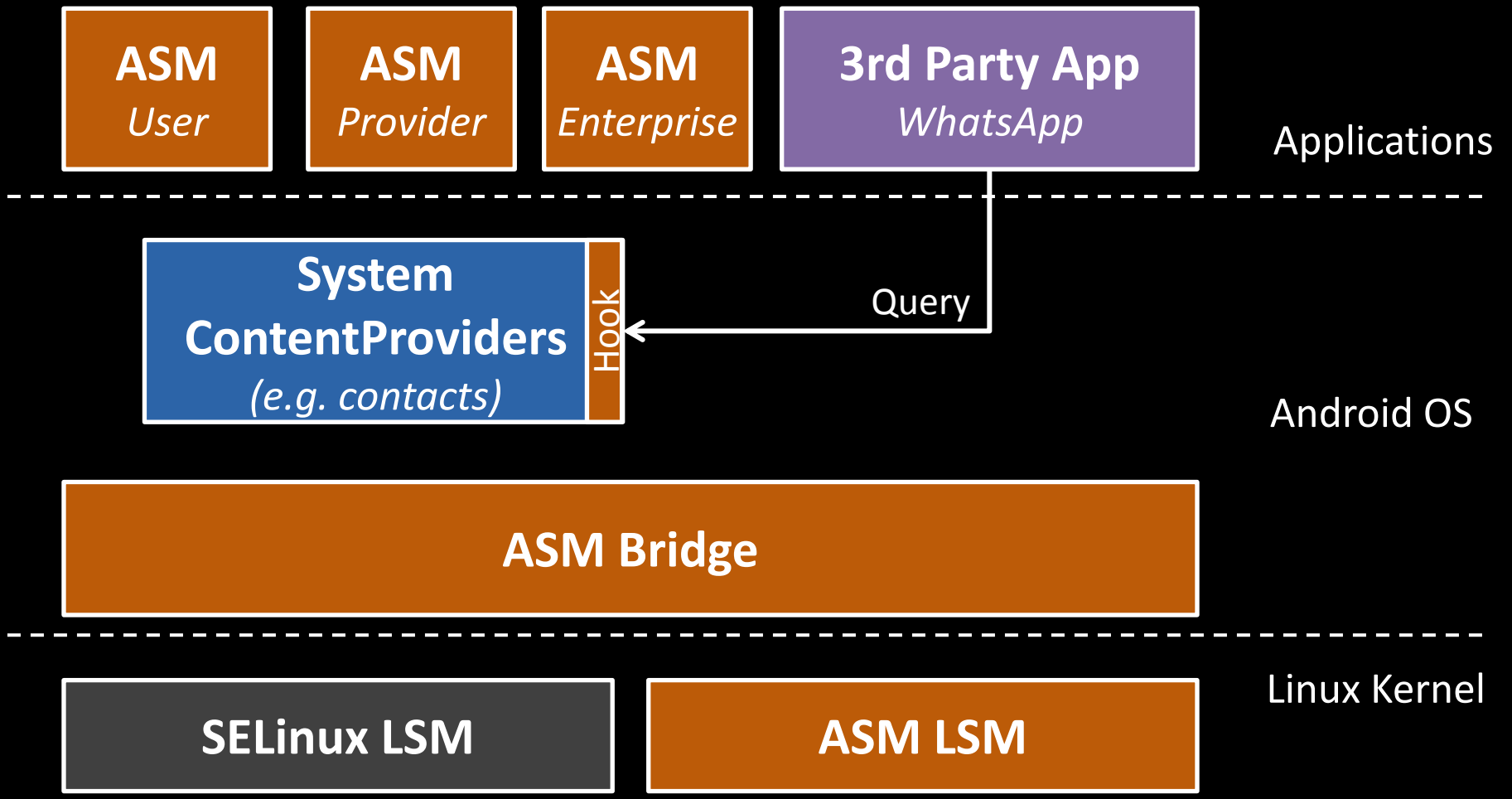

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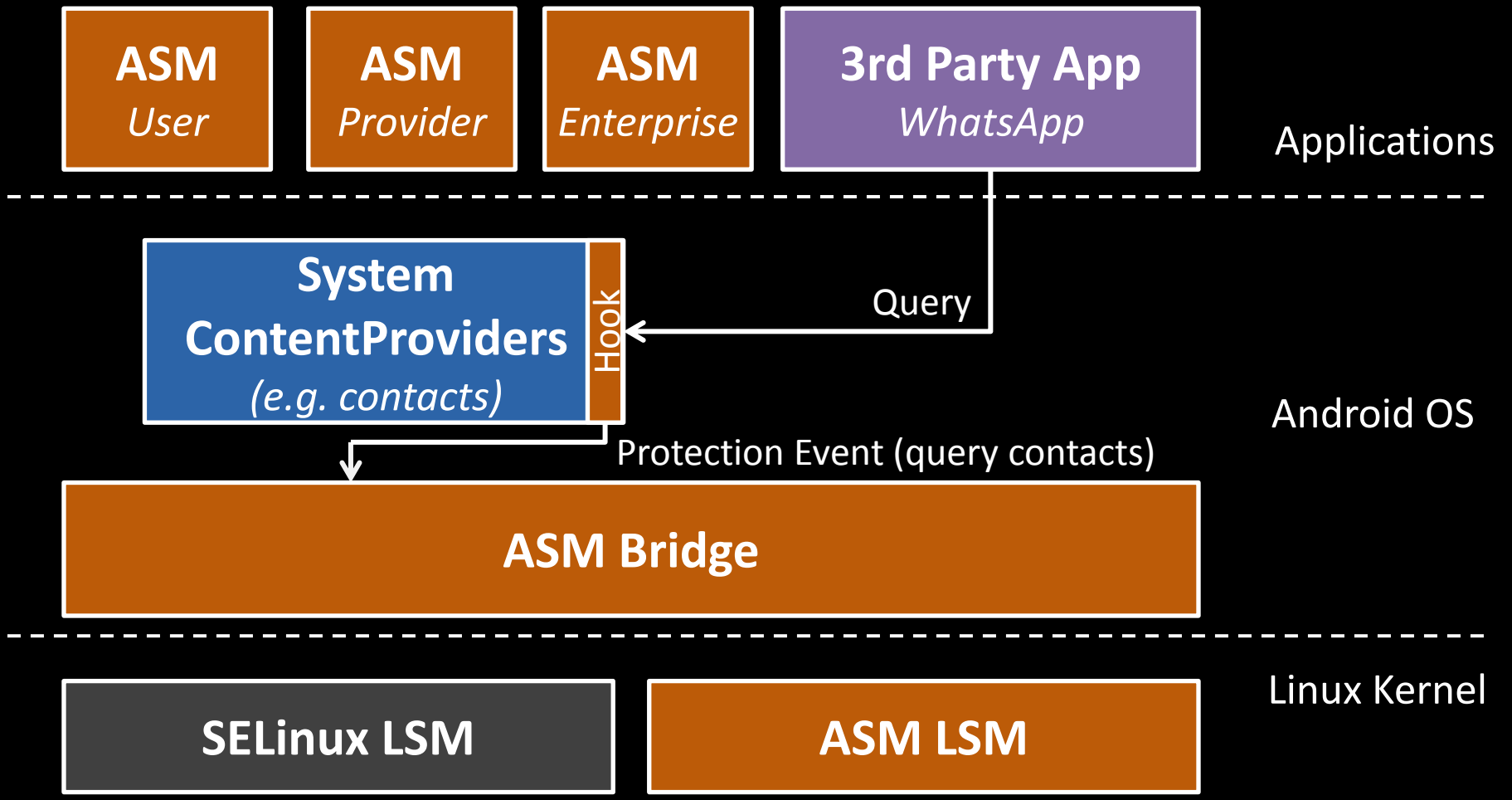

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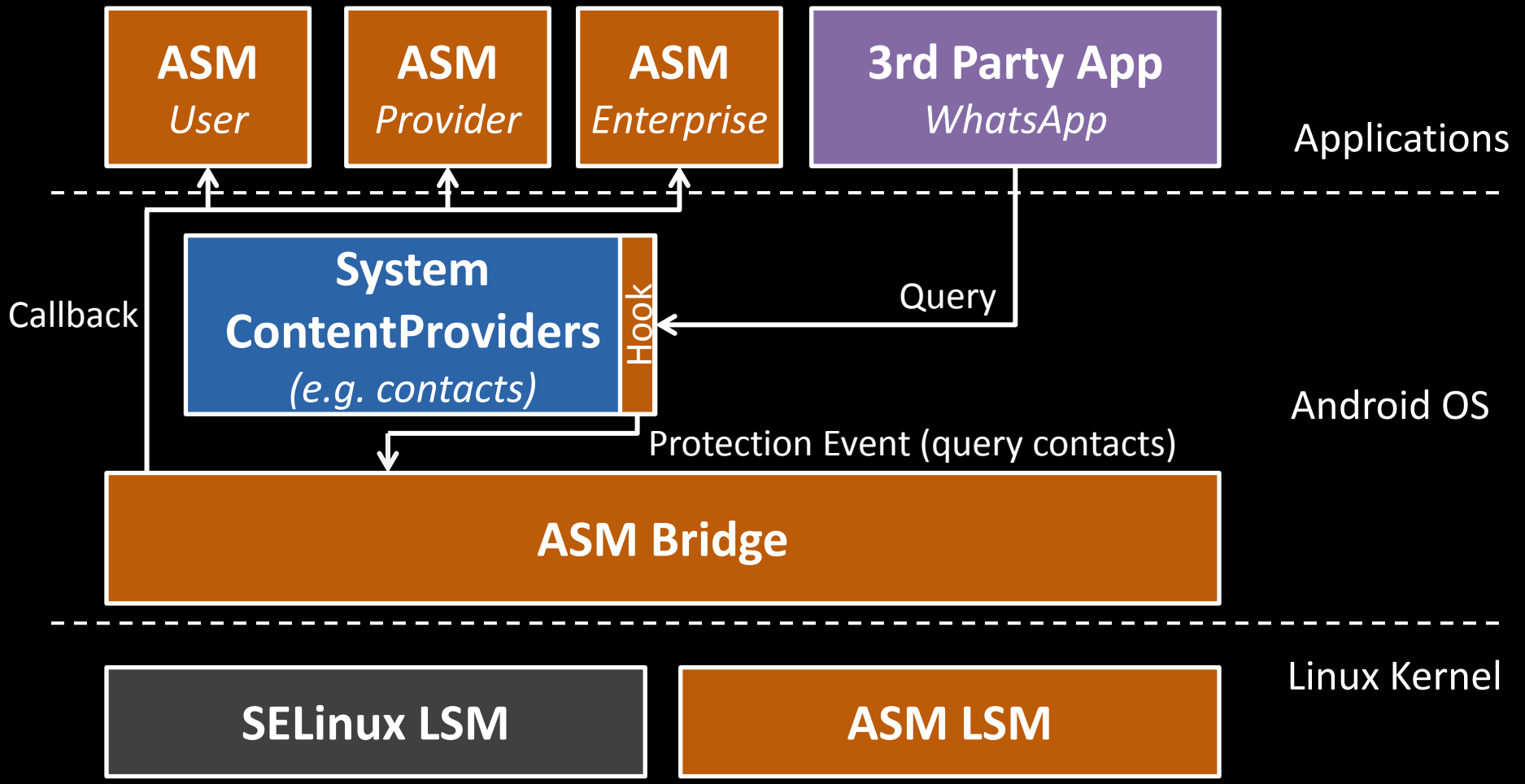
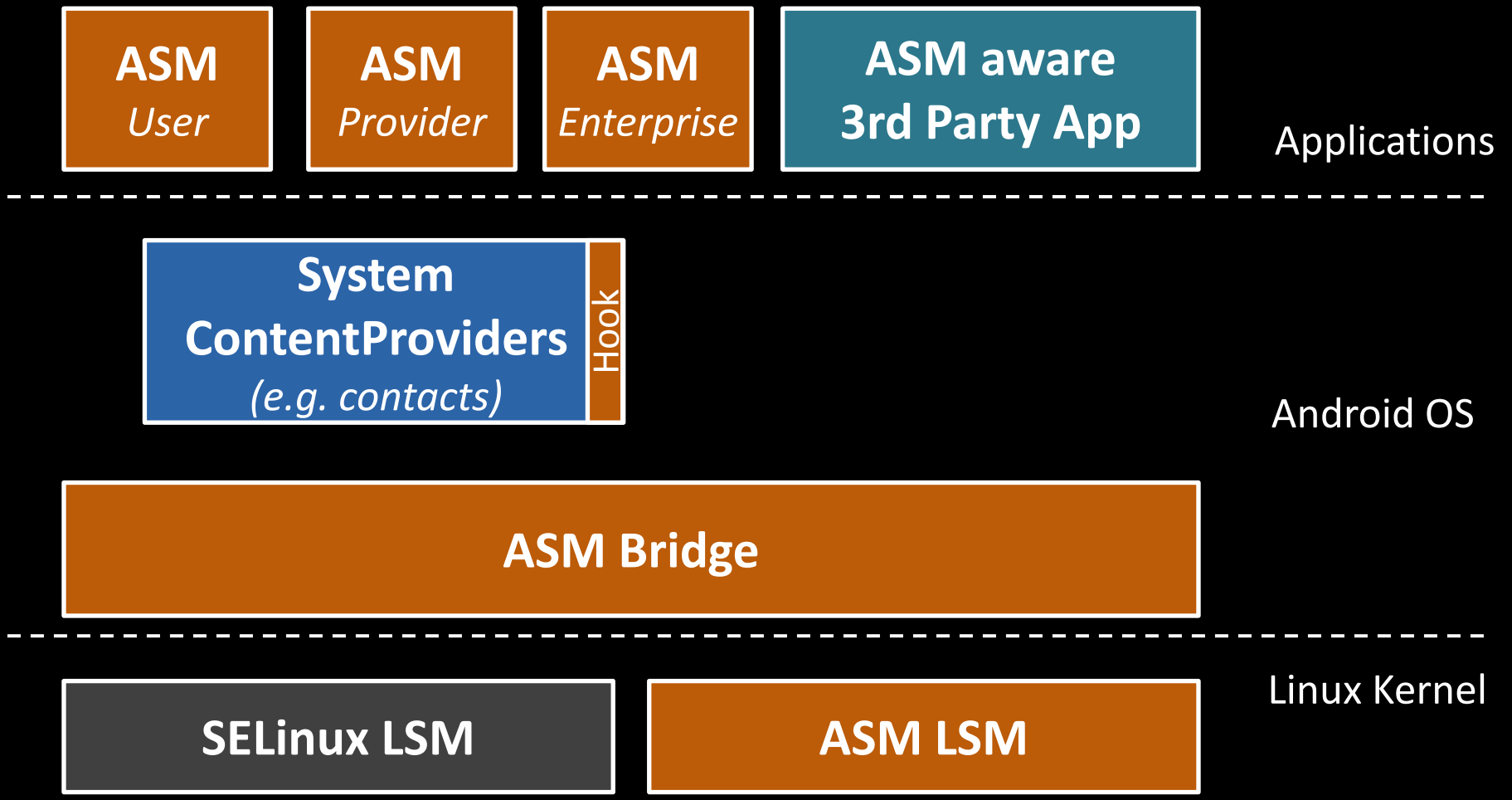


Support for 3rd-Party Hooks



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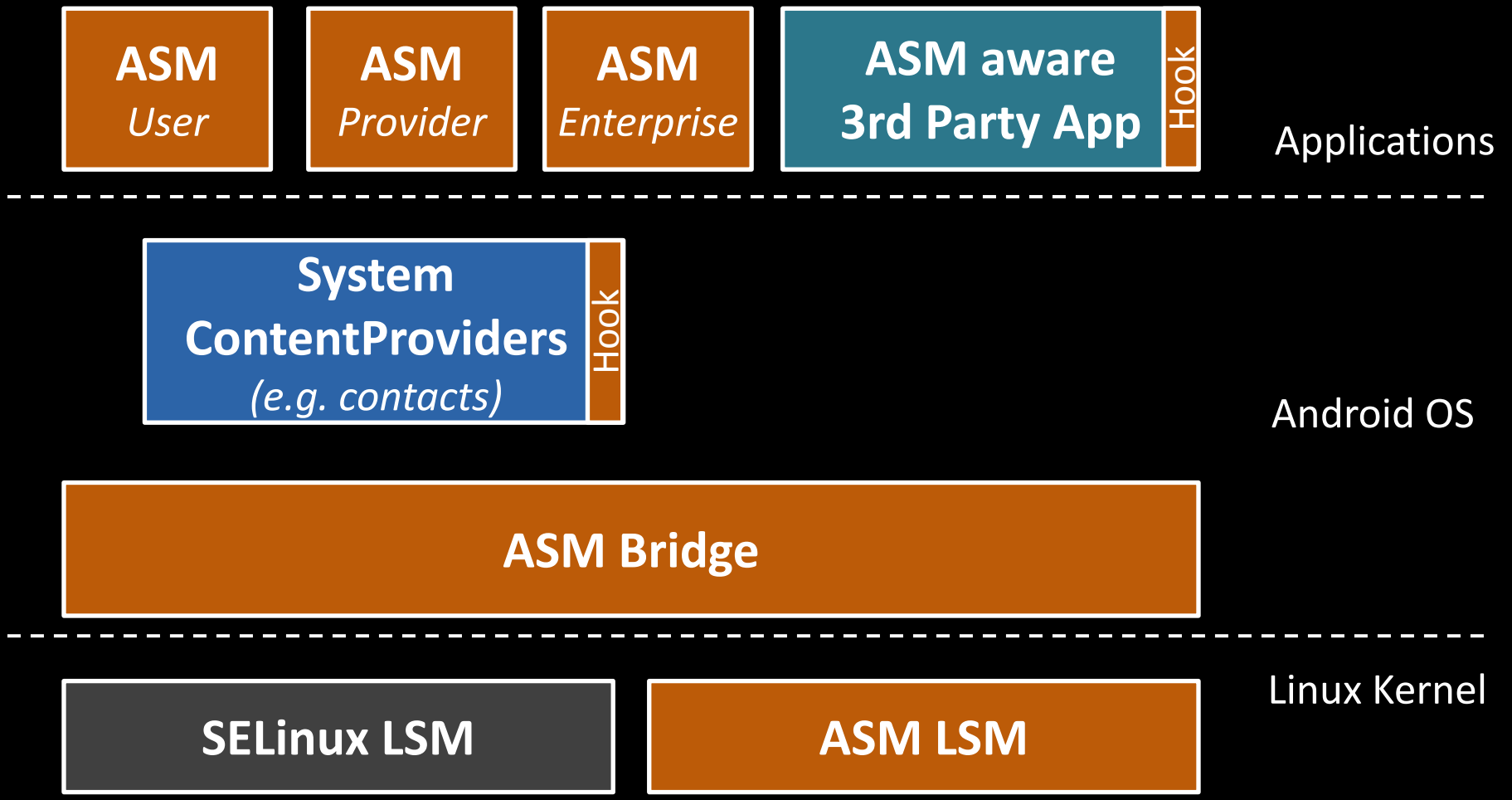

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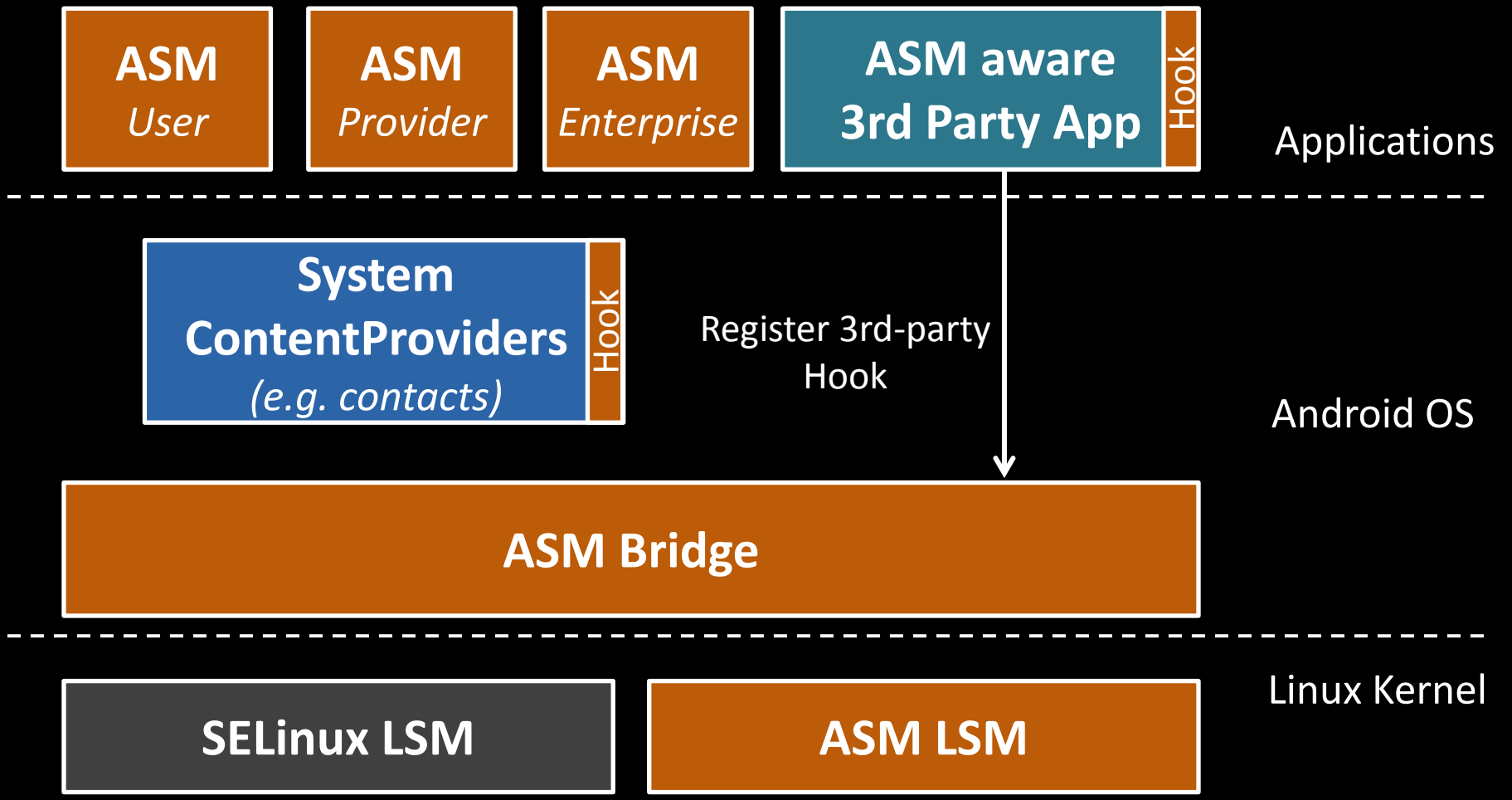


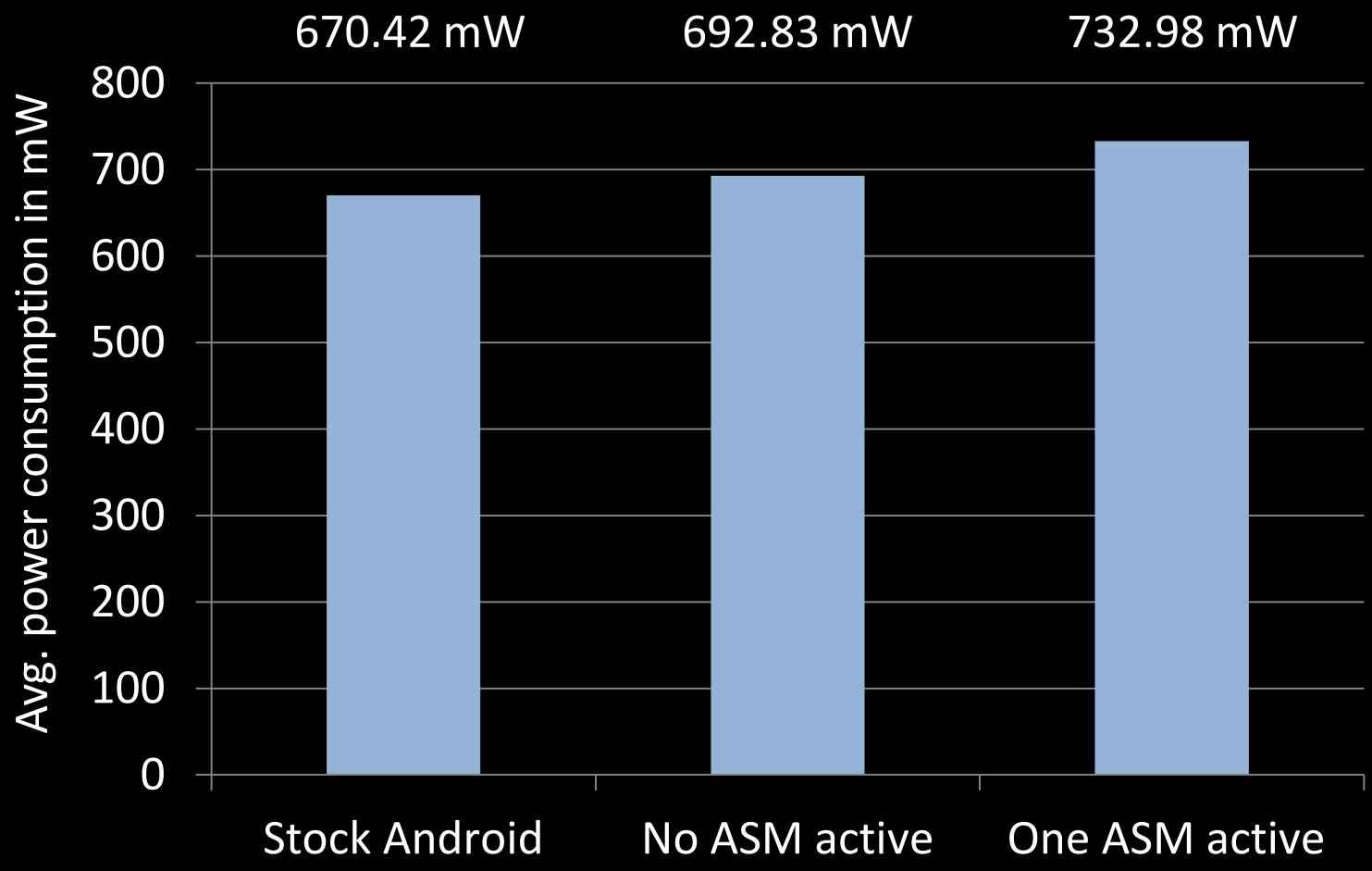
Evaluation

Experiment Setup

- **LG Nexus 4**
- **Android 4.4 (with ASM extensions), Linux MSM Kernel 3.4**
- **Evaluated aspects include User Interface (Activity), Contact, File and Socket operations**
- **Considered impact of a plain ASM**
- **Automated Test Suite**
  - Performance Overhead: Java System.nanotime()
  - Power Consumption: Qualcomm Trepn Profiler

Performance

Power Consumption



Example Use Case

ConXSense
Context Aware Access Control

- Goal: Context-aware access control

ConXSense [ASIACCS 2014]

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Context Aware Access Control

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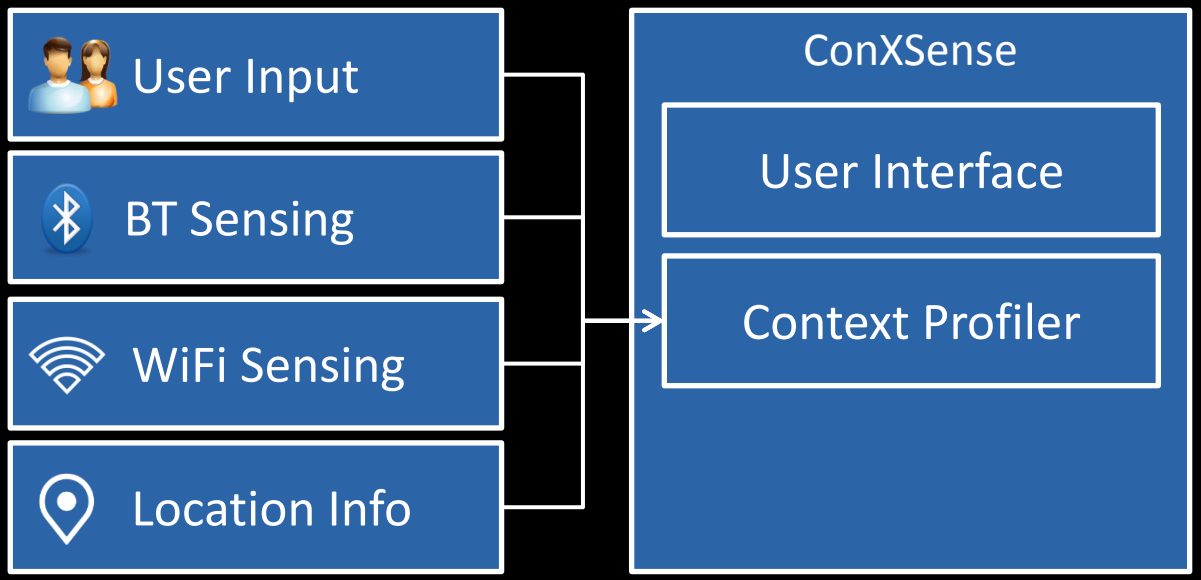
  - Context-aware access control enforcing policies by user context profiling
  - Includes access control on sensors (e.g., GPS and camera), sensitive information (e.g., contacts) and apps



ConXSense [ASIACCS 2014]

ConXSense
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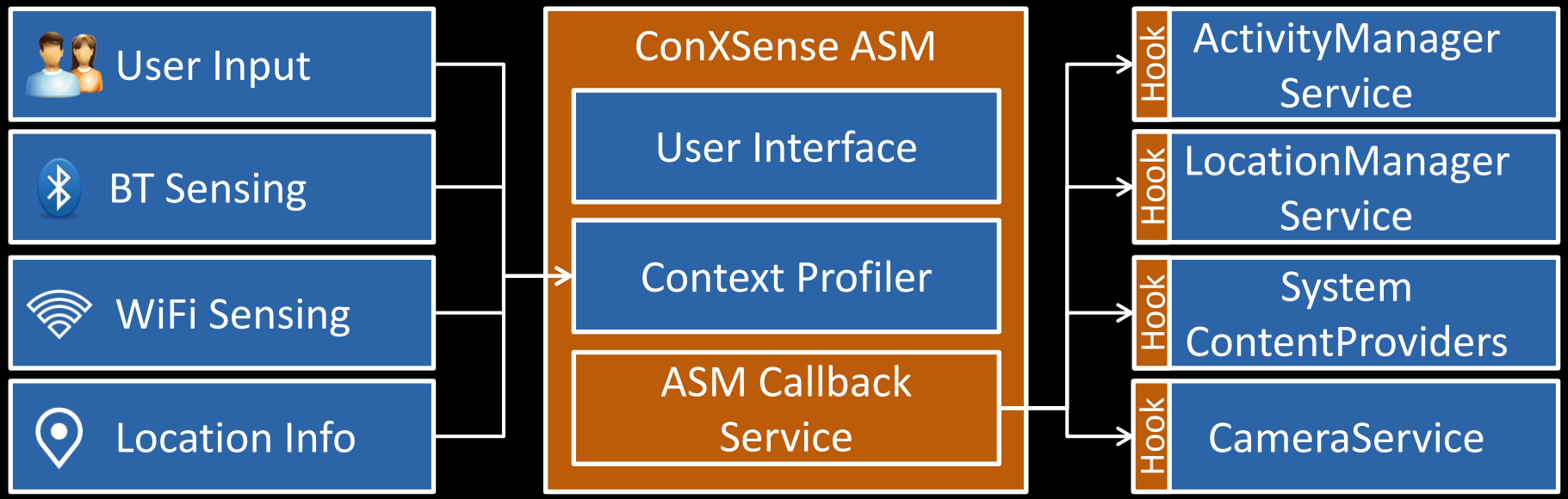
- Goal: Context-aware access control
  - Context-aware access control enforcing policies by user context profiling
  - Includes access control on sensors (e.g., GPS and camera), sensitive information (e.g., contacts) and apps
- ASM based implementation:



ConXSense [ASIACCS 2014]

Conclusion

- **ASM greatly simplifies use-case specific solutions**
  - Developers don‘t need to modify system components
  - Implementation of security solutions as apps
- **Currently working on further use-cases**
  - Dual Persona Phone
  - Dynamic Application Behaviour Analysis
- **Port to new Android versions**
- **Push ASM to device vendors, AOSP**
  - Google, OEMs – please call us ☺

Thank you!

Questions?

http://www.androidsecuritymodules.org