# Privacy Policy Modelling And Analysis for Android Applications

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# Access Control Policies

→ Mobile applications access user information via phone's resources

- Access control policies managed by system: permissions
- Permissions to access resources of the phone
- Geolocation, SMS, Contact List, Phone Calls,...

- Android: Either permission granted, either installation refused
- No possibilities of constraints over permissions
- Lack of granularity for managing access to resources
- Access to resources = mobile privacy management

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→ Lack of granularity for privacy management

# Constraints over Policies

→ Several tools exist for adding such constraints

- On Android: *Apex* (User defined constraints over permissions) [1],
- *ConUCON* (context-aware usage control mechanisms) [2]
- ...

→ Those tools allow declaration of constraints over policies

Example

- *Facebook* application can only access Internet between 06:00PM and 08AM
- *AngryBirds* cannot access localisation
- *Twitter* application can only access localisation when inside UK

[1] Khan et al., "Apex : Extending Android Permission Model and Enforcement with User-defined Runtime Constraints"

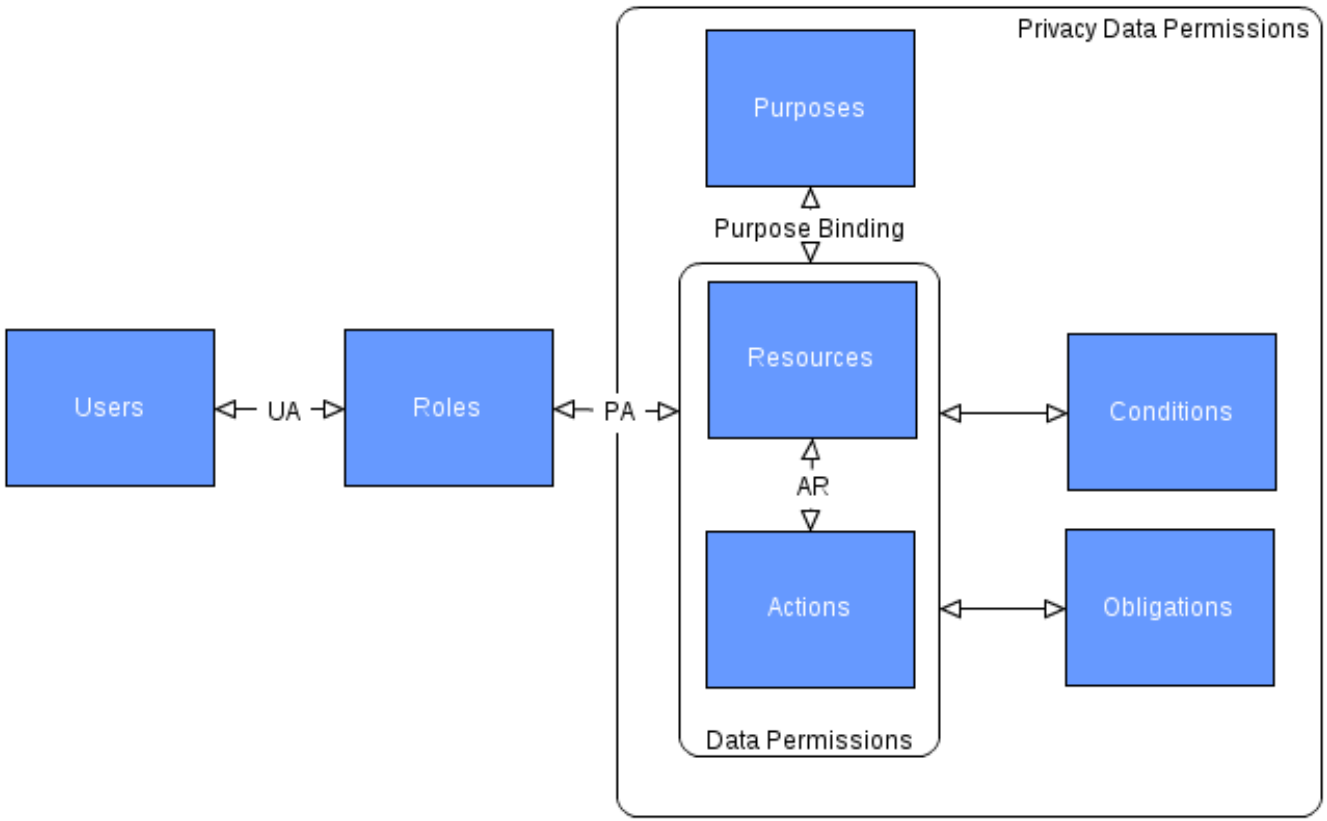
[2] Bai et al., "Context-Aware Usage Control for Android"

# Modelisation of policies

- Constraints can either be defined by users, or by system
- User-centric or context-aware privacy management
- Conflicts between constraints can arise
- Tools have to ensure the satisfiabilty of constraints

- Toward a model based on P-RBAC
- Allows reasonning and modelling of policies
- Manage conflicts between constraints
- Based on a well-known proved access control policy (RBAC)

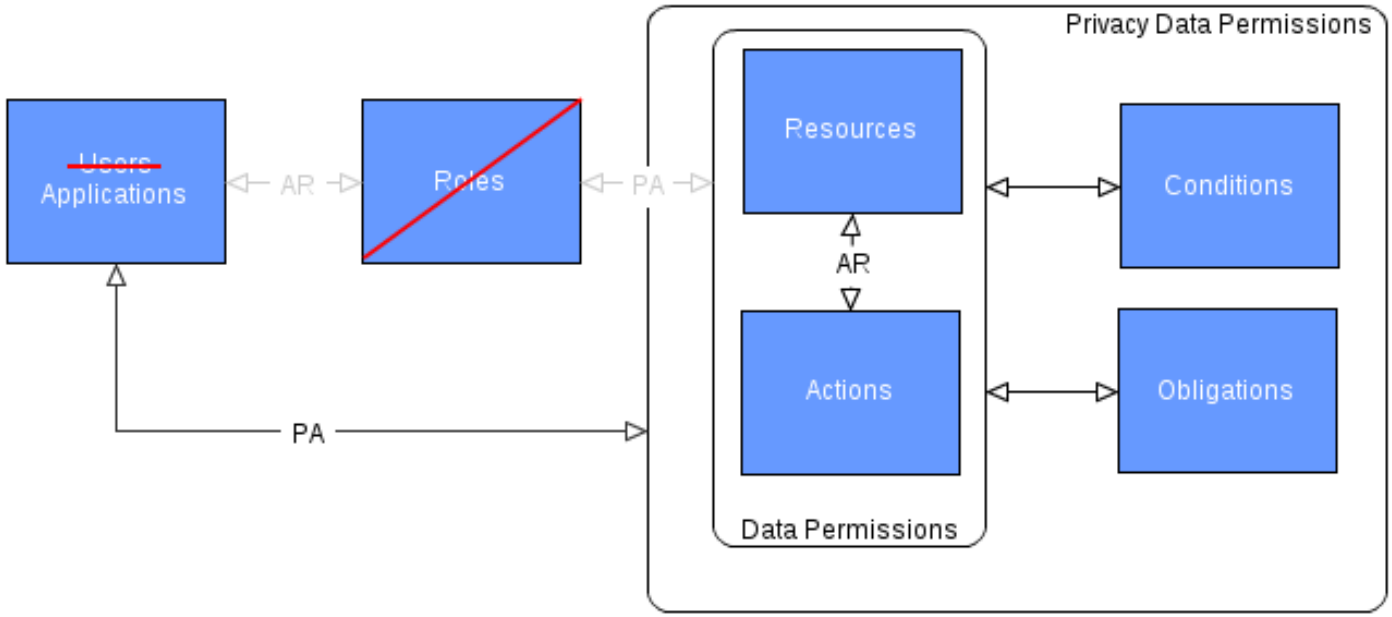
# USING P-RBAC TO EXPRESS POLICIES




Restated mainly from [3]

[3] Q. Ni et al., "Privacy-aware role based access control", SACMAT '07

# Using P-RBAC to Express Policies



# P-RBAC Examples

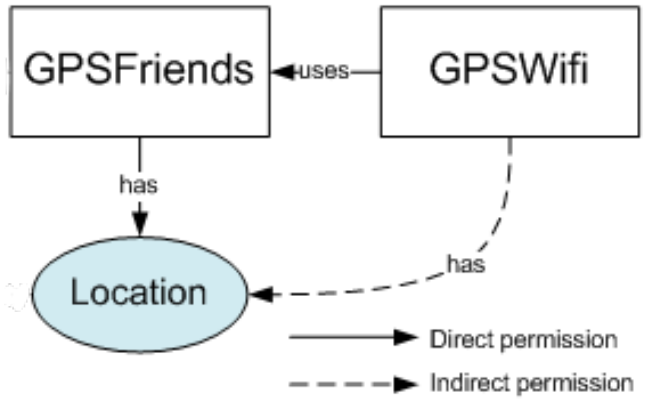
- *permission*(FaceBook, ((access, Internet), ($time > 20 \wedge time < 8$), Log_Access())
- *permission*(Twitter, ((access, ACCESS_FINE_LOCATION), ($time > 20 \wedge time < 8$), Log_Access())

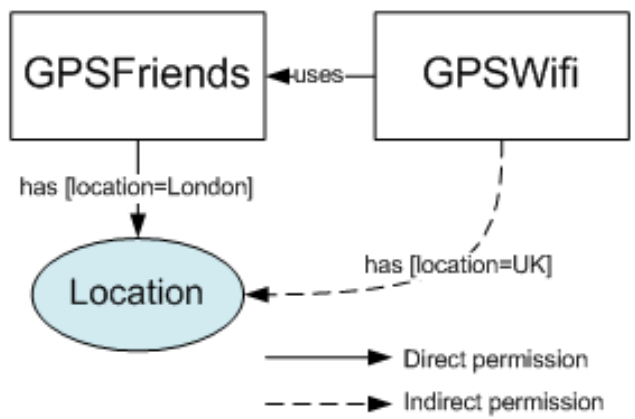
Conflicts could arise if user add a constraint conflicting with one of the above

- *permission*(Twitter, ((access, ACCESS_FINE_LOCATION), ($time > 8 \wedge time < 12$), Log_Access())

Necessity of conflicts checking.

# Problem With Dependencies




→ Need to take dependencies into account

# Representing Dependencies

- Graphs are created when permissions granted to applications (∼installation)
- Constraints over graphs are added depending on tool used (installation, anytime,...)
- Need for a dynamic monitoring of those graph along evolution of concerned applications

- Indirect links have to be managed to avoid privacy and security breaks
- Idea of **groups of applications**, policies (constraints+permissions) applied to groups, and not standalone applications.

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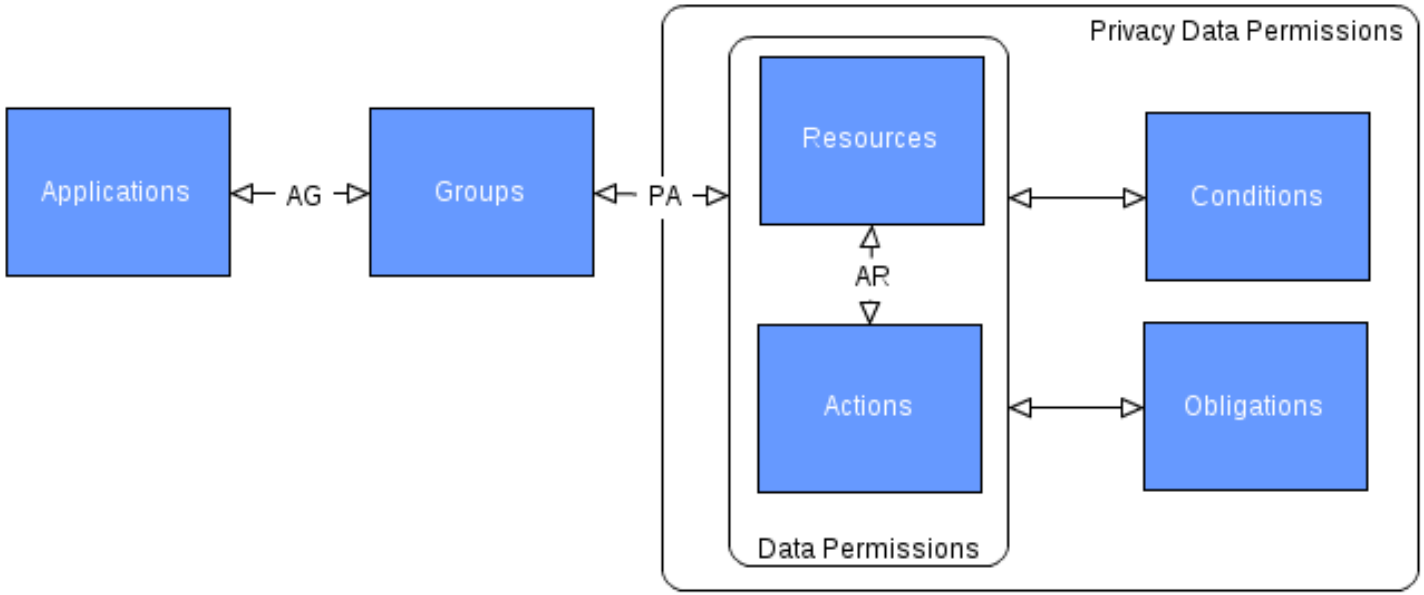
→ Dependency groups

# Dependencies in P-RBAC



# P-RBAC Examples

$Permission_2$: ($Group_1$, ((use, ACCESS_FINE_LOCATION), $Location = UK$, Log_Access()))

$\rightarrow$ restraining all applications belonging to this group by a location constraint on geolocalisation.

$Permission_2$: ($Group_1$, ((use, INTERNET), $time > 16$ and $time < 8$, Log_Access()))

$\rightarrow$ restraining all applications belonging to this group to access Internet only during authorized time interval.

$\rightarrow$ Multigroup belonging and groups hierarchy also have to be discussed.

# Conclusion & Future Work

## Conclusion

- P-RBAC allows to model access control policies of mobile applications
- Dependencies between applications can raise privacy issues
- Managing policies over groups of applications allow to resolve some of them

## Future Work

- Extend the model to other mobile platforms ×
- Allow the expression of policies using a REL (ODRL) ✓
- Development of a prototype for Android applications ✓
- Study privacy changes along dependencies evolution ×