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# Demonstration of Kapuer: A privacy policy manager on Android

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**Abstract**—In this demonstration, we present KAPUER, a system for managing users’ privacy policies on Android. The system includes an authorization recommendation engine that learns user’s preferences in terms of privacy and proposes him high level rules to protect his privacy from applications. Kapuer also provides a interface to manage all the rules it has created.

## I. INTRODUCTION

Since smartphones exist, a large number of applications have been created to meet all kinds of needs that a user may have. Google Play Store, the official Android applications market contains over one million applications and surveys from Google in 2013 reveals that an American smartphone’s user has an average of 33 applications installed on his device [1]. Each of these applications needs permissions to access features like networks or user’s data. We have analyzed some applications to find that they each requires an average of 11.4 permissions for a total of 376 on a typical smartphone. In order to protect their privacy, user’s should be able to manage which permissions an application can use. An adapted management system is needed to process all those permissions.

The problem is the following. On one hand, writing low level rules that handle a single permission is easy but it produces unmanageable policies consisting in too many rules. On the other hand, writing high level rules that handle a set of applications or a set of permissions produces more manageable policies with less rules but the process is harder and requires an analysis.

The majority of smartphone’s users don’t have the required skills to make this analysis and write these high level rules. The idea behind KAPUER is to handle this process instead of the user. KAPUER interacts with the user each time a permission unhandled by a rule is requested. In this interaction, the system informs the user of the request and asks him his decision : accept the application to use the permission or deny it. This decision allows KAPUER to learn the user’s preferences in terms of privacy. Once it has learns preferences through some requests, Kapuer proposes high level rules to the user. If the proposition is accepted, the rule is written in the authorization policy and will be used next time a permission handled by the rule is requested (Figure 1).

## II. DEMONSTRATION

The demonstration has two parts. First we explain the users’ preferences learning process of KAPUER using our

simulation environment. Then, an implementation of KAPUER on an Android device describes interactions with users and the privacy policy management features.

### A. Preferences learning

N°	Crit1	Crit2	Crit3	ScoreChoquet	ScoreKagop	ScoreWMean
0	Lampe Torch...	Paramètre	Lire	0,52	0,29	1,69
1	Doodle Jump	Contact	Lire	1,49	1,76	0,72
2	Clean Master	Wifi	Lire	1,48	1,14	1,73
3	Petite gorge...	Paramètre	Lire	0,25	1,68	1,38
4	Pages Jaunes	Paramètre	Lire	0,95	0,92	1,83
5	Vous avez ca...	Contact	Lire	1,88	1,95	1,34
6	Pages Jaunes	Paramètre	Ecrire	0,45	0,81	0,73
7	Facebook	Téléphone	Exécuter	1,24	0,85	0,42
8	Adobe Reader	3G	Recevoir	0,80	1,59	1,22

Fig. 2. KAPUER experimental platform

An experimental platform has been developed to run simulations and for providing information about user’s preferences learning process (Figure 2). The simulator allows to specify a given user model through a set of predefined privacy policies. Then, the simulator can create random requests to use during the simulation. We decompose a request for a permission in three entities : the application making the request, the resource requested the action made on the resource. In a real device, KAPUER interacts with the user and asks for a decision each time there is a request. The simulator uses the predefined user model to automate these interactions. Thus, a simulation with thousands of requests can be completed within few seconds where it would take a long time with a real device and user’s interactions. Finally, we can compare privacy policies proposed by KAPUER to the predefined user model. The simulator provides different metrics to analyze the learning process.

A simulation with thousands of requests can be completed in one time but to visualize preferences learning, a simulation can also run step-by-step. In this case, a window shows all the

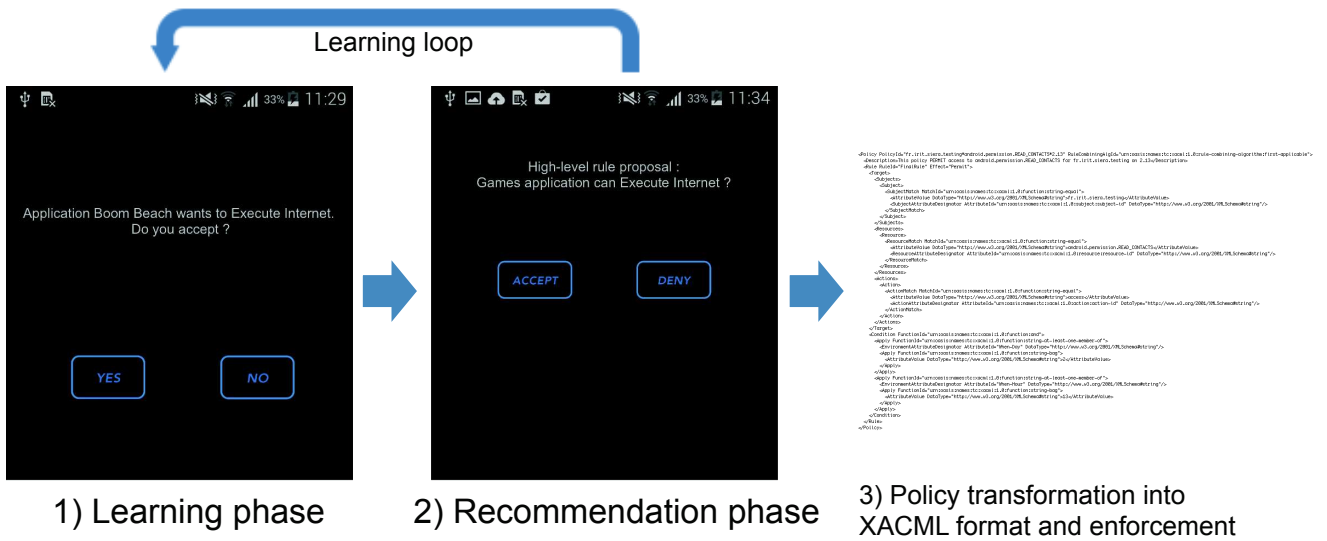


Fig. 1. KAPUER's cycle

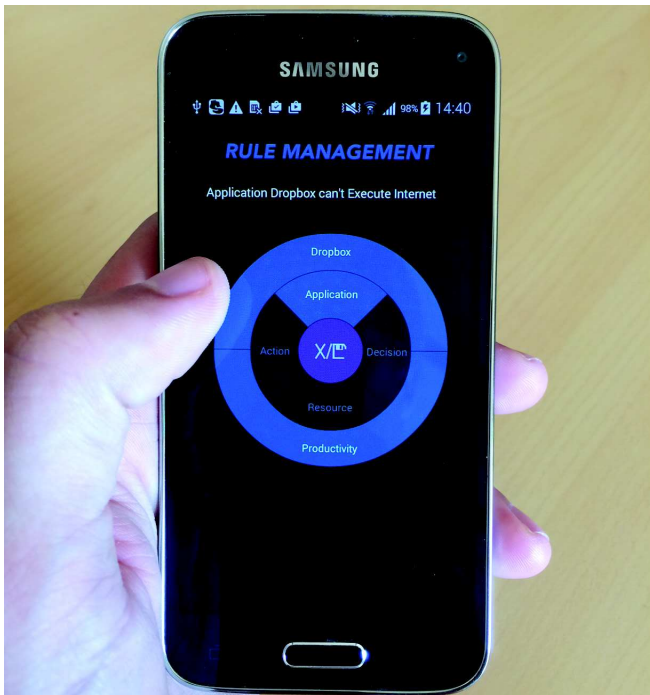


Fig. 3. Implementation of Kapuer : Rule management

details regarding the calculations of user's preferences. More explanation about our problem solving model can be found in [2], [3].

### B. Android implementation

KAPUER has been implemented for Android 4.4 and is available on [www.kapuer.org](http://www.kapuer.org). We have modified the Android permission management process which leads us to modify the source code of Android. We have used the Xposed framework [4] to perform this task. This implementation provides the same recommendation engine as for the simulator, but now,

KAPUER interacts with the user each time a permission request is intercepted. The user's preferences in terms of privacy are learned with the decision of the interaction. After some requests, when some learning has been done, KAPUER proposes high level authorization rules to the user. If accepted, these rules are written in the policy. The authorization system is handled by an implementation of XACML [5].

The implementation provides also features to manage the privacy policy :

- Visualization of all installed applications and their permissions. Information is given for each permission to see if it represents a risk in terms of privacy and if it is handled by a rule written with KAPUER.
- Visualization of KAPUER's policy and all the rules.
- Management of all these rules. Each rule can be edited or deleted (Figure 3).
- Statistics and informations about the uses of permissions by applications like the list of last permissions requested or the most requested permission.

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