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DISTRIBUTION OF MOBILE APPLICATIONS TO USERS IN THE RAIL TRANSPORT OPERATION ENVIRONMENT

DISTRIBUCE MOBILNÍCH APLIKACÍ K UŽIVATELŮM V PROSTŘEDÍ PROVOZU ŽELEZNIČNÍ DOPRAVY

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1 INTRODUCTION

As in other transport sectors, mobile applications have become an important part of rail transport operations. The development of these applications involves various technologies and methodologies. In the context of rail operation, where the requirements are specific, it is a challenging task to establish universal recommendations for mobile app development that can benefit both developers and users. The authors explore this concept in the larger context as outlined in research [1].

The main ways of distributing applications to users and their comparison have been described in many studies. The performed researches show that different variants of mobile application distribution to users have different attributes that make them suitable for specific types of applications and/or for different target user groups. Most apps are distributed through app stores, which have received the most attention in the studies. The ways in which apps are searched for in these stores were examined in detail, including how apps are optimised for this search. App distribution also depends on the way the device is used by users, as described in the performed surveys. Special attention was given in the studies to the direct installation of the app on the device.

The specific needs of mobile apps for the rail transport operations - user management, security and other parameters, identified in study [1] by authors and highlighted in this article - have not yet been focused in this area. The contribution of this

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work lies in the comparison of the most suitable distribution methods with consideration to these key characteristics.

The aim of this article is to review the state of current knowledge in the field of mobile application distribution, summarise the current possibilities and evaluate the advantages and disadvantages of each type of distribution with respect to the unique needs of mobile applications in rail operations.

The article first describes in general terms the key features of distribution types and how these types can differ. Then, it specifically describes each type of distribution and summarises its advantages and disadvantages. Attention is given to the device types classification according to the user's usage and ownership, as this is an important area in rail operations.

2 MATERIALS AND METHODS

This paper uses a systematic literature review approach. The methodology aims to achieve clear, objective results by utilizing a structured search process with specific criteria to identify relevant literature. This approach minimizes bias and ensures transparency by synthesizing information from multiple studies, identifying patterns and drawing robust conclusions. This method is based on research [2] and [3].

The aim of the systematic literature review is to identify gaps in knowledge and suggest improvements to current practices. It involves identifying areas, defining objectives, selecting sources, examining articles and presenting results. This approach improves understanding and informs future studies.

The generally recognized databases Web of Science and Scopus, as the most comprehensive source of scientific articles in the field, were used as a source of information. In addition, information was drawn from recent scholarly articles, the references of which were duly cited in the reference list. The selection included scholarly articles and literature searches from 2017 to 2023.

3 RESULTS

There are different approaches for distributing mobile applications with different characteristics (reach, application quality and security, user access, platform of the target device and use friendliness etc.). It is important to choose the appropriate distribution method for a specific application and user group.

The distribution of mobile applications for rail transport operations has specific needs, especially the following areas need to be focused on:

- high demands on the security of distribution - both of the mobile device itself and of the data transmitted, processed and possibly stored during the installation and update of the application, including internal data. In addition, the user often accesses downstream information systems containing key carrier data with his identity, and a breach of these would represent a serious, high-risk situation. Even ownership of the device is often restricted by the employer for this reason - see below.

- dealing with different states of connection to the data network (online/offline) - when the user is moving (on the train), there are often disconnections and reconnections to the data network, and it is important to keep the state of the application itself and the internal data in the application as up-to-date as possible (e.g. tabular timetables in the app ETD (Electronic track documentation) [4].

For this review, the following types of distributions have been selected that can be considered for applications in rail transport operations.

3.1 App stores

Mobile app stores provide a unified environment for managing, purchasing and installing software applications, eventually other features. These stores are designed for different operating systems (OS) and offer platform-specific apps.

Advantages

- easy access for users to install and update the application,
- analytics - some app stores include functionality for mobile app developer analytics,
- app verification - most app stores guarantee a certain level of app offering through an approval process, which is trusted by users,
- user-friendliness - app stores offer various features for users such as app reviews, sharing options, etc.

Disadvantages

- access to the application - users are not authenticated in the vast majority of cases, which may not be desirable for internal applications,
- approval of the application - checking for compliance with application quality and security rules causes delays in getting the application to users,
- fees - some app stores require developers to pay fees for their services,
- dependency of the app on the store - apps are dependent on the chosen store, a store outage may limit the availability of the app; apps must also meet the requirements of specific store.

Online app stores are further divided into two categories - native platforms that are integrated into the OS (Google Play, AppStore), and alternative third-party platforms. Within these two categories, there are many different app stores with different features and specifications.

App distribution

In general, the app distribution method for all app stores is similar and involves uploading the app to the console, receiving platform feedback, testing, releasing new versions, and providing continuous updates.

Searching for apps

App store search is similar to searching for websites using a search engine, with results and ranking based on complex algorithms [5]. The criteria of a specific app store are often overridden by app characteristics and user opinions [6]. Search algorithm optimization is a growing topic, with research focusing for example on heterogeneous hidden Markov model [7] and content-based filtering [8]. App Store Optimization (ASO) focuses on optimizing mobile applications, focusing on metadata, appearance, localizing product pages, review strategies, app visibility, and monitoring and responding to competition [9]. Implementing ASO during development is crucial, but it can be abused for better rankings [10].

From the research conducted, it can be concluded that app stores are suitable for the distribution of mobile apps that are to be distributed to a large number of users and meet all the conditions for approval in the store. The installation and further maintenance of the app (updates, etc.) is in the hands of the mobile device user.

3.2 Mobile device management

Ownership and use of a company mobile device

For proposing an appropriate way to distribute a mobile application on a device, it is important to know how devices can be used, especially in an in-house environment.

BYOD (Bring Your Own Device) allows employees to use basic apps on their smartphones, but high risk of loss makes minimal integration possible. COPE (Company

Owned/Personally Enabled) and CYOD (Choose Your Own Device) programs focus on enterprise applications, integration, and security, allowing non-enterprise functions. Containerized tools maintain separation of personal and work data, applications, and employee privacy. COBO (Company Owned/Business Only) and COSU (Company Owned/Single Use) prohibit personal use of mobile devices, with COBOs used in regulated industries or high security environments [15].

Mobile device management tools

There are various tools that fall under the mobile device management.

MDM (Mobile device management) is used in companies with high security requirements. It includes deployment of applications on the device, enterprise policies and backend infrastructure [11].

MAM (Mobile Application Management) solutions enable companies to control access to enterprise applications and content on BYOD devices, allowing for easy removal of personal data in case of device loss or employee departure [12]. MAM is similar to MDM except that it is only applied to specific applications on the device, not the entire device [13].

EMM (Enterprise Mobility Management) manages applications, content, and identities on devices through application wrapping and containerization, while UEM (Unified Endpoint Management) supports endpoints across multiple platforms, eliminating need for multiple solutions [14].

There are plenty of off-the-shelf products - the best rated for 2022 include Kandji, Microsoft Intune, Google Workspace MDM.

Advantages

- centralized management - MDM enables centralized management of all mobile devices in an organization, simplifying the management, updating and configuration of applications on these devices,
- more control - the IT (information technology) administrator has more control over mobile devices and applications. He can set rules for data access, monitor usage, and manage devices remotely,
- enhanced security - MDM allows to implement security policies such as passwords, data encryption and remote data deleting, which increases the security of mobile devices and data,
- easy updates - app updates can be easily and efficiently made to all mobile devices in an organization, simplifying management and increasing consistency across devices.

Disadvantages

- costs - the purchase and implementation (or development of a custom one) and operation of MDM requires the cost of IT staff, hardware and software,
- limited flexibility for users - IT administrator has – according to type of device usage - more control over mobile devices and applications, which may be perceived negatively by some users,
- some mobile device settings may need to be adjusted to allow MDM and application distribution,
- limited availability - in some cases, apps distributed using MDM may be restricted to certain platforms or devices, which may limit the availability of apps to certain users or user groups,
- high security requirements - because MDM has extensive access to devices, it is important to ensure sufficient protection against potential attacks, which makes the acquisition and maintenance of MDM more demanding compared to other solutions (finance or human resources)

From the above features, it is clear this method is suitable for enterprise environments with specialized applications, with high demands on the security of applications and devices.

3.3 Direct installation into the device

Another way to install the app is to install it directly on the mobile device. This is directly dependent on the OS.

Android

The Android OS use an Android Package Kit (APK) or App Bundle (AAB) to distribute and install mobile applications [16]. The APK contains the content to run, while the AAB contains the project content and other metadata. AAB is a publishing format and cannot be installed on Android devices, which delays the generation and signing of APK files. Google Play servers generate optimized APK files with device-specific resources and code for installing apps.

Operating system iOS

Installing IPA (iOS and iPadOS application) files directly on iOS devices is not very widespread, as Apple has very strict restrictions for installing apps on its devices. For developers or app testers, direct installation of IPA files can be useful. Developers can use Apple's developer certificates to install and test their apps directly on their devices, without having to publish the app to the App Store.

Advantages

- speed - direct installation allows to quickly upload and install the application without the need to interact with the distribution platform (application approval, etc.), which is especially used by developers for quick testing or distribution of the application to a small group of users,
- independence from the app store - allows to install apps that are not available in the app store.

Disadvantages

- security - direct installation can be risky if the user installs a malicious file, which can lead to malware infecting the phone or stealing sensitive data,
- need to allow installation from unknown sources - requires permission to install apps from unknown sources, which can increase the risk of security threats, especially if users don't know exactly what they are installing,
- limited device or OS support - some devices and OS may not support direct installation of applications.

From the information obtained, it is possible to conclude that direct installation of the application on the device is particularly suitable for the development and testing of mobile applications, installation of applications from alternative sources, or distribution of the application in a closed environment with a small number of users.

4 CONCLUSION

Although more studies and researches have been conducted on the topic of mobile application distribution, the specific needs of applications for rail transport operations have not yet been addressed in detail. Because the needs of applications in this field are different from those of traditional commercial applications, it is important to conduct a review of existing technologies with this particular focus.

The article describes the current situation in the field of distribution of mobile applications to users for railway transport, especially the special demands of this type

of applications. It summarizes the main types of distribution and compares their advantages and disadvantages. It first describes the most common way of app distribution - through app stores, the life cycle of apps in these stores and the principle of app discovery. Next, attention is paid to distribution in the corporate environment, including the management of mobile devices and the applications on them. Then, direct installation of an application on a mobile device is described and cases where this method is an appropriate choice are presented. The advantages and disadvantages of these main distribution methods, which are crucial for mobile applications in railway operations, are highlighted.

As a result of the survey carried out in this paper, it can be said that the distribution types have quite different parameters and are therefore suitable for different types of applications. By comparing information from different expert sources and considering the current direction of research and development of new technologies, it can be concluded, that for commercial applications, used by a large number of users, app stores are the most suitable, whereas for in-house environments with fewer users and specific security requirements, mobile device and application management solutions are more suitable.

These findings are an important basis for establishing an input base for more precise recommendations, for the distribution of mobile applications for rail transport operations.

As these summaries are a stepping stone to determine a specific approach for the distribution of mobile applications for rail traffic, it is recommended to conduct follow-up detailed research on the specific distribution methods selected using scientific methods and to validate them on a specific case in a real traffic environment. It would be appropriate to integrate the research into a broader set of general recommendations for the development of mobile applications for rail traffic.

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Summary

This paper deals with the distribution of mobile applications from the perspective of the needs of applications to support rail traffic operations, whose needs are very specific, especially with respect to security and a characteristic group of users. The authors conduct a systematic literature review in order to provide a comprehensive overview of the field and to identify gaps in current knowledge, focusing on parameters key to rail transport operations. The research identifies and describes the types of mobile application distribution that can be considered for this area. App stores provide a unified and user-friendly environment for developers and users and other features, but have security limits and approval delays. Mobile device management (MDM, etc.) offer the ability to set security policy and control over the device and applications, with the disadvantages of cost of the solution, limited user flexibility, and the need for secure access to manage the system. Direct installation of an application on a mobile device is fast and independent of other systems, but there is a risk of installing malicious files and limited boot or operating system support should be considered. Each of these methods is therefore suitable for a different group of applications and users. Thus, the study results in a summary of these parameters that are important to apply in a rail traffic environment. After conducting the study, the authors noted the need to further compare the results in detail using other scientific methods and to incorporate this partial research into a broader set of recommendations for the development of mobile applications for rail operations so that a consistent environment can be created for both developers and users of these mobile applications.

Resum e

Tento  l anek se zab yva distribuci mobiln ch aplikaci z pohledu potrieb aplikaci pro podporu provozu  elezni n  dopravy, jejich  potriebu jsou velmi specifick , p edev m s ohledem na zabezpe en  a charakteristickou skupinu u ivateleur . Auto i prov ad ej  systematick  p ehled literatury s c ilem poskytnout ucelen  p ehled o dan  oblasti a identifikovat mezery v sou asn ch znalostech se zam eřen m na parametry kl i ov e pro provoz  elezni n  dopravy. V yzkum identifikuje a popisuje typy distribuce mobiln ch aplikaci, kter  lze pro tuto oblast uva ovat. Obchody s aplikacemi poskytuj  jednotn  a u ivatelsky p iv etiv e prost ed i pro v voj a e i u ivatele a dal i funkce, maj  ale bezpe nostn  limity a prodlevy p i schvalov n . Spr avy mobiln ch za izen  (MDM atd.) nab zej  mo nost nastaven 

bezpečnostní politiky a kontrolu nad zařízením a aplikacemi, nevýhodou je cena řešení, omezená flexibilita uživatelů a potřeba zabezpečení přístupu ke správě systému. Přímá instalace aplikace do mobilního zařízení je rychlá a nezávislá na dalších systémech, existuje ale riziko instalace škodlivých souborů a je třeba uvážit omezenou podporu zařízení nebo operačního systému. Každá z těchto metod je tedy vhodná pro jinou skupinu aplikací a uživatelů. Výsledkem studie je tedy souhrn těchto parametrů, které je důležité aplikovat v prostředí provozu železniční dopravy. Autoři po provedení studie zaznamenali potřebu výsledky dále detailně použitím dalších vědeckých metod porovnat a tento dílčí výzkum začlenit do širšího celku doporučení pro vývoj mobilních aplikací pro provoz železniční dopravy tak, aby bylo možné vytvořit jednotné prostředí jak pro vývojáře, tak pro uživatele těchto mobilních aplikací.

