

ŚKUP CARD

A POLISH PROJECT
WITH AN ITALIAN HEART



“When you are walking high in the mountains, you do not always have complete awareness of the path you have already travelled and only when you reach the top you do actually realise how high you have climbed.”

When you are walking high in the mountains, you do not always have complete awareness of the path you have already travelled and only when you reach the top you do actually realise how high you have climbed. Something similar happened to us with the ŚKUP Card project in the region of Silesia in Poland. Three years of very intensive work have passed which culminated in the greatest system ever implemented by AEP being given its final approval by the project owner.

So we have decided to dedicate this document to the description of the ŚKUP system which is the result of a public investment of almost 50M Euros. In these notes we try to explain the effort made by the other partners and ourselves to implement this Electronic Ticketing System, which can rightly be included among the jewels of all Europe.

The most interesting characteristics include the card's value in cash so to all intents and purposes it is a bank and not an EMV card, it is complete, and has a wide-ranging Check-in/Check-Out use that many other Countries are now only debating.

The ŚKUP system is not something as yet to be decided - “we will do...”, “we will implement...”, etc. This is a concrete reality that has been tested and is up and running, a reality in which thousands of AEP devices are working and have produced almost two-million sale transactions in the first quarter of this year (1-3/2016).

The success of the ŚKUP project has

also been due to the extraordinary organisation provided by Asseco Poland that had to coordinate many different suppliers from various countries and a team of a thousand people.

One of the reasons for the positive results is the intensive work carried out by the Test teams who worked for many months. The availability and correctness of the service and network data (i.e. stop coordinates) have also been fundamental. Without them, problems experienced in the field might have been insurmountable. So, was everything perfect? Starting up such a huge system cannot be achieved without a few incidents and even in this case, there were some obstacles in the beginning due, above all, to the personnel and the users themselves who all needed to familiarise themselves with the new card and devices. The strong organisation behind the ŚKUP Card has rapidly directed the rate of help to absolutely physiological levels, demonstrating that every new Electronic Ticketing System not only requires electronics and software but also robust management and support organisation infrastructure in addition to providing users with the correct information.

AEP would like to take this opportunity to thank the customer Asseco Poland for trusting them as well as the tens, maybe hundreds, of people, in-house and external, who collaborated with skill and enthusiasm to translate the ŚKUP Card project into reality.



Silesia

Silesia (Śląsk in Polish, Silesia in Latin and in English) is a historic region in Central Europe that now largely belongs to Poland with smaller areas belonging to the Czech Republic and Germany. Silesia corresponds to the higher and middle reaches of the

River Oder and is clearly delimited by the Sudeten mountain range to the south. Its historic capital and main centre is the city of Wrocław. The other main towns are Katowice, Bytom, Gliwice, Wałbrzych, and Opole.

With almost 8 million inhabitants, Silesia has its own language and history as well as the highest income in Poland. In fact, it has a lot of coal mines which mainly lie on Polish territory and support great industrialisation composed of the metallurgical, chemical, and textile sectors.

The metropolitan area of Silesia is one of the key centres in the country, integrating 14 of the largest towns of Silesia and the Dąbrowa Basin. Two million inhabitants live on a surface of 1,200 square km.

It represents one of the best investment areas in Poland with a large labour market and cultural and tourist attractions too.

ICT Role

The information and communication technologies are an integral part of the social network of developed economies in as far as a modern society not using Information and Communication Technologies (ICT) is unthinkable. They cause deep and fast changes in advanced economies affecting the types of goods and services produced, production methods and systems used, and the location of production activities, infrastructure, and the organisation of company change.

ICT goods and services are increasingly used by citizens to meet the needs of everyday life and by public administrations

so that they can provide cheap and timely services as well as by companies for their production activities. ICTs make production processes more efficient and also offer a wide range of product innovation. New ICT goods and services create new demands, new markets, and new production sectors [1].

e-Government

Digital Administration or e-Government is a digital management system for Public Administration. In addition to actions for organisational changes, it enables the processing of documentation and management of procedures by using ICTs.

Digital Revolution in Silesia

The effort to build an IT society in Poland began in 1994 ("Strategy Report," 1994) [2].

EUROPEAN UNION Smart use of financial resources made available after Poland became a member of the European Union has allowed the information technology society to develop.

The main aim of the actions taken is to develop the ICT infrastructure, digital content and services as well as improve skills in ICT infrastructure development and use as well as digital services.

STRATEGY In the month of April 2009, the Silesia Regional Assembly approved a resolution on the strategy for developing the information technology society until 2015 in three main directions:

- Civic: disseminating the availability of ICT infrastructures as well as digital content and services for citizens to use;
- Public Administration: improving PA efficiency by using the ICT infrastructure as well as digital content and services;
- Entrepreneurial: increasing competitiveness by creating and using ICT infrastructures as well as

digital content and services.

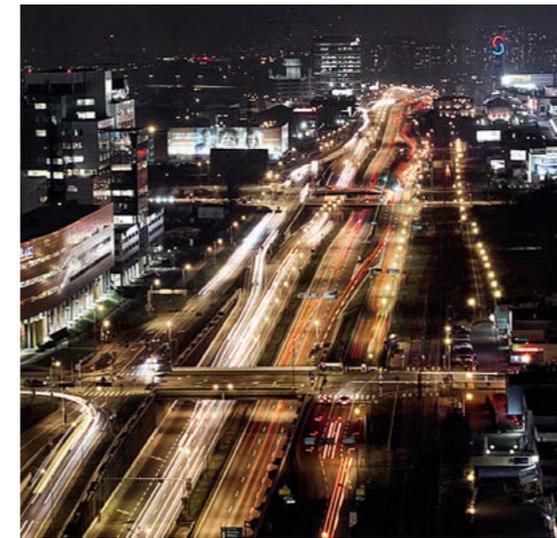
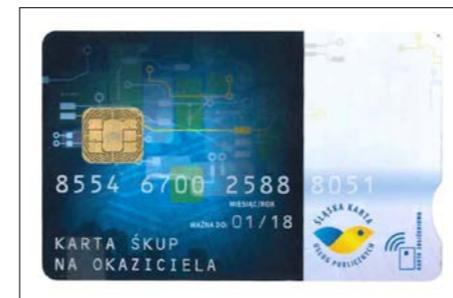
Five Goals

With these aims in mind, five strategic objectives and courses of action to be taken were identified:

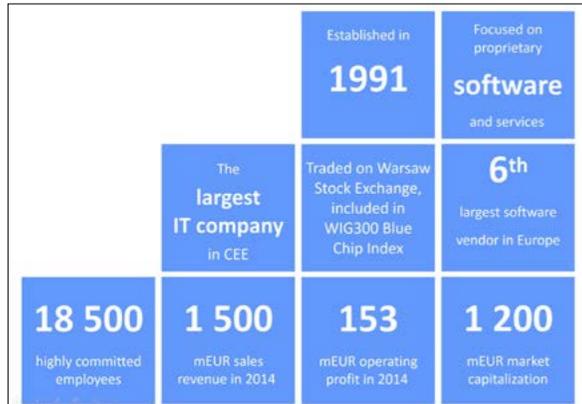
- Boosting awareness of and skills in the use of ICT infrastructures and digital services;
- Enhancing technical and economic accessibility to ICT infrastructures;
- Increasing quantity and usefulness of digital content and service;
- Increasing participation of ICTs in the economic development process;
- Improving development coordination and development.

ŚKUP Card

The largest project in value ever carried out in the Silesian Voivodeship in the field of e-government services is the Silesian Public Service Card (Śląska Karta Usług Publicznych, abbreviated to ŚKUP).



SILESIA EUROPE



Top 100 European Software Vendors					Truffle Capital
Rank	Company	Sales revenues 2013 (software + services) [EUR millions]	Sales revenues 2012 (software + services) [EUR millions]	Change	
1	SAP	29 512.3	25 930.0	+13.0%	
2	DASSAULT SYSTEMES	1 887.5	1 853.4	+1.8%	
3	SAGE	1 522.6	1 591.4	-4.3%	
4	HEXAGON	1 309.6	1 282.8	+2.1%	
5	WINCCOR NIXDORF	1 257.3	1 257.3	0.0%	
6	ASSECO GROUP	1 063.0	1 002.1	+6.0%	
7	SOFTWARE AG	856.5	922.2	-7.1%	
8	DATEV	752.8	736.7	+2.2%	
9	WOLTERS KLUWER	720.9	733.4	-1.7%	
10	SWIFT	580.2	594.9	-2.5%	

Asseco Group
The fastest growing producer of software in the Top 10

Asseco Poland is one of the largest European ICT companies and formed the consortium with mBank to implement the ŚKUP project. The preceding tables show some meaningful figures about its significant presence. AEP operated as Asseco's subcontractor.

Who conceived it?

The ŚKUP Card system was made by a consortium composed of mBank and Asseco Poland. The Consortium worked with a lot of subcontractors and one of them was AEP - and we take the liberty of thinking that it was the most important which operated on behalf of Asseco Poland as described in this document.

For whom?

The project was completed for KZK-GOP (Komunikacyjny Związek Komunalny Górnośląskiego Okręgu Przemysłowego), the Upper Silesia Inter-Municipal Transport Association founded in 1991. The legal basis for the establishment of KZK-GOP is the Local Government Act of 8th of March, 1990 which recognises the municipalities as responsible for the organisation of public transport.

In Poland, municipalities can enter into a partnership to jointly carry out public activities whose performance is too much for the capacity of one individual municipality, as was the case in the urban area of Katowice.

Therefore, the organisation of local transport needed to be agreed, the KZK-GOP consortium was established which in turn assigns the management of specific areas or sections to different companies.

Coverage

The KZK-GOP service almost covers the whole conurbation of Katowice and some surrounding areas over a surface area of 1,800 square km, carrying almost one million

passengers a day. Currently, KZK GOP includes Katowice, Bytom, Bobrowniki, Bedzin, Chelm Slaski, Chorzow, Czeladź, Dabrowa Mining, Gierałtowiec, Gliwice, Imielin, Cinghiale, Łędziny, Mysłowice, Piekary Slaskie, Pilchowice, Psary, Pyskowice, Radzionków, Ruda Slaska, Rudziniec, Siemianowice Slaskie Siewierz, Slavkov, Sosnowiec, Sośnicowice, Świętochłowice, Wojkowice, and Zabrze.

Tariff Integration

The integration of public transport has facilitated the creation of an integrated tariff system, time coordination, and equitable allocation of public funds.

mBank

mBank (previously known as Brebank) has been listed on the Warsaw stock exchange for 24 years and is synonymous with innovative solutions in the banking sector. It was the first completely on-the-Internet bank in Poland, where it is now one of the strongest and fastest growing financial brands. It is 69.54% owned by Commerzbank AG (Germany).

Asseco Poland

Asseco Poland SA (<http://www.asseco.com/>) is the largest IT company listed on the Warsaw stock exchange and is a European software market leader. As an international system integrator, the company has now become an important player in the European market and is included in the top ten listed European Software Providers.

DanubePay

This organisation is responsible for the security of transactions and, by using the AEP ET system, it manages the allocation of profits to the stakeholders on an accrual basis.

AEP's Role

Asseco Poland chose AEP Ticketing Solutions as its partner in implementing the ŚKUP system. This means that AEP has operated as a subcontractor of Asseco Poland in providing the following:

- ET - The Easy Ticketing, the central ticketing system (ET- CSC) with many additional modules;
- Remote SAM Management subsystem (ET-RSM);
- Communication subsystem (ET-LMW);
- Other modules, such as miniAVM;
- 1,500 on-board subsystems (devices + software);
- Verifier subsystem for 320 ticket inspectors (devices + software)
- Standardised libraries for the management of ŚKUP Cards on different platforms (ET-QUICK).

All these elements are widely described below.

The photos show, Mr. Romano Urbanczyk, chief of the Katowice Municipal Transport Association, announcing that thanks to the introduction of the ŚKUP system, KZK-GOP tariffs will not increase this year.



THE PLAYERS

THE PROJECT ŚKUP CARD

The ŚKUP Card project (Silesian Public Services Card) involves the implementation of an IT system aimed at facilitating the provision of public service using electronic means and supporting management of public administration. The main idea of the project concerns the construction of an integrated electronic pay system for services provided by local government able to collect data on request from each individual service and the relationships that develop between them.

Economic Value

As mentioned above, the ŚKUP Card represents the largest project ever made in the sector of e-Government services in the Silesia Voivodeship.

The total cost of the project amounts to €35,836,206.08 and has been co-funded by the European Union to the tune of €23,496,650.90. Including maintenance for 5 years, the projects exceed 44M EUR (190M PLN).

The scope of the ŚKUP project goes far beyond its economic dimension.

The cities and towns involved

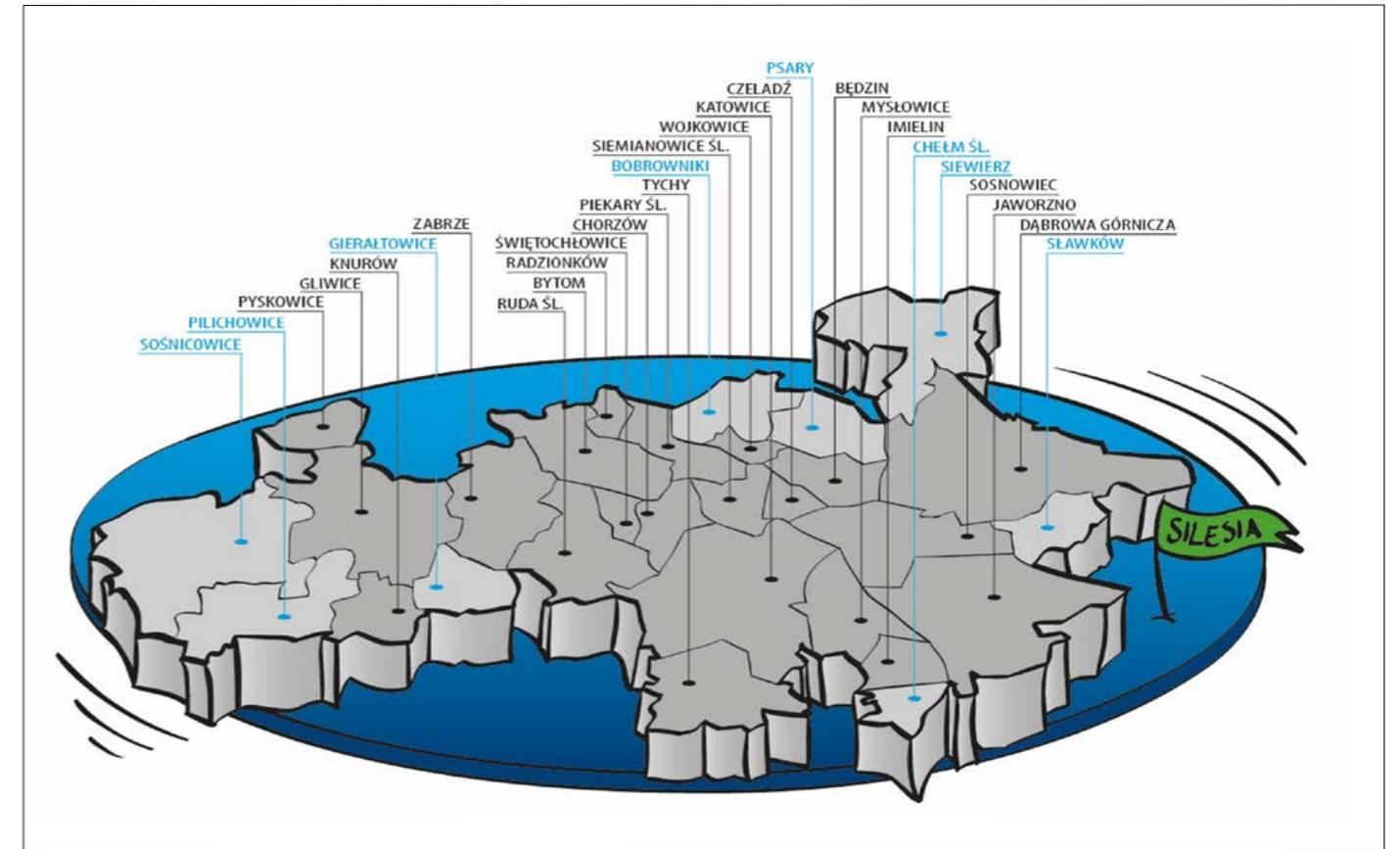
21 towns and cities in the Silesian Metropolitan Area (Będzin, Bytom, Chorzów, Czeladź, Dabrowa Górnicza, Gliwice, Imielin, Jaworzno, Katowice, Knurów, Mysłowice, Piekary Śląskie, Pyskowice, Radzionków, Ruda Śląska, Siemianowice Śląskie, Sosnowiec, Świętochłowice, Tychy, Wojkowice, and Zabrze).

Openness

The ŚKUP system architecture provides the opportunity for new partners to join the project even after it has started operating.

Numbers

- Customer Portal;
- 40 Customer Service Points (POKs);
- Self-service machines;
- 223 parking meters;
- 410 pay terminals for municipal services;
- 800 sales points;
- 7.969 on-board AEP devices on about 1,500 equipped vehicles, of which about 330 are trams;
- 320 devices for ticket inspectors;
- 20 data collection points;
- Two Data Centres (main and backup);
- Central supervision and control system;
- Clearing system;
- 700.000 operating cards.



Top left: the towns in the ŚKUP project (in black).

Trams are widely used for urban transport in the region of Silesia.

What does it allow?

The ŚKUP Card is a multifunctional card issued by mBank, which already allows:

- Payment for public transport by electronic tickets and flexible tariffs as fully described below;
- Payment for parking using the electronic coin and functions such as "Park & Ride";
- Digital administration: identification and electronic signature;
- Cashless payments at offices, cultural centres, libraries, gyms etc. and also at the premises of the project partners.

Physical Card

MODEL DESfire by NXP has been chosen as the physical card.

NON EMV ŚKUP Card is not an EMV card but offers comparable security levels, in some cases even higher. For instance, it uses an in-air encrypted protocol rather than a free-to-air protocol like the EMV.

QUANTITY At the end of March 2016, about 40,000 ŚKUP Cards were activated but their number is rapidly increasing and 700,000 units are expected to be fully operational. This figure alone is indicative of the project's importance and components.

Card Types

The new integrated KZK-GOP tariff system provides for the use of the ŚKUP cards as Travel Documents. Two types of cards are envisaged:

- Personal card;
- Impersonal card.

PERSONAL CARD The personal card contains all of the user's identification data and only the owner is authorised to use it. The card can also contain information about the tariff scheme and so, where applicable, authorises the purchase of tickets at reduced rates.

The personal card can only be purchased at the POKs (Customer Service Points) that issue it. The user can also go to POKs to obtain duplicates, which may be free of charge or cost a fee depending on the case. Applications concerning the issue of a card can be filled in and submitted in person at any POKs or via the Internet by entering the specific portal.

The user must present a photograph and an identity document so that personal data can be checked, and sign a contract with KZK-GOP and mBank that in fact is the card's issuing organisation ("issuer"), associating the card to a bank account.

A small fee is charged to compensate for production costs. This amount is charged to the associated account.

The card will be collected at the POK specified on the application and can be used once activated.

IMPERSONAL CARD The impersonal card does not contain personal data, anyone who holds it is authorised to use it. Applications can be submitted to POKs, Passengers Service Points (POPs) equipped with the specific device and through automatic vending machines (TVMs). A deposit is required, which is confirmed by acknowledgement of receipt. The card can be returned with refund of the deposit paid.

Electronic Purse

ŚKUP CARD FUNCTIONS The ŚKUP card can perform, among the others, the following functions: electronic money/purse and electronic support for Travel Documents.

IPE (Electronic money/Purse Instrument) contains the information on funds available and makes it possible to perform transactions with electronic money.

In this, the ŚKUP card may differ from the traditional implementations used by the Local Public Transport, where the so-called purse only has a conventional value for the

participating companies. The purse in the ŚKUP Card is publicly recognised as having the actual value of money.

The electronic money contract is deemed to have been concluded with the first credit on the IPE, which implies the acceptance of the corresponding regulatory provisions by the user. The card can be used as a means of payment at service retailers and suppliers accepting ŚKUP cards.

Money can be deposited on the IPE:

- Cash, at POKs (Customer Service Points) or POPs (Passenger Service Points).
- With a transfer order from the account via the portal.

MZK PURSE In addition to the IPE described above, the ŚKUP Card also includes a second purse subject to less strict rules used by KZK-GOP for its employees.

Check-In/Check-Out

The Check-In/Check-Out system in the ŚKUP system, which increasingly attracts the attention of Transport Companies, is one of the most meaningful real implementations on a global level.

The ŚKUP card IPE system enables direct purchase of tickets on public transport vehicles. Km, zone, or time tariffs can be selected.

CHECK-IN / CHECK-OUT In the case of km tariffs, the amount is paid in proportion to the distance actually travelled thanks to the so-called Check-in/Check-out method (CICO) used

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When the passenger enters a vehicle, he/she scans the card on the AEP validator (Futura 3A, F240B). Unless other Travel Documents are already present, the display shows the farthest stop a passenger can reach with the remaining amount which

ŚKUP CARD



CHECK-IN / CHECK-OUT

is available on the IPE and is immediately charged. When getting off the vehicle, the passenger scans the card again and the excess amount is returned. As a result, only the amount corresponding to the distance actually travelled is paid.

REWARDS In addition to sanctions for those who do not use it, the ŚKUP system also provides incentive mechanisms of the Check-In/Check-Out system in discounts for those who use it regularly.

Other tariff schemes

ZONE OR TIME-BASED In the case of zone or time tariffs, the passengers can select the number of zones required or the validity time, and again make the payment using IPE.

MULTI-TRIP TICKETS A multi-trip carnet can be bought and used within a determined period, usually monthly.

PAPER TICKETS In line with the original assumptions, including after the introduction of the ŚKUP Card, paper tickets will continue in force. They will have to be validated on board but only on the front-door validator (F240B by AEP).

Use of the Validator

MANY USES The ŚKUP system is very articulated and diversified. Many uses are possible, mainly based on using the purse. For example, there are also:

- Multiple Check-In – this also enables one single card to be used for other travellers and in addition, to select the ticket type (for example, adults, children, pensioners, luggage);
- Transfers – the ŚKUP Card also enables transfers to be made so that the new journey can be evaluated as a continuation of the earlier one. For instance, if the first journey covers 10 km and the second is 5 km long, the amount due for 15 km is charged at the

end and this is more favourable. The maximum time between the two trips can be configured on the system

VIRTUAL VALIDATORS There are so many operations which can be executed on the validators that KZK-GOP has decided to implement virtual models via the ŚKUP Card website.

Distribution Network and Top-Ups

Such a large-sized system as the ŚKUP Card has to be provided with wide capillary sales and support network. At the moment, it is composed of the following:

POK - Customer Service Point – is a network of forty points prepared by mBank to provide a complete system support service. Counters are located in places easily reached by users such as urban centres, trade centres etc. POKs can accept applications and deliver personal cards. They can also activate and replace cards, as well as offer technical support in case of problems.

POP – Passenger Service Point – there are six and they are directly managed by KZK- GOP. They provide information on the transport network. They accept applications for new cards and more in general, requests or complaints. POPs also sell KZK-GOP tickets. All type of tickets - single, monthly, quarterly, several-day etc. - can be purchased.

In addition, they offer card top-up services, sell Tariff Products, provide information, and block cards on a customer's request, for instance, following loss or theft.

POINTS OF SALE Passengers can use another 800 points of sales that sell top-ups and Tariff Products on the customer's card and impersonal cards. The Points of Sale are located in shops, news-stands etc. and are indicated by a large logo.

ON-BOARD SALE –almost 1,500 multifunctional AEP CDB-6 PLUS model units (see following paragraph);

TVMS — there are 109 self-service machines for top-ups and sale of paper tickets.

CUSTOMER PORTAL – many operations such as application for new cards, top-ups etc. are available online (<https://portal.kartaskup.pl/>).

On-board Sale

Thanks to the multifunctional CDB-6 PLUS unit by AEP, drivers can sell tickets according to KZK-GOP's current tariffs, and also distribute tickets to people entitled to them free-of-charge if they are not in possession of a ŚKUP Card.

Tariff Integration

INTEGRATION Thanks to the functionalities described, more vectors have been integrated.

Security

As already mentioned, the ŚKUP Card has the value of cash and is issued by a bank. So it can easily be imagined how much attention has been paid to security-related aspects.

TOP-UPS Cards cannot be topped-up directly but this is possible via DanubePay which provides a cryptogram that the devices in turn transfer to the card. It recognises them and increases the money counter accordingly. So every top-up operation must compulsorily be authorised by the central system.

The exceptions to this rule are validators which at most can credit back the sum charged on check-in during the check-out phase.

SAM UNLOCKING SAM modules are locked on powering up, and require a complex security procedure to start working. This

procedure is performed by AEP (ET-RSM) in the Remote SAM Management system and as an additional benefit, offers the certainty that buses only enter into service when they are completely operational and working.

ET-QUICK

When we talk about security, we not only refer to the protection against fraud but the security of operation is also important too.

Therefore, the ŚKUP Card project does not allow all of the many stakeholders involved to process the ŚKUP cards. They are very complex objects, and an error made by one individual could affect the whole system.

The solution to this problem is ET-QUICK, a single library made by AEP, which directly interprets configuration files generated by ET-CSC and processes the ŚKUP Cards accordingly.

Thanks to ET-QUICK, new operators and/or suppliers can be added easily. The library's use is standardised and considerably simplifies all testing operations.

As an additional advantage from using ET-QUICK, KZK-GOP is able to limit the diffusion of sensitive information connected with the card structure and the way of processing it, further contributing to the security of the whole system.

As you would expect, hundreds of people have been working for a long time to implement, test, and put such a huge and important



Above, the ŚKUP Card portal (<https://portal.kartaskup.pl/start>) is very wide ranging and contains a great deal of information. Google translator can also be visited easily by people who do not know or speak Polish.

Below, mBank is synonymous with innovative solutions in the bank sector. It was the first completely on-line bank in Poland, and is now one of the strongest and fastest growing financial brands in Poland.



B A N K C A R D

ET - THE EASY TICKETING, THE HEART

system like the ŠKUP Card into service. It is a great satisfaction to AEP that ET - The Easy Ticketing was selected as the core of the whole system. This is our Electronic Ticketing System that is also increasingly successful internationally.

ET - The Easy Ticketing

ET - The Easy Ticketing, abbreviated to "ET", is AEP's software application suite for Electronic Ticketing. In using it, large, medium, and small-sized Transport Companies can finally access an easy to use high quality solution. Being modular, their system can be constructed quickly using AEP devices such as validators, vending machines, on-board computers, and so on. These companies have one single supplier in AEP which is open to communicating with the world.

SINGLE CODE ET was developed using a logic which is very similar to that of AEP devices and is based on a single code, which is the same for all users from the youngest to the oldest. It is composed of standard modules that have been implemented industrially and so are streamlined being well-engineered. All customisations are determined using a set of parameters to meet the specific requirements of any Company without needing to change any of the code. When changes to the code are really necessary, they are incorporated into the common source and so can potentially be accessed by any Customers.

MODERN ARCHITECTURE: the ET project is relatively new and has been able to exploit the most modern IT technologies, such as web services.

WEB BASED: ET is based on a form of web-server architecture and can be used by an indefinite number of workstations,

using a simple browser such as MS Internet Explorer, and on any PC via the Internet or the corporate network. Part of the software applications can also operate locally in order to guarantee the continuity of service in case of communication channels failure.

MODULAR AND FLEXIBLE: ET has a modular structure and can be introduced gradually, growing together with the Company's need. Each additional module or sub-module is available separately so that the initial investment can be reduced while the real needs are met.

OPENNESS: thanks to the widespread use of the web service, structurally ET guarantees the opportunity of integrating other platforms such as accounting, movements, management of financial flows, etc. with all the advantages that you can easily imagine.

MULTI-COMPANY: ET is based on a multi-company/multilevel structure, so it is also suitable for several Companies working in synergy or for the creation of Area Centres. For example, ET enables a single Regional Centre capable of offering its services to each Company to be set up which maintains its own full autonomy and independence with considerable reduction in the investment costs.

COMPLETE: ET offers different modules to cover all possible electronic ticketing requirements: central system, ticket offices, resale shops, websites, self-service ticketing machines, on-board systems, web shops, etc and also includes the possibility of adding the functions typical of very big systems such as Remote SAM Management and Massive Issuing Centres.

PERFECT INTEGRATION: system software, firmware, and devices are conceived and designed by teams working in synergy and are consequently perfectly integrated one with the other.

EASY TO USE: ET was judged by the users to be one of the easiest e-Ticketing systems to use. The whole project is based on the assumption that its users are not computer engineers. Users are tasked with managing transport, not learning IT.

ET in the ŠKUP project

In particular, the following ET modules have been adopted:

ET-CSC – is the application for the Supervision and Control Centre that forms the basis for the whole ET system. It can manage one or more Transport Companies, including companies organised hierarchically and working in synergy. Because of the wealth of functions, it can be the core of an entire interoperable regional system, as confirmed by this specific application.

ET-LMW – Communication Management. Communication between the central system's software and remote devices plays a very important role in each e-ticketing system. ET-LMW manages these communications in a standard and secure way, offering the user many service and diagnostic functions.

ET-RSM – Remote SAM Management enables SAM modules to be managed in a centralised way. It manages black lists, remote activation and plafond, guaranteeing the security of the entire system. Should any thefts occur, it automatically deactivates the devices after a limited number of operations. It is one of the cornerstones of security in the whole system.

ET-MOB – on-board inspection. This checks travel documents, validation, sales, and the issuing of sanctions, using - in this case - a smartphone connected to the

portable AEP Mod. TPV reader;

ET-VAL – this is the validation module used for validators and multifunction units. It manages the interface with the driver, communication, etc.

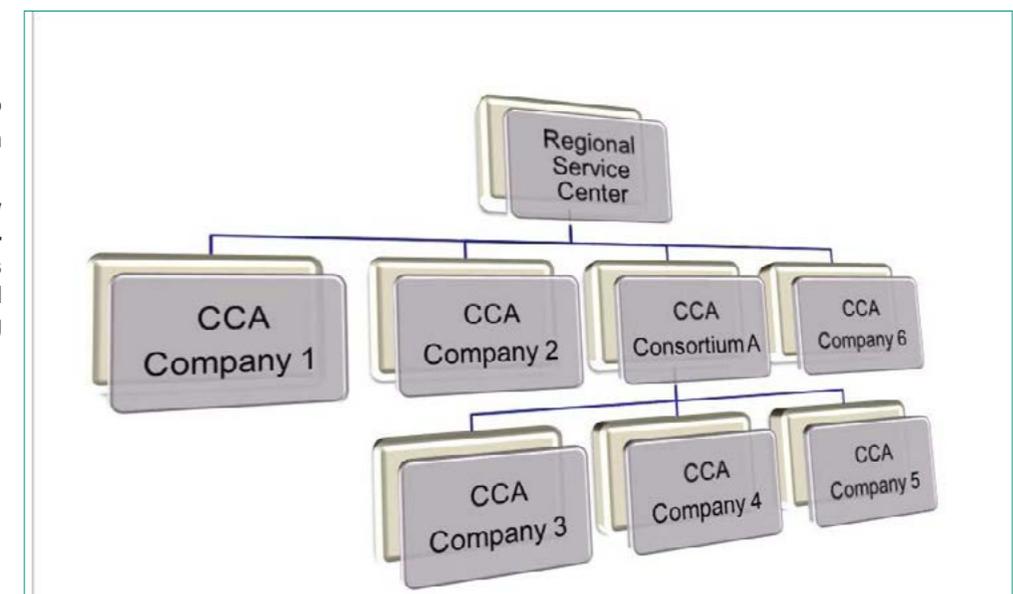
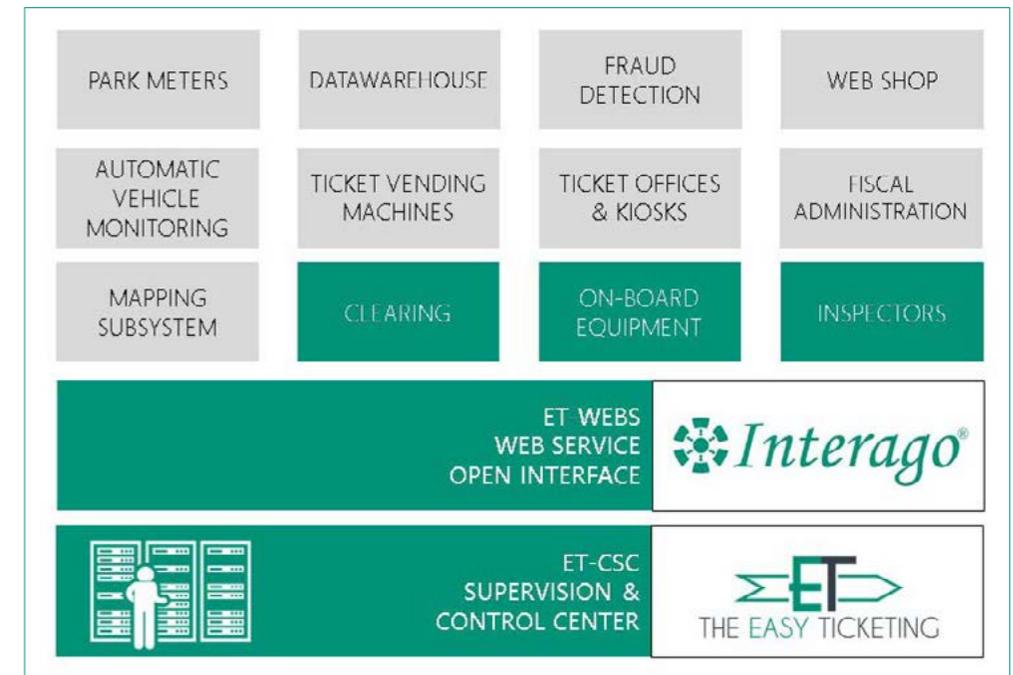
ET-MINIAVM – uses SBE infrastructures for fleet monitoring. It facilitates the identification of vehicle position and analysis of service regularity, constantly informing the driver of how late the journey is progressing or how much in advance of the timetable the vehicle is.

ET-TIC-BUS – this is the application for on-board CDB-6 PLUS multifunctional units making them the component the on-board system is based on. Its ET-VAL module functions as a contactless validator.

ET-QUICK – standard library for the management of the ŠKUP Card (page 13).

Above, the main modules of the ŠKUP system. Parts provided by AEP are shown in green.

Below, ET - from the outset The Easy Ticketing was designed to manage hierarchical organisations. This feature is key to the ŠKUP project where a good 35 operators manage their service using KZK-GOP.



ET HEART IN THE PROJECT OF THE ŚKUP CARD

JAK ZAPŁACIĆ KARTĄ ŚKUP ZA PRZEJAZD

Masz zapisany na karcie bilet okresowy?
Przyłóż kartę do kasownika przy **WEJŚCIU** i wyjściu. Okresowy bilet elektroniczny jest ważny tylko wówczas, gdy przy wejściu karta zostanie przyłożona do czytnika. Prawidłowy odczyt karty urządzenie zasignalizuje sygnałem dźwiękowym i zapaleniem zielonej diody. Dodatkowe przykładanie karty przy **WYJŚCIU** pozwoli Ci kupić kolejny bilet z **PROMOCJĄ**.
Przykładaj dwa razy i oszczędzaj!

KZK GOP

PROGRAM REGIONALNY
NACJONALNA STRATEGIA SPÓJNOŚCI

Śląskie
Pozitivna energia

UNIA EUROPEJSKA
EUROPEJSKI FUNDUSZ ROZWOJU REGIONALNEGO

Regionalny Program Operacyjny Województwa Śląskiego – realna odpowiedź na realne potrzeby



Above: one of the posters promoting the ŚKUP system. Top right: an operator workstation at the KZK-GOP centre. Middle: Interago® is the brand AEP is using to identify ET's open interface - The Easy Ticketing. It does not correspond to a specific module (there are several) but to AEP's strategic concept of favouring interaction with third parties' systems. ET-RSM is based on the AEP CSR-10.

AEP Heart

The figure on page 15 shows ŚKUP's system architecture. As you can see, ET-CSC is hosted on the data centre and forms the basis of the whole system via the Interago® interface (see below), which integrates with the other subsystems by using the web service.

DISASTER RECOVERY There are two very structured data centres. Given the strategic importance of the system, in case of IT disasters a second back-up data centre about 50 km away is ready to come into operation.

HIERARCHIES The ŚKUP system uses ET's ability to define hierarchical multi-company structures. In fact, transport in the region of Silesia is organised by four companies (KZK-GOP, MZK Tychy, PKM Jaworzno, and MZKP Tarnowskie Góry), and is carried out by a good 35 different operators.

Openness

Many Electronic Ticketing Systems are designed to protect the manufacturer's intellectual property as their main purpose. They are intrinsically "closed" and only reluctantly integrate with third party systems.

On the other hand, AEP followed different strategic lines in the case of ET, indeed favouring the integration of third party subsystems. This openness forms the basis for the ŚKUP Card's success.

So many manufacturers can integrate their products, such as:

- Self-service machines which also use the ET-QUICK library described on page 13 (the new self-service premium RTVM-T by AEP was not available at the time the ŚKUP contract was signed);
- AVM sub-system;

- POS network for top-ups at the Points of Sale;
- Parking places subsystem;
- POKs and POPs network;
- etc.

MODULARITY In addition to this openness, one of the most interesting characteristics of ET is its modularity and above all, the fact that its design is based on industrial criteria. This means that all AEP's customers including the smallest company with only ten buses share the same code to the ŚKUP Card system. Benefits are evident and even more important when talking about reliability, thanks to the test implicitly shared by all the users.

PARTICULARITY But such a large system as ŚKUP obviously has different features and some parts of the code have been customized, above all for the devices, while other modules have been specifically designed and implemented for ŚKUP and made available to other Customers at a later stage.

Remote SAM Management

QUIS CUSTODIET...? SAM modules greatly increase the security of any system as long as their distribution and use is carefully monitored.

Installed on the central system, the remote SAM (Remote SAM Management, or RSM) management system offers numerous services to SAMs installed on the system such as:

- **CEILING:** management of the "threshold" which prevents a stolen device from executing a number of top-ups higher than the authorised threshold in case of no communication with the centre.

- **POSITION TRACKING:** this defines and checks the physical position of SAM modules in the different devices;
- **BLACK LIST DEI SAM:** a black listed SAM will not be authorised to generate value, and so to execute top-ups. Cards topped-up with a black-listed SAM are locked, etc.
- **ADMINISTRATIVE FUNCTIONS:** such as the definition of "ceilings", activation of a SAM, black lists, production reports, etc

ACTIVATION – activation of SAMs can be requested using ET-RSM:

- Never;
- Only once - for the first activation;
- Every time that the SAM is activated.

CSR-10 is a fundamental physical component for the ET-RSM. It is a redundant device, designed by AEP, with double power system, double connection to the Ethernet so that it can use two different Ethernet switches, and two blocks composed of 4 independent SAM modules. The 8 SAMs normally work in parallel. In the case of failure of a part of the CSR-10, the system works in a degraded mode using 4 SAMs. Designed for the ŚKUP system, it has become a standard product available to all Customers.

Bank Top-up via the Internet

Card top-ups via the Internet is a key function and very much appreciated by users because of its practicality, and by Companies because of the resulting cost savings (the ET system not only enables top-ups but also the purchase of new contracts, renewal of season tickets, etc.)

ET HEART IN THE PROJECT OF THE ŚKUP



DISTRIBUTION OF LISTS The technique used to execute top-ups following a purchase on the Internet is converging towards a common model: the user connects to a portal and buys. The effective writing of the new credit on the card on buses and trams is entrusted to AEP validators whose central system sends the list of purchases, which has been named blue list in the ŚKUP system. The operation is carried out before the card is scanned.

WHY NOT IMMEDIATELY? Why on the contrary is data not immediately written on the card? Because:

- Users do not have a contactless reader on their PC at home;
- If they did, their use would generate many problems in terms of both security and for logistical reasons. The variety of PC brands and models, operating systems, drivers etc. are enough to make people aware of the huge organisational effort required to support customers in the possible situations.

IS EVERYTHING ALWAYS OKAY? Top-ups via the Internet are therefore apparently based on very simple principles and are proposed by many Electronic Ticketing Systems nowadays. However, the operation is anything but simple in practice and it is not infrequent to learn that this or that system “loses” some top-ups or even executes a top-up many times.

BANK RELIABILITY No mistakes are allowed in the case of the ŚKUP Card system. The purse has the value of cash and is managed by a big bank. Consequently, AEP and ŚKUP engineers had been working for many months to achieve totally reliable levels, including those of a bank. Once again, benefits resulting from this effort have become a common heritage and so are extended and granted to all ET system users, including small-sized companies.

On-Board Checks

The Control Subsystem can understand both control functions for inspectors and other functions for validation, sale, and fines issued by mobile staff. That has also been implemented by AEP and is based on the ET - MOB module using the physical MOB platform, traditionally offered by AEP and based on the smartphone and the portable AEP TPV reader.



Left, a POP (Passenger Service Point) and right, a POK (Customer Service Point) of ŚKUP Cards.



ON BUSES & TRAM



Tram vehicles from previous generations are still in service in the Silesia region. Consequently, the SBD project had to use special systems, for example, a 40 V service power supply voltage.

Thousands of AEP Devices

Almost 8,000 AEP devices are installed on transport vehicles in service in the region of Silesia, namely:

- 1,455 CDB-6 PLUS multifunction units (driver console with selling functions and on-board computer);
- 3,686 Futura 3A validators;
- 1,385 Futura 240B validators for smart cards and paper tickets;
- 1,443 sEthernet automotive SW16 switches for the on-board network;
- 1,385 GPS-3 modules.

This installation has one of the highest number of AEP devices created so far.

1		Mod. PT8 40Vdc	1xGPS 2xCDB-6 2xPrinter 2xPower supply for printer 2xSW16 2xDC/DC 2xF240B 6xF3A	5		24 Vdc	1xGPS 2xCDB-6 2xPrinter 2xPower supply for printer 1xSW16 1xPreDisp. 2xF240B 2xF3A
2		Mod. 116Nd 26Vdc	1xGPS 1xCDB-6 1xPrinter 1xPower supply for printer 1xSW16 1xPreDisp. 1xF240B 5xF3A	6		24 Vdc	1xGPS 1xCDB-6 1xPrinter 1xPower supply for printer 1xSW16 1xPreDisp. 1xF240B 3xF3A
3		E1 28Vdc	1xGPS 1xCDB-6 1xPrinter 1xPower supply for printer 1xSW16 1xPreDisp. 1xF240B 3xF3A	7		24 Vdc	1xGPS 1xCDB-6 1xPrinter 1xPower supply for printer 1xSW16 1xPreDisp. 1xF240B 2xF3A
4		105 40Vdc	1xGPS 1xCDB-6 1xPrinter 1xPower supply for printer 1xSW16 1xDC/DC 1xF240B 3xF3A	8		24 Vdc	1xGPS 1xCDB-6 1xPrinter 1xPower supply for printer 1xSW16 1xPreDisp. 1xF240B 1xF3A
11		105N 40Vdc	1xGPS 1xCDB-6 1xPrinter 1xPower supply for printer 2xSW16 2xDC/DC 2xF240B 6xF3A	9		24 Vdc	1xGPS 1xCDB-6 1xPrinter 1xPower supply for printer 1xSW16 1xPreDisp. 1xF240B
10		111 40Vdc	1xGPS 1xCDB-6 1xPrinter 1xPower supply for printer 1xSW16 1xDC/DC 1xF240B 5xF3A	Composition of On-Board Systems for the main types of vehicles. AEP devices are in use on all transport vehicles.			

Composition

The figure on the right shows the composition of an On-Board system (SDB) for trams. It includes:

- Two CDB- 6 PLUS multifunction units, one for each drivers cabin;
- Two F240B validators installed in an extreme position so that the previous paper tickets can also be validated in addition to the ŠKUP Cards;
- Six Futura 3A validators;
- One SW16 smart switch;
- Other complementary elements.

A smaller number of devices has obviously been installed in the case of buses as shown in the following table.

What about its functions?

The main functions of the SDB are the following:

- Management of service shifts;
- Localisation of the vehicle and recognition of the stop;
- SBD supervision;
- Communication via the GPRS/UMTS and WIFI;
- On-board sale;
- Validation.

One was not enough

Some tram cars are not turned at the terminus. The driver moves from the drivers cab at one end to the cab at other end. So trams are provided with not one CDB-6 PLUS but two: one for each drivers cabin, and the driver can drive using one or the other. The one that is not used is automatically deactivated.

SW16, a smart type

The vehicular SW16 Ethernet switch has been specifically designed by AEP for this application.

In fact, it aggregates several functions in the same unit. Functions are listed below.

ETHERNET SWITCH WITH 15 PORTS.

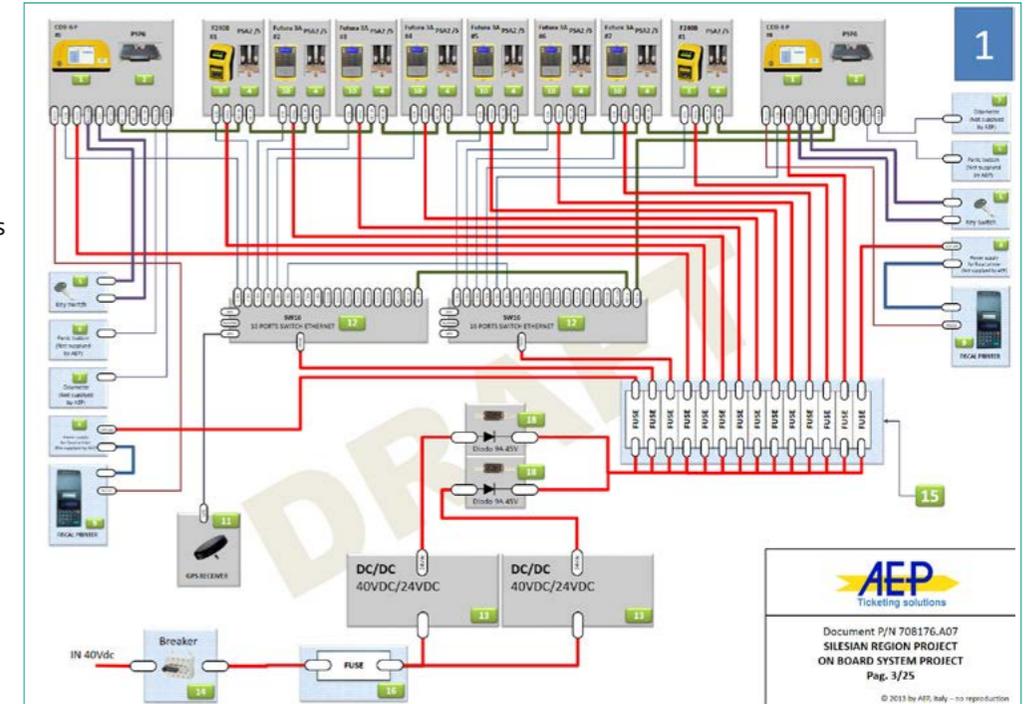
LOCALISATION SERVICES The AEP GPS-3 receiver is directly connected to the SW16 that distributes the localisation service to the other devices via the Ethernet in the form of coordinates.

TIME/DATE SERVER SW16 provides time/date services, obtained from the GPS.

ACTIVATION MANAGEMENT each AEP device is always able to manage its activation via the ACTIVATE signal line. The ŠKUP project faced an obstacle: connection between the cars of a tram train only provides the Ethernet line so it is impossible to use an additional connection. On the other hand, the vehicle's peripherals can be activated or deactivated by the SW16 using one single Ethernet control. When CDB-6 PLUS runs the command, the status of all validators changes to activation. So in order to compose new transmissions, all you need to do is deactivate and reactivate the Ethernet network's car connector.

AVM, not only ticketing

Even if it cannot be seen, the CDB-6 PLUS also executes AVM system functions, board side, recognises the 5,497 stops on the network, and determines the position of the transport vehicle in real time Data is sent to the ground and via the ET-LMW, and ET-CSC is later



transmitted to the fleet monitoring system (AVM).

Anticipated test

Another interesting solution implemented in the ŠKUP system roll out is the technique used to test on-board systems. AEP has designed two modules to be located in place of the validators of the multifunctional unit. The two modules are connected by a standard PC Ethernet cable. The cables test is immediate using these and possible even without the need to install the devices immediately. Due to the huge number of transport vehicles, the installation actually took many months and it would not be worth installing the devices well ahead of entry into service.



The CDB-6 PLUS is an evolution of the CDB-5 PLUS, and is AEP's first multifunctional unit, a very successful product due to its completeness and compactness. It is easy to use thanks to the touch display, and also offers the functions of a contactless validator.

The ŠKUP project now includes 1,455 CDB-6 PLUS. Trams with two cabins include two of them, one at each end.

VALIDATORS



Next: Futura 3A and an F240B among the thousands in the ŚKUP Card project. An F240B installed on the front door means the previous paper tickets can continue to be used for a period of time.

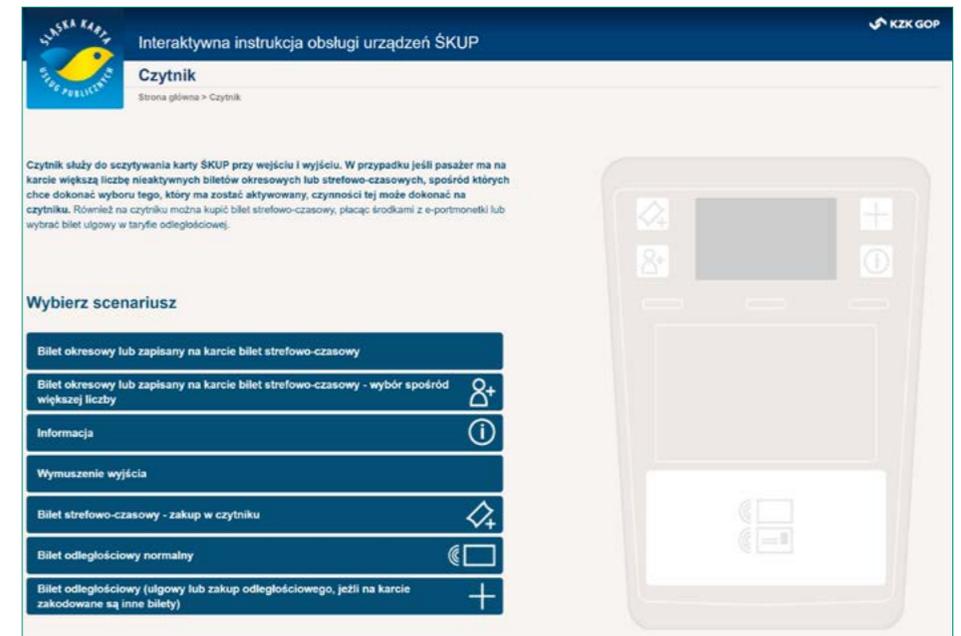
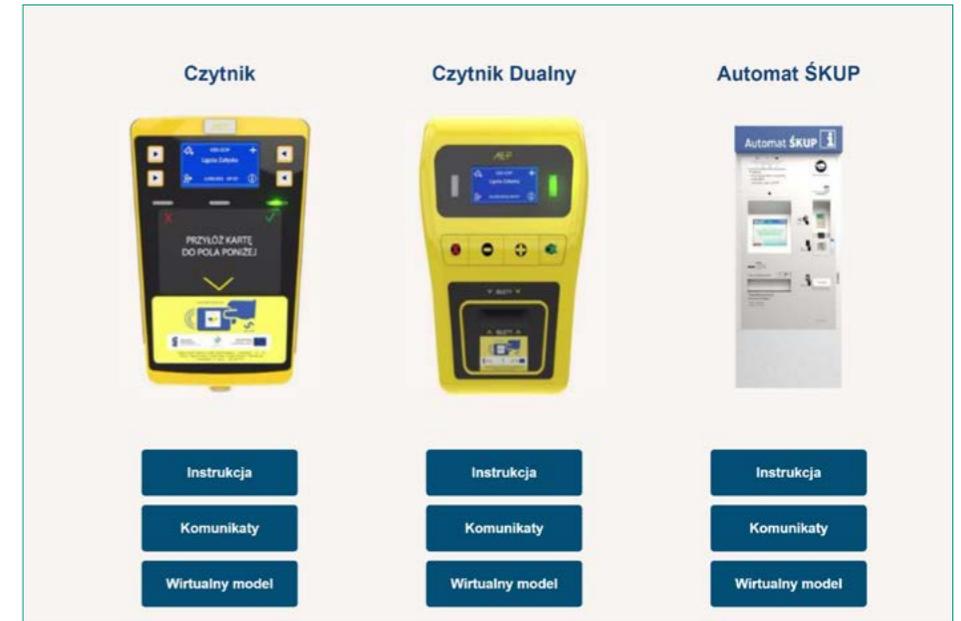
Testing modules described in the text are installed instead of validators and CDB-6 PLUS



The extraordinary portal of the ŚKUP Card makes it possible to receive interactive instructions and “play” with the virtual models of on-board devices and TVMs.

Next: it is also possible to present a virtual card to the validator, which turns on its LEDs like the real ones! (http://www.kzkgop.com.pl/public_media/instrukcja_skup/)

Below: instruction page. It is possible to select the cases of use and receive detailed instructions “live”. This is the first time in AEP’s experience that such an interesting solution has been offered to make the customers’ approach to electronic ticketing easier. Every possible individual screen of the validator is represented and described on the website.



ONE SINGLE WEB SITE

SOME DATA

	January	February	March	Total
Device Sale Operations (excluding CICO)	571.223	602.600	654.932	1.828.755
Check-in / Check-out purse sale operations	10.936	25.110	32.620	68.666
Validations (Futura 3A and F240B)	478.574	1.322.310	1.778.984	4.058.441
Checks (MOB)	2.384	4.879	7321	14.584
Number of travels	434.786	436.703	468.319	1.339.808
Kilometres travelled	7.742.820	7.779.282	8.302.678	23.824.780
Number of circulating vehicles per month	1.484	1.480	1.501	
Top-ups via the Internet (Blue List)	2.597	3.536	4.464	11.157

	Numbers
Number of Stops	5.497
Routes	152.570
Shifts	1.882
AEP CDB-6 PLUS multifunctional units	1.455
AEP Futura 3A Validators	3.686
AEP F240B Validators	1.385
AEP SW-16 vehicular switch	1.443
MOB devices for inspectors	320
Cards distributed (at Jun 15th 2016)	90.788

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OTHER LARGE AEP SYSTEM



ATM & Trenord Milano

- 221 stations, 2,210 buses, 2498 metro access gates
- 17 depots, 8 parking lots
- 3M transactions/day
- 700M passengers/year
- Massive production centre
- Installation supervision



GTT Torino and other BIP companies

- Complete system
- Company control centre
- Ticket offices
- +6.000 AEP devices
- 200M passengers/year
- Ticket vending machines
- Includes some 20 Companies (Extra.to, ATAP Biella, SUN Novara...)



Egyptian Railways

- One of the largest economic institutions in Egypt and the Arabic world. The biggest in the sector of passenger and cargo transportation
- 500M passengers/year
- Raily, the AEP platform for railway networks
- AEP DTIC-A readers



SNTF Algeria Railways

- Network of 4575 km and 217 stations
- 33M passengers / year
- Travel document sales
- Seat/couch reservation with preference meal, air conditioning, animals etc.
- Reservations at stations, travel agencies, Internet portal and on-board
- Network central definition (lines, train composition, tariffs, timetable etc.)
- Accounting (down to station level)
- Sales data collection and statistical analysis
- Management of stations with discontinuous communication



AEP Ticketing Solutions
Via dei Colli, 240
50058 Signa (Firenze, Italia)
+39/055.87.32.926
www.aep-italia.it

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