Information systems for passengers inside the vehicles of public transportation in Nur-Sultan (Astana)

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ABSTRACT

While traveling through the cities by public transport, it is important to have enough and quality information about the following lines and transfers between them – especially, while checking-in. Nur-Sultans' public transport vehicles lack the working electronic information panels in their interior. The purpose of this paper was to propose the design of the electronic information panel inside of the buses. The whole screen should inform passengers inside the vehicles while traveling about the current position of the vehicle and possible transfers. It should serve as an alternative to mobile applications. It includes all the positives of inspected systems from other countries and few more like for example: the ability to react on real delays of vehicles and informing passengers about irregularities on the routes. There would be no need to use a smartphone to search for the connections.

Key words : public transport, vehicle, information system, stop, check-in

1. INTRODUCTION

In multimodal transport, users use at least two different types of transport to reach their destination. Therefore, multimodality refers to the optimal use of different modes of transport. [1] The components required for an effective transport system cannot be underestimated, because the transportation industry is one of the largest growth areas for electronics and implanted computers. The intelligent transportation systems are prime target markets for the commercially available board- and system-level solutions. [2] In today's world, it is common that on the bus

stops all the important information about public transport (PT) in the cities can be found. The bus stops in the modern world are equipped with PT schedules or electronic information panels. On the board of the vehicles (bus, trams, trolleys… etc.) are information panels too. The information about departure times of bus lines can be found on schedules at the stops, internet pages as well as in mobile applications.

The bus stops in Nur-Sultan (former Astana), Kazakhstan do not include enough of these information sources for passengers. There are no schedules and PT schemes at the stops. There are only electronic information panels at the bus stops, web page, and mobile applications. The authors decided to make an analysis of current state and propose improvements of the information systems for passengers of PT of Nur-Sultan.

2. INFORMATION SYSTEMS FOR PASSENGERS OF PT IN NUR-SULTAN

The information systems of PT outside the vehicles can be sorted to mobile applications and electronic information panels at bus stops.

2.1. Mobile applications

The special mobile application of PT used in the city of Nur-Sultan by passengers is called Astra Bus. It can be used in various ways. For example, passengers can choose the starting and ending points of their trip and the application then generates the route with needed bus lines (see Figure 1). Unfortunately, it doesn't show the nearest bus stop on the route. Another way is using the lists of each bus line, where the information about numbers of lines, routes, and times of service and the intervals for the all-day time of service can be found. After selecting a bus line, the application shows the route of the line and the current

positions of all the vehicles of the chosen bus line (see also Figure 1). It also shows delays and lockouts [3-4].

The application is connected with contactless Astra Plat chip card with pre-paid credit (see Figure 2). The card carries long-term tickets and can be used as an e-wallet. Log in is possible using the registered phone number and thanks to that it is possible to see for example the account balance. The Astra Plat card can be used in all vehicles of PT of Nur-Sultan. It can be bought in special stands situated in the city center or other places. The card is valid for 5 years and has a 2 years warranty. It costs 400 KZT (approx. 1 USD). The card enables the possibility to change between vehicles of PT transport. The single ticket is valid for 90 minutes. It is also possible to buy a ticket valid for 1 month, for 3 months or 10 trips [5].
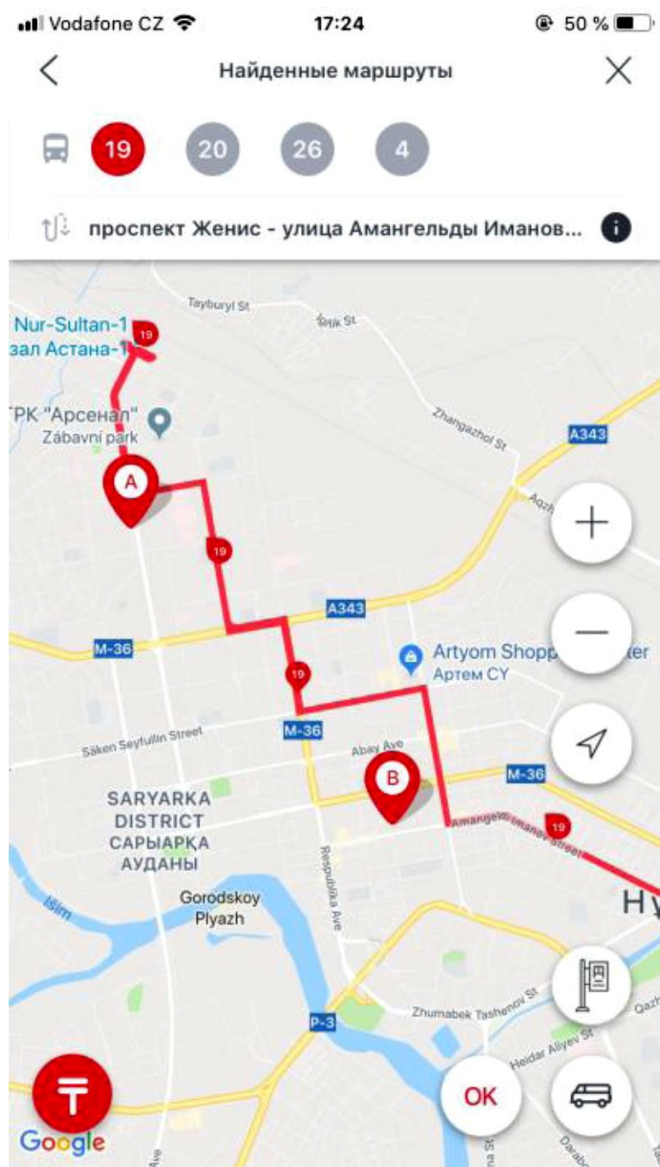

Figure 1: Example of choosing the starting and ending points of trip with help of the application Astra Bus

Other (more general) mobile applications working in Nur-Sultan are Yandex.Transport and Moovit. These applications are not designed for Nur-Sultan only. They are used in many different cities and countries [6].

Like Astra Bus, Yandex.Transport shows the route of the chosen transport mode, directions and the current positions of the vehicles of chosen bus line. Passengers using Moovit can choose the starting and ending points of their trip and the application then generates the earliest connection, shows the route on a map, the length and time of the trip. Unlike Astra Bus, Moovit shows the nearest bus stops on a map. The application is also able to show all the lines of PT in a chosen city with a detailed description or the routed and times of arrivals to the stops [7-8].

Both Yandex.Transport and Moovit can display information about selected bus stop like which bus lines pass through the stop and their arrival times.

Figure 2: Example of contactless chip card Astra Plat used in Nur-Sultan

2.2. Information panels at bus stops

The bus stops in Nur-Sultan are equipped with electronic information panels (see Figure 3). So those even the passenger who does not possess a smart phone with mobile applications for PT can learn about incoming PT vehicles, their arrival time and terminal stations.

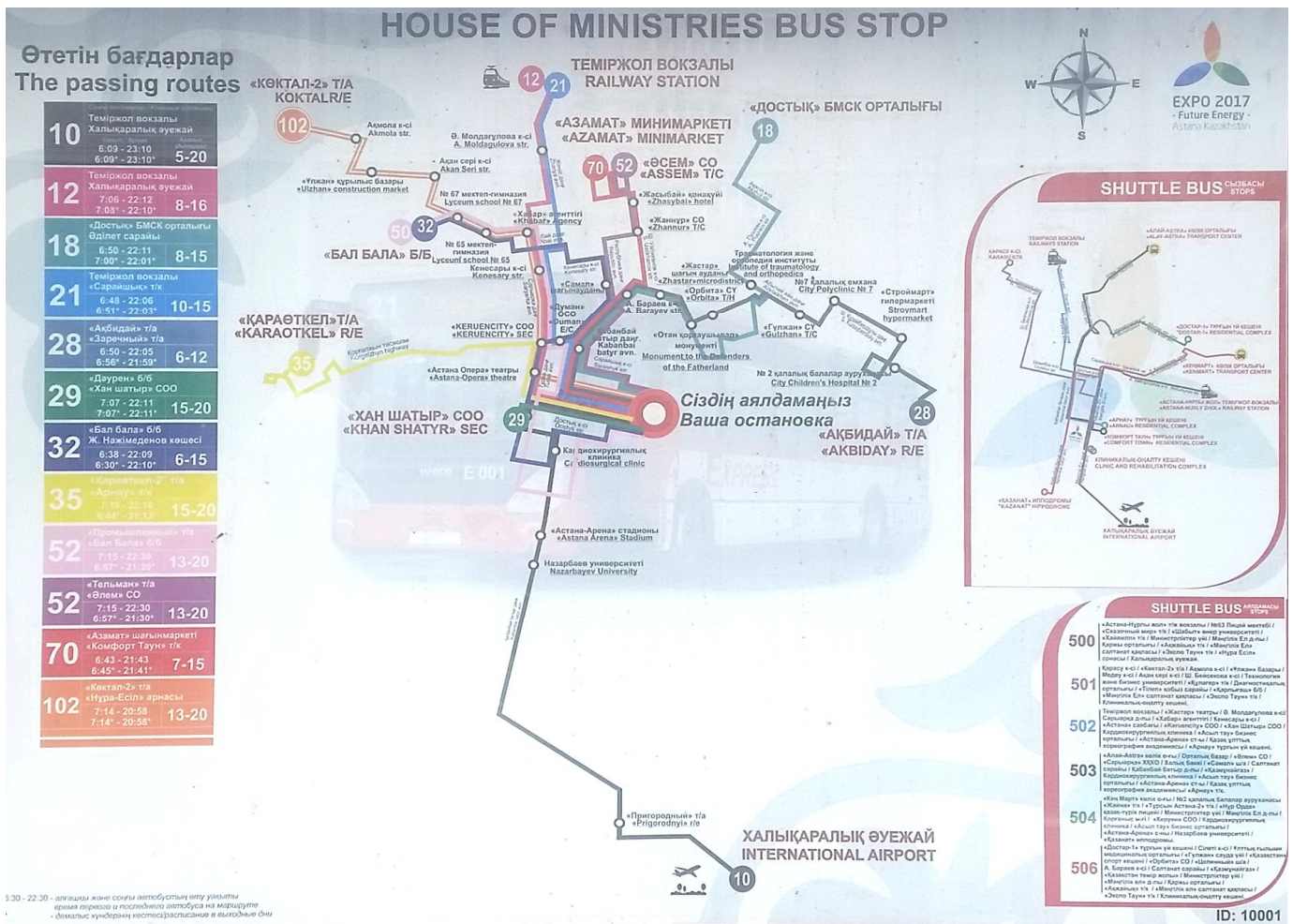

Figure 3: Information panel at a bus stop in Nur-Sultan

Figure 4: Example of the scheme of passing routes only at the most frequented and used bus stop "House of Ministries" in Nur-Sultan

The real arrival times are calculated based on the knowledge of current positions of vehicles on the routes and it is being updated many times during the time buses spend between stops. As a result of that, the information on panels is quite precise. However, this is not equivalent to schedules of bus lines [9].

In European countries the schedules are planned based on the demand of transport in the morning and afternoon rush hours and the rest of the day. Each line has its own schedule. Public transport vehicles arrive to their stops at regular intervals adjusted to the demand during daytime. There are different schedules for working days and weekends. The schedules in post-soviet countries like Kazakhstan are created differently. They are based on graphical timetables of certain numbers of vehicles circulating at their lines but with no noticeable adaption to daytime (rush hours). The number of vehicles of each line does not change during the day much – only during lunchtime, as drivers have approx. 30 min break. While they are having lunches, no one drives their buses – they are not being used at all until the return of drivers. This may cause significant delays

of public transport vehicles [10-11].

The schedules of the bus lines are very general – giving only the information about all-day intervals. There is no detailed information about the intervals during rush hours or arrival / departure times. The intervals are only estimated on the probability of delays of the vehicles trapped or not in congestions. For example, the only information about the interval of line no. 10 is 5 – 20 minutes, the interval of line no. 14 is 8 – 20 minutes and the interval of line no. 46 is 5 – 12 minutes. This is a huge problem as without the mobile applications or electronic information panels the passengers have no chance to predict the arrival of a bus or to learn whether they can catch a certain bus at interchange stop or not. If the electronic information panels are broken, the passengers can rely only on mobile application and not everyone owns a smart phone.

There are no schemes of all the lines PT of Nur-Sultan at the bus stops and no information about travel time or the expected arrivals at the following stops. Only the lines passing through a selected stop can be found, including the information about their all-day intervals (see Figure 4).

This makes planning transfers for passengers very complicated. When a passenger waits at a stop and desires to travel to a destination where none of the lines from that stop leads, they are fully dependent on their smart phone applications (if they own them) as otherwise there is no way to get to know the right way to the place of interest.

3. CHECK-IN

In 2018 the tariff and conditions and the check-in conditions of PT of Nur-Sultan were changed.

The conductors are no longer in the vehicles so that getting in a bus is possible only through the first door by the driver. The other doors are for getting out of the vehicle (the information for passengers displayed outside the vehicles see Figure 5). There is a check-in terminal inside of each bus to control the payment of a fare. While getting in the vehicle, the passengers put their chip cards to the terminal, which confirms the payment of fare within 2 ~ 3 seconds. It shows the price of the route and the current account balance. If the terminal is broken, the passenger can travel free of charge. Another option to buy a ticket is by the driver. They sell an only one-way ticket for cash. There is no checking out of the vehicles and the validity of a ticket is limited by time.
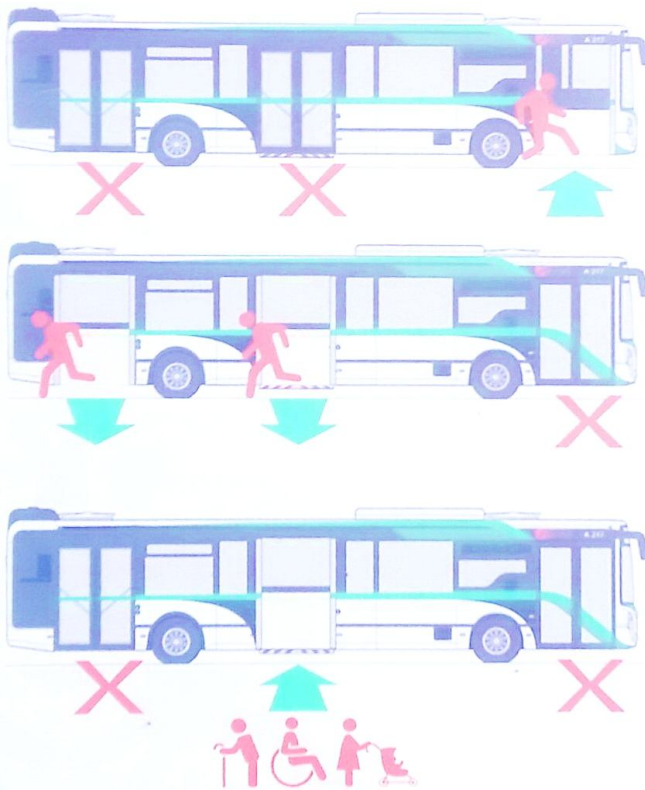

Figure 5: Information for passengers about the new check-in system and conditions displayed outside the vehicles of Nur-Sultan

The long-term tickets can be used only with a chip card. It is not possible to buy a ticket via the mobile application.

The short time tickets are not transfer tickets and cannot be purchased before getting in the vehicle.

4. CURRENT INFORMATION SYSTEMS IN PT VEHICLES OF NUR-SULTAN

4.1. Current information system in PT vehicles

Inside of the vehicles of the public transport of Nur-Sultan (buses) are electronic information panels. These panels are generally expected to show the information about the number of a line, its destination, or for example sequence of intermediate stops. Unfortunately, the panels on the board of the PT vehicles of Nur-Sultan are used only for advertising purposes if they are even being used (see Figure 6).

Figure 6: Information panel inside of a bus used only for advertising

Figure 7: The content of the information panel inside of a public transport vehicles used in Zürich (Switzerland) during section with more than 3 stops before final stop

4.2. Information system in PT vehicles abroad

The electronic panels in the PT vehicles can be found in many different countries. The perfect examples are in Zürich (Switzerland – see Figure 7) and Dresden (Germany – see Figure 15). They display not only the information about the number of the line, its final stop, or sequence of intermediate stops but also different things. While getting closer and closer to the next stop, they change to another mode showing departure times of all lines from the following

stop and their terminal stops. This is useful especially for tourists and people who are new to the towns – it helps them as they can see all the options offered by the next stop (numbers of the lines, terminal stations, types of PT, departure times and delays).

5. AUTHORS' PROPOSED IMPROVEMENTS OF THE NEW CONTENT OF ELECTRONIC INFORMATION PANELS IN NUR-SULTANS' PT VEHICLE

The authors suggest adjustments of the electronic information panels for PT vehicles of Nur-Sultan. They recommend following the examples from Switzerland and Germany.

5.1. Information on display in sections between stops

In between two stops in the new design of the display of the electronic panel there would be shown following information (see Figure 8):

1. Number of the bus line

2. Next 5 stops (the nearest would be graphically different from the others), the dotted line next to the terminal stop would symbolize the existence of more stops after the presented 5

3. Next to each displayed stop, there would be the indicative arrival time

4. The possibility to transfer to another line in the following stops and their types - city buses, suburban buses and express buses. The symbol of city buses would be a bus in a green square. The symbols of suburban buses and express buses would differ only in color of the square – blue for suburban and red for express
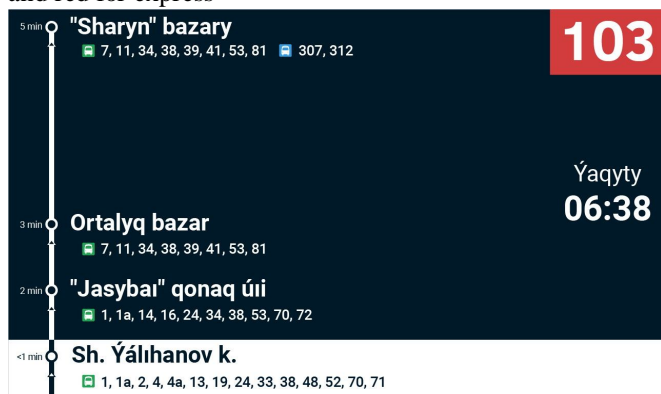

Figure 8: Proposal of the information panel inside of a bus – example for section with less than 5 stops before final stop. Notice there is no dotted line and there are two different kind of bus lines – city bus (green) and suburban (blue). Express bus line no. 103

If the bus line leads to a train station, the stop should be marked with a symbol of a train, to make it clear, that there is a possibility to transfer to a train (see Figure 9).

If the bus line goes through different zones (typically suburban buses), there would be a horizontal line on display dividing the stations into zones (see Figure 10).
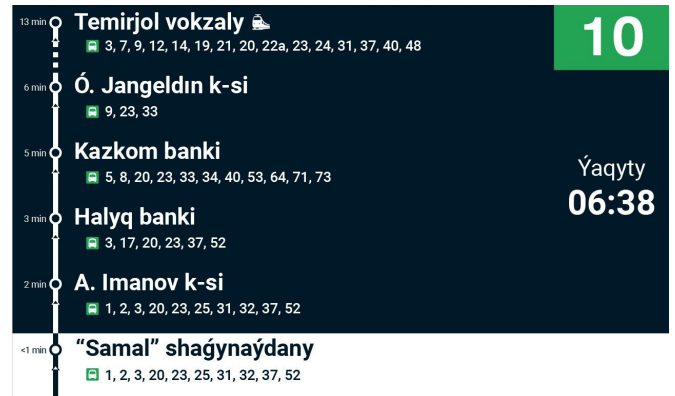

Figure 9: Proposal of the information panel inside of a bus – example for section with more than 5 stops before final stop. See the dotted line. Notice symbol of a train station next to the final stop. City bus line no. 10

Figure 10: Proposal of the information panel inside of a bus – example for section with 2 different zones. Notice the horizontal line. Suburban bus line no. 300

Different variations of the way the information is shown on the display for the cases with less than 5 stops left before the final can be seen in examples for the express line 103 in the Figure 8 and for the city bus line 10 in the Figure 11.
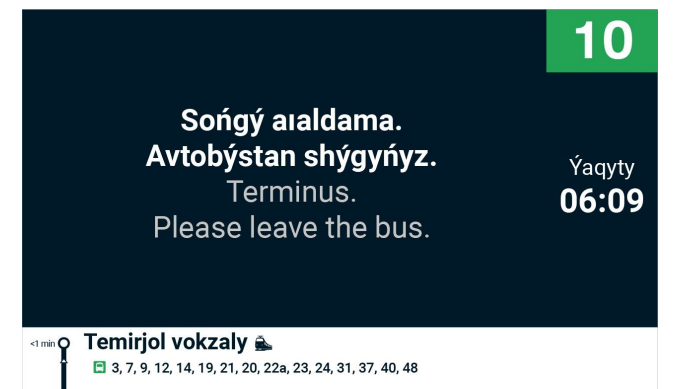

Figure 11: Proposal of the information panel inside of a bus – example for section before final stop. Text should be in both local and English languages. City bus line no. 10

For the bus lines going to the airport, it is recommended to translate the bus stop at the airport to English and use a plane symbol next to the name (for example see Figure 12 for city bus line no. 10).
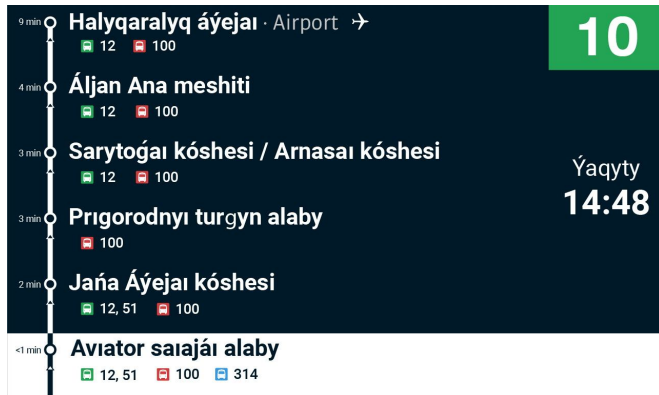

Figure 12: Proposal of the information panel inside of a bus – example for section between 2 stops for the bus going to the airport. Stops that serve regular flights are shown with the small plane symbol. City bus line no. 10

With the cooperation with Nursultan Nazarbayev International Airport in city Nur-Sultan, it is possible to show on a few pages information about departing flights to the passengers inside the bus for their convenience, as information about departures isn't that relevant in this case (for example see Figure 13 for express bus line no. 100).

Figure 13: Proposal of the information panel inside of a bus – example for section before final stop at the airport. Text should be in both local and English languages show on a few pages information about departing flights to the passengers inside the bus. Express bus line no. 100

In case of a traffic interruption, it is recommended to highlight with yellow color part of the route, that has some irregularities like a diversion, changes in stops or big difference in travel times comparing to the normal situation for example due to congestions (see Figure 14). As well it is recommended to use a diversion symbol next to the number of the line to inform passengers about possible changes in their commute and prepare possible a new route.

Figure 14: Proposal of the information panel inside of a bus – example for section between 2 stops with operational restriction on the line marked e. g. yellow diversion symbol. Suburban bus line no. 300

Figure 15: The content of the information panel inside of a public transport vehicle in Dresden (Germany) – example right before arriving to the stop

Figure 16: The content of the information panel inside of a public transport vehicle in Zürich (Switzerland) – example right before arriving to the stop

5.2. Information on display right before arrival to a stop

The information on display right before arrival to a stop would be based on the principle explained in the examples of Dresden (Germany – see Figure 15) and Zürich (Switzerland – see Figure 16). The panel would switch to a different mode allowing the passengers to see all

connections from the next stop together with their line numbers, types, departure times and final stops (see Figure 17). This facilitates orientation, as the passengers can see which lines and vehicles they can transfer to at the next station, their departure times (or delays) and what their final destinations are (see Figure 15 or Figure 16 as example from abroad). Making orientation easier is a great improvement as it increases the quality of service, therefore it positively influences the interest in using public transport.

Figure 17: Proposal of the information panel inside of a bus – example right before arriving to the stop. Express bus line no. 103

The panel would not show the possibility to transfer to the same line to which the bus (inside which the panel is placed) belongs, as it would make no sense.

If the next station is not a transfer station the display mode will not change. The lines going to the depot would not be shown at all at any stop.

For the final stop in the head of the display would be shown text "Final stop" in both languages and in the body will be shown estimated departures for this stop according to the same principle as is shown in example in Figure 13 and in Figure 17.

Figure 18: Proposal of the information panel inside of a bus – example for right before arriving to the final stop (display for stop that is a part of operational restriction). Note the diversion symbol and yellow stop marking to alert passengers on the restriction. Express bus line no. 103

In case the next stop is in a section of the route, where there is a traffic interruption like diversion or changes in stops, it is recommended to highlight this situation with a yellow color and with a diversion symbol next to the number of the line (for example see Figure 18) as it was already mentioned about.

6. OPPORTUNITIES OF ELECTRONIC INFORMATION PANELS INSIDE OF VEHICLES

Releasing the information about the current position of PT vehicles and the possibilities to transfer to the passengers inside of the vehicles should increase the satisfaction of the passengers. The planning of the route would be more effective and flexible - it would lead to an increase in the attractiveness of PT of Nur-Sultan.

7. CONCLUSION

After the analysis of the information systems for passengers of public transport in Nur-Sultan and the analysis of today's information systems inside of public transport vehicles in exemplary cities, the authors designed the proposal of the new information system in Nur-Sultan – electronic information panels inside of the vehicles of public transport. Today the electronic information panels inside of the public transport vehicles are being used only for commercial purposes. This is not beneficial for passengers, who need to learn about the following stops. The proposed design is a combination of the positives of examined systems and more improvements added by the authors. For example, if passengers don't have smart phones or their batteries are dead, they can read the information about the number of the line, its destination, and sequence of intermediate stops, times of arrival, the possibility to transfer to another line in the following stops and their types, departure times and final stops on display inside of a PT vehicle. Other benefits added by the authors are: If there were some traffic interruptions the part of the route with irregularities (like big difference in travel time due to complications or changes in stops) would be highlighted. The diversion symbol would be used next to the number of the line in order to inform the passengers about possible complications on the route. If the bus was near the airport, it would be possible to show some information about departing flights to the passengers inside the bus for their convenience.

As the proposed design makes orientation easier it will lower the stress of passengers as they can know in advance whether they can catch the connecting line or not. The panels are designed to be clear and easily understandable.

As written in previous chapter, similar electrical information panels are used in many European cities with well-developed

public transport system like Zürich (Switzerland – see Figure 7 and Figure 16) or Dresden (Germany – see Figure 15). Another example of a place, where electrical information panels inside of the PT vehicles are used is Prague, capital city of Czech Republic. However, they are not as well as designed as the proposed design for Nur-Sultan. They provide only the information about the sequence of intermediate stops and the final stops. They don't display anything about the departure or arrival times of the other lines at stops. People in European towns are used to be informed about the lines and appreciate it.

The proposed design guarantees easier travelling through Nur-Sultan by buses and could lead to higher attractivity of public transport.

If people give up on using cars to use the public transport more often, it will have a positive effect not only on the smoothness of travelling through Nur-Sultan by lowering congestions generated by cars (especially during rush hours) but also on the environment.

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