



Instructions for organizers

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The development of the system was co-funded by the Erasmus+ project ORIENT.



1. Basic Information

The ToePunch system is a punching system for trail orienteering. Its key components are a box (ToePunch unit) and a set of seven NFC/RFID Competitor chips.

Any ToePunch unit can be used for any role in the system depending on its configuration. For changing the configuration and executing control commands,

a set of special Admin chips is used. A chip is first configured with the ToePunch Config Tool, a special mobile application, and then touched to a unit to apply the configuration or command. The same mobile application is used for preparing Competitor chips as well.



Fig. 2 Chip set



Fig. 1 ToePunch unit

All collected race result data (competitors' start and finish times, answers for all controls etc.) is stored both in ToePunch units and in Competitor chips. The data from the units can be transferred directly via a WiFi connection and processed on a server. The data from chips can be read out using the mobile application ANT (ant.yq.cz, the same as used for timed control marshals' work but in version 4.10 or higher) and sent to a server.

WARNING! Unfortunately, some new units only communicate with a chip when it is in a **short distance (up to 1 cm)** above the unit, **not** when the chip is **lying directly on the unit!**

2. Preparation – chips

For ToePunch unit configuration, you will need a set of **Admin** chips that are part of the ToePunch package. The chips are labeled by common function names and it is recommended to use them for functions according to the labels. Some of them are already configured and prepared to use.

If you want to prepare an Admin chip, take the appropriate chip, start the ToePunch Config Tool, select the Configuration Chips Writing Parameters menu item, select the chip type you want to prepare, check or change displayed parameters and then touch the chip on the **BACK** side of your mobile. For the first time, it will take some time since you have to find the exact place, where your mobile/tablet has the NFC reader. Typically it is in a corner, in the mid of an edge, or in the center of the device. If the write operation succeeds, the application writes a message "OK. Touch another chip" and you can continue with a new chip.

You can also verify the successful configuration of the chip by selecting the Configuration Chips Reading Parameters menu item, touch the chip and verify its content that will be displayed.

Most operations with ToePunch units have to be confirmed by a special **Ack PIN** chip. This one is already preconfigured with default values in the set, as well as the **Station Info** chip that is used for getting information about units.

Every competitor must have a set of seven **Competitor** chips (Start/Finish/Info chip and chips for answers A–E and Z). The set is marked with a number that identifies the competitor. By default, the starting number can be used for this purpose. The way chip numbers are assigned to competitors depends on the software used for result processing.

The Competitor chips are to be prepared by the ToePunch Config Tool (in a similar way as the Admin chips) and once they are prepared they can be used for their whole lifetime without any change.

Before starting into a race, each competitor has to clear (and configure for the race) all chips in her/his chipset. It is done by sequentially touching all the chips to a ToePunch unit configured and marked as the CLEAR unit. During the operation, Clear unit shows an identification of each chip on its display and emits a sound and light signal. The Clear unit can be available to competitors at the competition presentation point, but it **must also be available at the start** or in the pre-start area. The Clear function is also incorporated as one of Special operations in the ANT application, so it can be used in case of lack of ToePunch units. **If a problem is detected during the clear operation, we recommend replacing the chipset by a new one.**

3. Preparation – communication

Toe units need to communicate via a WiFi network in the two following situations:

- If you want to use ToePunch for time keeping, the clocks of all Start and Finish units (see Chapter 3) must be synchronized. If you want to use the ToePunch also to check punching order, you must synchronize all units. The easiest way to do this is to configure and connect the units to a WiFi network and use the NTP protocol. Usually, you can only do it once shortly before the event, in a good network environment. Another option is to use a WiFi hotspot started on a smartphone with a data SIM. The amount of data used for NTP is negligible.
- If you want Toe units to send result data directly to a server, you will need to connect them to a WiFi network “in a forest”. A WiFi hotspot as mentioned above is usually a more accessible option there. However, you will still need a good mobile data signal coverage. We recommend preparing one or more smartphones with an event-wide general WiFi hotspot and configuring all ToePunch units to use this WiFi network if needed.

Except for these two situations, the units do not need to communicate during a competition, so no special conditions for a WiFi connection are expected.

4. Preparation – units

The Event Organizer prepares a sufficient number of ToePunch units:

- One **Clear** unit. This unit clears competitor chips and configures them for a new race. In case of lack of units, the Clear function is also available in the ANT application. The Clear unit sets race data to all chips, so **it has to be configured again for each race** with the Race chip.
- One **Start** and one **Finish** unit for each part of the course. Competitors touch the Start/Finish/Info chip to these units to record their start and finish times. **We recommend using two units for each Finish point as a backup if possible.**
- An **Answer** unit for each control point in the course. The number of a unit is not a sequence number - one unit can be used for different controls in different classes. Competitors touch the proper answer chip to this unit to punch their answer.

For good functioning, the units must have sufficiently charged batteries. There are two batteries in the unit:

- The main operational battery has a voltage of 3.7 V and capacity 1200 mAh (4.44 Wh). It was tested to run in the ready state for more than 60 hours. The current voltage of the battery can be shown on the unit's display by touching the Station Info chip. If the voltage is lower than 3.7 V, we recommend charging it using a regular charger with a micro USB cable. The socket is located in a hole on the side of the box (see Fig. 4). **Be extremely careful when handling the USB connector to prevent breaking it!** The charger unit glows red while charging and blue once the battery is charged.
- The other battery powers the unit clock when a box is switched off. It is a regular CR2032 battery and it is located inside the box. The expected lifetime of the battery is at least one year. Insufficient battery capacity causes resetting the clock which is signaled by a **TIME ERROR message** on the display.



Fig. 3 Unit interior

The unit is turned on with a switch located next to the USB socket (in a hole on the side of the box). Fully charged units remain charged almost 24 hours, so it is possible to turn on and configure them in the evening before the race.



Fig. 4 USB socket and Power switch

Each unit has to be configured for the specific role assigned to it in the competition by an Admin chip of the **Station** type. However, this role can be set once for the whole lifetime of a unit.

- The Station/Clear chip is used to configure a unit as the Clear unit.
- The Station/Start and Station/Finish chips are used to configure a unit as the Start or Finish unit. It is important to use well paired start/finish units for each course part (in normal circumstances with the same station number – e.g. Start 1 and Finish 1).
- The Station/Answer chip is used to configure a unit as an Answer unit. If you have more classes, only the main class can follow the numbers from 1 to N while in other classes, the assignment of Answer station numbers and course task numbers have to be defined in software for result processing. No two Answer boxes can have the same number!

Additional configuration steps usually involve:

- Setting the Race ID and the Start 00 date and time by an **Race** Admin chip to all boxes.
 - The Race ID depends on the system used for result processing. If you have your own system, you can use any number. If you use a result server (e.g. top.yq.cz or preoresultat.se), you have to use the correct ID assigned to your race by the server.

It is important to configure all units used in a race before the race. We recommend configuring some spare units in case a unit needs to be replaced. In the case of a multistage event we also recommend preparing Race Admin chips for each stage in advance. If you use the top.yq.cz server and ANT (version 4.11.3 or higher), the easiest way how to make a Race

chip is to configure ANT for the race and then select Special Action menu item Make ToePunch.Race chip.

- Setting WiFi network parameters (SSID and password) by a **WiFi** Admin chip. According to a communication plan (see Chapter 2) you should prepare chips for all networks.
- Time synchronization by a **Time(NTP)** Admin chip. This chip issues a command to contact an NTP server to synchronize the time. The server name or address and time zone is stored in the chip and the chip can be used repeatedly (just watch out for daylight saving time changes). The units remain synchronized with a reasonable precision for a few days but we recommend using the Time chip again when configuring all units for a new event. **The time should be checked whenever the box is switched on before or during a competition.**
- Manual time setting by a **Time(Now)** Admin chip for emergency cases. The ToePunch Config tool writes the current time plus a margin (10 seconds) to the chip, so you can touch multiple units with the chip, and when the time margin runs out, you can touch all units with the AckPIN chip to confirm storing the previously configured time to the unit's clock.
- Configuring a server for data upload by a **Server** Admin chip. You must set the server IP address, port, service URL and upload mode. **All the parameters must be set** and they are stored into the box memory. This step is needed only if you use data upload directly from ToePunch units. If you use chip read-out by the ANT application, you don't need this. We recommend making Server Admin chips for all servers you plan to use in advance and use them as needed. If you use the same server in two consequent races, you don't need to reconfigure ToePunch units.

If you configure units the day before competition, you can leave them switched on. If you decide to turn them off and on just before the race, **you have to check (and fix) the clock of each unit.** This is especially important for Start and Finish units; for Answer units it is good for competitors to check their course time.

There are some more Admin chips used during both the preparation and competition phases:

- An **Ack PIN** chip. Operation of all the above mentioned Admin chips is protected by a PIN. The main reason is to guard against accidentally touching an unknown chip to a unit. The security reason is only a secondary issue, so the default setting using a default PIN is sufficient in typical cases. After using a protected chip, the unit shows the *"Waiting for PIN confirm"* message on its display and you should touch the appropriate Ack PIN chip to the unit. If you decide, for some reason, to use a different PIN, you will need to change the Ack PIN chip and to reconfigure all units using a special **Set PIN** chip.
- A **Station Info** chip displays the status of a unit. We recommend having more these chips prepared so that marshals on the course can perform basic diagnosis in case of problems. Touching the Station Info chip causes displaying three screens in a sequence.
 - The first screen contains the unit type and number and the firmware version.
 - The second screen contains the serial number of the unit, current main battery voltage, date and time.
 - The last screen contains the currently configured Race ID, start time of the race, WiFi network SSID and server for upload.



Fig. 5 Station Info output sample #1



Fig. 6 Station Info output sample #2



Fig. 7 Station Info output sample #3

- **Upload** chips. If you use sending data from Toe units directly to a server, you can use these chips for an out-of-order upload. There are three types of upload:
 - **Incremental.** This upload sends only records that have not been sent yet.
 - **Race.** This version sends all records from the current race.
 - **Full.** This is an emergency upload in case of unexpected problems – all records from the unit memory are sent.
- **Upgrade** chip. Follow the news on the top.yq.cz server and **upgrade units to the latest** released firmware version (currently v2.0.6).

After configuring all units, we strictly recommend to take a chipset and “run” a race of your table, read out the chipset and check that everything is OK!

5. Preparation – software

Data from the ToePunch system has to be processed in a result system.

Currently, the Event Organizer has three main choices:

- Using the server top.yq.cz with a web application for result processing. To get an access to this server, write a message to top@yq.cz.
- Using an Excel worksheet which is the method used for local trail-o competitions in some countries. We have developed an Excel macro that can read data transferred from Toe units either via the Internet or a local technical equipment, check it and convert to an Excel sheet.
- Using the preosultat.se server. This server can accept data both from ToePunch units directly, or via a read-out point made by the ANT application.
- Using an own solution for processing data from ToePunch units.

Depending on the selected system, the organizer has to prepare a race configuration in the system so that it can calculate the results properly. Namely it means the number of course parts, ToePunch station numbers belonging to particular parts, competitor chip numbers etc.

6. Preparation – results

Result processing options depend on the software used and network possibilities:

- The most common way is to set up a chip read-out point where all competitors read out their chips using the ANT mobile application. This can be either at the finish or in the competition center. **Do not forget to designate a trained marshal for the read-out point, with a charged mobile phone/tablet with NFC support and ANT app installed.** If the read-out point is well covered by a signal, you can send the data immediately and take full advantage of your result system by publishing the online results. If you have poor connectivity at your timed control stations, you can decide to store timed control data to the competitors' ToePunch chips directly at the stations by the ANT app and read it together with the data from the classic course parts at the read-out point.
- ToePunch units can upload data directly to the server via WiFi. You can either arrange WiFi coverage from an operator or dedicated WiFi router, or mediate it using WiFi hotspots operated on smartphones with data SIM cards, located somewhere along the course.

The result upload can be configured in one of three modes:

- Sending after each punch. This mode is more attractive but is it very energy consuming.
- Sending with a configurable period. This mode is sufficient enough in most cases and it is energy efficient when using a reasonable period (e.g. 10 min).
- Sending on demand. This mode is suitable in case of bad connectivity. A marshal comes to a Toe unit with a cellphone and uses a special Action chip Upload to invoke the upload.

7. Preparation – distribution

The size of Toe boxes is compatible with SportIdent (SI) card boxes (ca 111x56x33 mm, 150 g), so the organizer can use sticks/stands with SI box holders. Another way is to fix the box to any stick or stand by an adhesive tape. **Be careful when handling boxes at temperatures above 40°C as the boxes will soften slightly. Test whether all units are accessible for wheelchair users!**

At the Start or Pre-Start, a Clear unit has to be placed and the marshal there checks that all competitors use it for proper clearing and configuring of all chips in the set.

The Start and Finish units are to be placed as close to the start/finish line as possible.

The Answer units should be placed close to the decision points and distinctively marked by a control point number, or – in case of more categories – a control point number and class.

Once in place, all units should be checked with a Station Info chip to see if they are ready for the race. If you prepare ToePunch units in the evening before the competition, we recommend keeping them switched on. If you switch them off and plan to switch them on when placed on the course, **check also the time on the display** and if it is wrong, use Time admin chip to fix the unit clock.

8. After a race

If you use direct result uploading from the ToePunch units (either direct or mediated) then the data is available on-line and no special actions are needed after the race.

If you use chip readout with the ANT application, there should be one or more smartphones or tablets with the NFC support and ANT application installed and configured. You need to configure ANT with the same parameters as ToePunch units (the same ID, date of the race, number of tasks etc.). In case of using top.yq.cz or preoresultat.se, the configuration can be simply downloaded from the server (choose the Race menu, select top.yq.cz or preoresultat.se in the Source dropdown of the Configuration File section and then find the race using the magnifier glass icon at Race ID field). If you have more stages, we recommend downloading all configurations in advance so that you can later configure ANT from a locally stored configuration file without the need to contact the server in a forest.

Chip Readout should be started by an appropriate button on the main screen, as soon as you select Race supervisor Application mode in the Race configuration. After pressing the button, the app is ready to read a new set of chips. A marshal or a competitor touches all chips sequentially and the app confirms reading them. After reading all seven chips, the app informs user that reading is complete and the Save button can be used. By saving the data, particular TR0 result file is created, or extended. You can immediately continue reading a new chip set, or you can return to the main screen using the DONE button.



Fig. 8 ANT readout - start

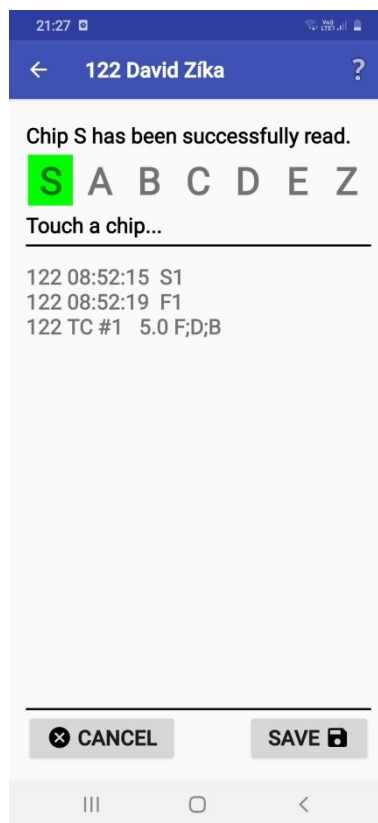


Fig. 9 ANT readout – chip read

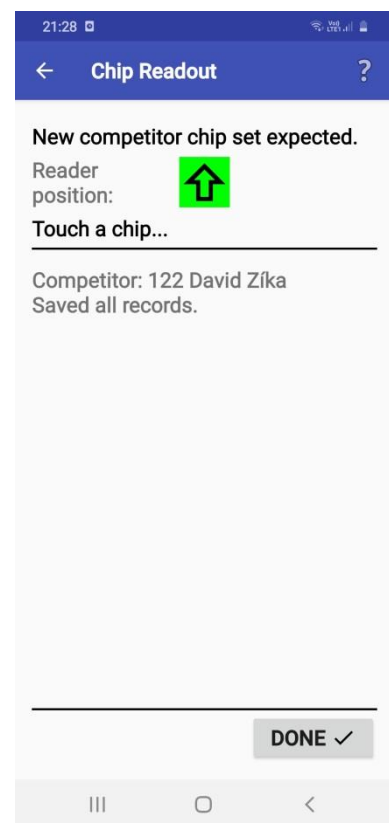


Fig. 10 ANT readout - completed

If you have a Bluetooth printer (e.g. the one used for SportIdent), you can print every competitor her/his list of answers and start/finish times. Setting the printer and pairing with the mobile/tablet is done via the Preferences menu item.

When you want to upload data that was read, you have to go to the Results screen. If you have correctly configured the upload parameters and you have new result data, you will see a screen like on Fig. 11. The green button in the right bottom corner will invoke upload of all unsent data to the server.

For preliminary results calculation, you need to merge particular result files. There is a button in the left bottom corner of the Results screen that makes the merged file and the preliminary results. You can then run an HTTP server on the mobile device publishing the directory files/pub where the HTML file is stored.



Fig. 11 ANT readout - results

9. Checklist

The following list contains basic rules to check whether your race is well prepared.

Before an event:

1. Charge all units shortly (some days) before the event (a blue LED indicates the completion of the charging process).
2. Check (using the Station Info chip) correct station numbers of all units (Start 1, Finish 1, Answer 1 – n and so on).

Before a race:

3. Check (using the Station Info chip) the clock on (at least Start and Finish) units. If it is wrong, synchronize it using the Time NTP or Time Now chips. After that, keep the boxes switched on.
4. Prepare the Race chip (e.g. using ANT app) and configure all units (including the Clear ones).
5. Check correct configuration of the race in your result system (station numbers) and “run” a race with a chipset of a virtual competitor, read-out and check if all data is set properly.
6. Mount the units and check once more that they are switched on using the Station Info chip.

Between races:

7. Check (using the Station Info chip) the voltage of all units and recharge those what are well below 3.7 V.