



## Instructions for organizers

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### 1. Basic Information

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

Any Toe unit can be used for any role in the system. Determining the role and setting parameters is done with Admin chips. These chips (as well as Competitor ones) are configured with the ToePunch Config Tool, a special mobile application.



Fig. 1 Chip set



Fig. 2 ToePunch unit

The primary storage of all competitor data (start and finish times, answers for all controls etc.) is in the appropriate Toe units and the backup storage is in competitors' chips. The data from the units can be transferred directly via a WiFi connection and processed on a server. Another option is to make a read out point where competitors' chips are read using the mobile application ANT ([ant.vg.cz](http://ant.vg.cz), the same as used for timed control marshals' work but in version 4.10 or higher).

### 2. 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) have to be synchronized. If you want to use ToePunch also for punching order checking, you have to 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 do it once before the event, in the event preparation phase and 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 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. We recommend preparing one or more smartphones with an event-wide general WiFi hotspot and configuring all Toe units to use this WiFi network if needed.

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

### 3. Preparation – units

The Event Organizer prepares a sufficient number of Toe units:

- One **Clear** unit. This unit clears competitor chips and configures them for a new race.
- 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 (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 is rechargeable and it was tested to run in the ready state for more than 60 hours. The current capacity of the battery can be shown on the unit's display by touching the Station Info chip. If the battery capacity is lower than 4 V, it is recommended to recharge it using a regular charger with a micro USB cable. The socket is located under a cover on the side of the box (see Fig. 4). **Be extremely careful when handling the USB connector!**
- 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.



Fig. 3 Unit interior

When the units are charged (or are being charged), they have to be switched on by a switch located next to the USB socket (under a plastic cover on the side of the box) and configured for the race.



Fig. 4 USB socket and Power switch

Each unit has to be configured for the specific role assigned to it in the event 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 type is used to configure a unit as the Clear unit.
- The Station/Start and Station/Finish types are used to configure a unit as the Start or Finish unit. It is important to use well paired start/finish units (with the same number – e.g. Start 1 and Finish 1).
- The Station/Answer type 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 unit numbers and course task numbers have to be defined in software for result processing.

Additional configuration steps usually involve:

- Setting the Event ID and the Start 00 date and time by an **Event** Admin chip. The Event ID depends on the system used for result processing. If you have your own system, you can use any number. If you use a server (e.g. preoresultat.se), you have to use the correct ID assigned to your event by the server. **It is important to configure really all units used in a race for the race.** We recommend configuring even some spare units in case a unit needs to be replaced. In the case of a multistage event we also recommend preparing Event Admin chips for each stage in advance.
- 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** Admin chip. This chip issues a command to contact a 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. For emergency cases, a manual setting is possible by a special version of the Time chip. **The time should be checked whenever the box is switched on before or during a competition.**
- Configuring a server for data upload by a **Server** Admin chip. The chip sets the server address, port, hostname, URL and an upload mode. This step is needed only if you use data upload directly from Toe units. If you use chip read-out by the ANT application, you can skip this step. We recommend making 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 Toe 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.**

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

- An **AckPIN** 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 AckPIN chip to the unit. If you decide, for some reason, to use a different PIN, you will need to change the AckPIN chip and to reconfigure all units using a special **SetPIN** chip.
- A **Station Info** chip. Using this chip you can check the status of a unit. We recommend having more Station Info chips so that marshals on the course can make a basic diagnosis in case of problems.

Touching the Station Info chip causes displaying three screens in a sequence.

- The first screen contains the type and number of the station 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 event ID, event start, WiFi network SSID and server for upload.



Fig. 6 Station Info output sample #1



Fig. 5 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.
  - **Event.** This version sends all records from the current event.
  - **Full.** This is an emergency upload in case of unexpected problems – all records from the unit memory are sent.

## 4. Preparation – chips

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.

All chip sets have to be cleared and configured for the race by sequentially touching all the chips to a Clear unit, which shows the identification of each chip on the unit display together with a sound and light signal. The Clear unit can be available to competitors at the competition presentation point and/or in the start or pre-start area. The Clear unit needs to be configured for the appropriate race before the operation.

The Competitor chips are to be prepared by the ToePunch Config Tool as well as the Admin chips and once they are prepared they can be used for their whole lifetime without any change.

## 5. Preparation – software

Data from the ToePunch system has to be processed in a result system. There is a new web application being developed for this purpose but it is not ready at this moment.

Currently, the Event Organizer has three main choices:

- Using an Excel worksheet which is the method used for local trail-o competitions in most 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 preoresultat.se server. This server can accept data from Toe units directly.
- Using an own solution for processing data from Toe 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, Toe unit numbers belonging to particular parts, competitor chip numbers etc.

### Using the preoresultat.se server

If the preoresultat.se server is used, you should first create and configure all competitions. The ID of a competition is written in the top left part of the screen as soon as a competition is selected.

Don't forget to set the possibility to use chips for data input. Currently, the system does not distinguish between different punching systems, so you need to visit the SportIdent section of the Database/Competitions → Edit Event Configuration page and select that SportIdent will be used.

Then you will need to assign ToePunch chip numbers to all competitors. This is again done under an acronym "SI-number" in the "Assign manually..." section of the Competition/Administration page.

The next step is to prepare the preoresultat.se system so that it accepts the control numbers exported by the ToePunch system. Our export format is done so that it corresponds to the default "Code number SI-units" assigned by preoresultat.se. The only difference is that for "Arrivals" and "Departures" of course breaks, the finish (21-29) and start (11-19) numbers are used. So for a course with two breaks, the order of Start and Finish unit numbers will be 11, 21, 12, 22, 13, 23 (see Fig. 7).

No. of start-stop along the course (time-controls, transport) that are not included in the maximum time:

**Code number SI-units:** Start:  Finish:   
 Arrival 1:  Departure 1:   
 Arrival 2:  Departure 2:

**Order controls must be punched:**  
 Number order  Free order

**Course controls:**  
 1  2  3  4  5  6  7  8  9  10  
 11  12  13  14  15  16  17  18  19  20  
 No. of controls:  21  22  23  24  25  26  27  28  29  30  
 31  32  33  34  35  36  37  38  39  40  
 41  42  43  44  45  46  47  48  49  50  
 51  52  53  54  55  56  57  58  59  60

No. of:	Correct answer:	Code number SI-units:					
1	<input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E <input type="radio"/> Z <input checked="" type="radio"/> -	A= <input type="text" value="31"/>	B= <input type="text" value="32"/>	C= <input type="text" value="33"/>	D= <input type="text" value="34"/>	E= <input type="text" value="35"/>	Z= <input type="text" value="39"/>
2	<input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E <input type="radio"/> Z <input checked="" type="radio"/> -	A= <input type="text" value="41"/>	B= <input type="text" value="42"/>	C= <input type="text" value="43"/>	D= <input type="text" value="44"/>	E= <input type="text" value="45"/>	Z= <input type="text" value="49"/>
3	<input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E <input type="radio"/> Z <input checked="" type="radio"/> -	A= <input type="text" value="51"/>	B= <input type="text" value="52"/>	C= <input type="text" value="53"/>	D= <input type="text" value="54"/>	E= <input type="text" value="55"/>	Z= <input type="text" value="59"/>

Fig. 7 Control configuration page in preoresultat.se

## 6. Preparation – results

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

- Toe units can upload data directly to the server either via a WiFi network or mediated by a WiFi hotspot and data SIM on smartphones. The smartphones can be located somewhere along the course, or can be carried by marshals.
- If you do not have a good mobile data connection, the Toe units can use a WiFi hotspot on a smartphone and store data in the ANT mobile application running on it. You have to configure ANT for the proper race and start the AMS (ANT Master Server) function. The Toe units have to be configured to use AMS by a Server Admin chip with type AMS. After collecting the data, the smartphone can be either moved to another place with a better signal, or attached to a local computer so that the data can be copied as a regular file.
- A chip read-out point can be made where all competitors read out their chips by the ANT mobile application; usually in a competition center. This application can also make preliminary results available by a local web server run on the mobile.

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 SI card boxes (ca 111x56x33 mm, 150 g), so the organizer can use normal sticks with SI holders. Another way is to fix the box in a vertical position to any stick by an adhesive tape.

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 Toe 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 it.

## 8. After a race

If you use direct result uploading from the Toe 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 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 preoresultat.se, the configuration can be simply downloaded from the server (choose the Event menu, select preoresultat.se in the Source dropdown of the Configuration File section and then find the race using the magnifier glass icon at Event ID field). If you have more stages, we recommend downloading all configurations so that you can later configure ANT from a locally stored configuration file without the need to contact the server.

Chip Readout should be started by an appropriate button on the main screen, as soon as you select Event supervisor Application mode in the Event 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 per-station result files are created, or extended. You can immediately continue reading a new chip set, or you can return to the main screen.

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 this picture. 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. 8 ANT - Uploading read data