

## MAPPING THE WORLD AND MAP CREATOR FUNCTIONS FOR COLLECTION, INTEGRATION AND DATA VISUALIZATION

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### ABSTRACT

Information technologies are changing the world we live. Nowadays modern people have access to web-based maps for the entire World. By one click we can visit the farthest location or whichever place we are interested in. There are several web sites, visited every day by millions of people for searching, routing or even adding data. But how it is made a global map? There are two main components – initial data and a tool for integration and visualization. When we are talking about detailed (navigable) Global Map, it is easy to imagine the resources needed to be build, and what about to be maintained and to be kept up to date! With regard of the tools, there are advanced GIS software available, even free ones. With that respect one of the components for mapping the World is available and we just need data - data for every continent, country, city, village, neighborhood, street, address, object. Does not sound that easy. Certainly not to the ability to many, but just few companies who map the World.

**Key words:** Information technologies, Global map, mapping tools, data visualization.

### INTRODUCTION

Information Technology (IT) is a group of technologies designed to collect, process, store and distribute sound, graphic, textual and spatial information. They are based on a microelectronic combination of computer

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and telecommunication equipment. Information technology encompasses the practical application of informatics and in this respect share some common features with engineering disciplines.

The term "information technology" in its modern sense was first used in 1958 by Leavitt H. and T. Whisler in an article in the Harvard Business Review, where they noted that "the new technology still has no definite name. We will call it Information Technology (IT). " The processed information is most often in a discreet form. Information technologies are sometimes also called digital (digital). Due to the important role of communications in modern information processing tools, the wider concept of information and communication technologies is often used. At the heart of information technology is the information (data) - their main task is to automate and systematize their work with computing equipment (computers). Information is a concept related to the objective property of the objects and phenomena (processes) to generate a variety of states that can be transmitted to other objects through interactions and sealing in their structure. Although there is no commonly accepted specific definition, information is usually understood as available, usable knowledge. In the narrower technical sense, the information is arranged in a row of symbols (data).

The theoretical basis for information technologies is information science - a science that deals with the collection, transformation, transfer and storage of information by random, including automated means. It studies the information in terms of its structure, its quantitative characteristics, the forms and ways of its presentation, as well as the information processes as a composition of the main information activities and the methods and means for their automation. Informatics is closely related to mathematics, linguistics, computer and communications engineering, geography and other sciences.

## MAP CREATOR BY HERE

Map Creator is a free, web-based and available on mobile mapping program for volunteer edits. Mobile version is in the stores for Android and iOS. It's creation has been inspired with the aim for having accurate, detailed and fresh Global Map. within the context of the crowdsourcing, as a social network phenomenon. Crowdsourcing is closely related to the social networks like Facebook, Twitter, LinkedIn, where individuals share some personal or interesting to them information in the network. By using the fact people likes to "share", crowdsourcing aims to obtain concrete knowledge in specific area. In the Geo science area, it is information from the ground for

the surrounding physical reality or to be used the so called local knowledge in order of map maintenance.

Despite of the fact Map Creator is a free web-based program, data content is owned by HERE Technologies. HERE is a pioneer in the digital mapping of the world with more than 30 years experience and global reach. HERE Maps are used by millions worldwide through mobile apps, social networks and in 3 out of 4 cars equipped with a navigation system. Map Creator is only one of the tools and methods used in the overall mapping process by HERE. By using the power of crowdsourcing, idea is to be gained access to the real time changes across the globe and those changes looked like initial data to be implemented into the map. Can be added or updated roads, routes, places and house numbers, to bring accuracy and context to the digital world. By editing data in the program, there are combined two stages from the digital mapping process:

- Initial data collection (variety of options and tools available – PND and GPS devices, mobile phones, cameras etc.), which could be replaced by local knowledge, if it exists;
- Geocoding – each edit in the program is a digital mapping and ideally reflects physical reality.

To ensure the highest quality all community content is verified before integration. Process flow contain:

- Moderation – automated and human verification;
- Validation - automated and human validation;
- Integration;
- Baseline map delivery cycle;
- Usage in the derivative products, e.g. here.com, HERE WeGo mobile app.

## **MAP CREATOR STRUCTURE, MAIN FUNCTIONS AND SPECIFICS**

HERE's road network contains different kinds of road geometry that's displayed by using various colors and icons. To render the correct display and routing information, it is important to accurately define their geometric representation, their traffic significance, and their attributes according to reality and/or local knowledge. The following

chapter gives an overview about the structural elements of a road in Map Creator.

## **1 Road structure**

### ***1.1 Road segments***

Road segments are the smallest sub-unit of a stretch of road. The geometric representation of a road segment is defined by its start and end points (nodes) and the shape and sub-shape points along the road segment (Fig1).

### ***1.2 Nodes***

Nodes are the start and end points of a road segment. If the road segment is connected to other segments, the node will be displayed as a diamond. If a road segment's node isn't connected to anything (e.g. a dead-end road), it will be displayed as a circle.

### ***1.3 Shape points***

Shape points are round and are used to define the shape of a road. They can also indicate the endpoint of a dead-end road.

### ***1.4 Sub-shape points***

Sub-shape points are small, dark circles along a road segment. Sub-shape points are important when creating a curved section of a road segment. If you move a sub-shape point to a new position, it turns into a shape point, and two new sub-shape points will be created on either side of the shape point. If needed, you can use the newly created sub-shape points to further define the shape of the road segment.



Fig.1: "Road structure"

## 2. Road attributes

Almost 50 road attributes can be used to describe various types of roads in Map Creator (e.g. speed limit, lanes, etc.). To simplify editing attributes on roads, there are several "Road types" (e.g. highway) which have a default set of attributes to prevent invalid combinations (e.g. pedestrians allowed on a highway). After drawing a new road or selecting an existing road, the "Road attributes" menu (Fig2) opens on the left and displays all editable road attributes. Click on each title to expand the section and see the attribute choices. Attribute information is critical for correct display and routing purposes and should be edited according to reality.

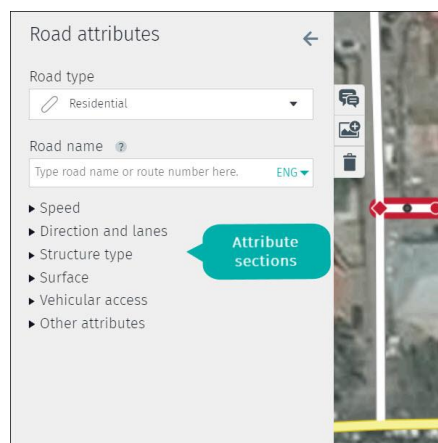


Fig.2: "Road attributes" menu with expandable attribute sections

## 2 Road types

It is important to designate a road type (Fig.3) because it defines relevance and importance of a road segment when optimizing route calculations. In Map Creator, all road types have a default set of attributes adhering to HERE specifications. Highway, main, local access, residential, parking lot and 4WD roads are mainly vehicular roads, while pedestrian zone, pedestrian road and trails are primarily for pedestrians and restrict vehicles.

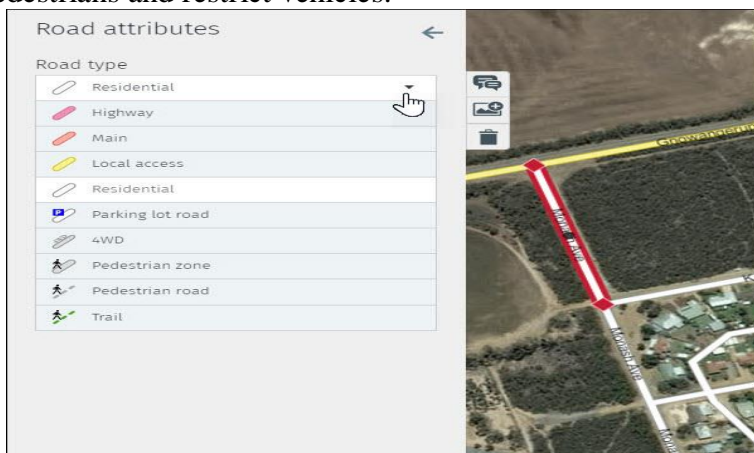


Fig.: 3 “Road types” in Map Creator

### 2.1 Highway

“Highways” are the main connectors between different countries, cities, and metropolitan areas. The main characteristics are: limited access, motorized vehicles only, relatively high posted speed, and a median separating traffic traveling in opposite directions.

### 2.2 Main

“Main” roads are primary or arterial roads with a high traffic thoroughfare between cities, villages, and within urban areas. They typically provide a fast connection to adjacent highways.

### 2.3 Local access

“Local access” roads are secondary roads with a moderate traffic flow which provide a relatively fast connection to cities and villages. Within urban areas they connect residential areas with main roads.

**2.4 Residential**

“Residential” roads are roads within neighborhoods. These roads are low-traffic and normally used by locals rather than as a thoroughfare, but can also connect to local access and main roads.

**2.5 Parking lot road**

“Parking lot roads” lead to parking spaces in front of shopping malls, convention centers, amusement parks, etc.

**2.6 4WD**

“4WD” is used when the road quality is only suitable for vehicles with 4 wheel drive. The “4WD” road type is only available in a subset of countries where this type has a frequent appearance (e.g. North America, Africa and Oceania).

**2.7 Pedestrian zone**

“Pedestrian zone” is a pedestrian-friendly shopping street where vehicle access is limited to delivery vehicles and emergency/service vehicles.

**2.8 Pedestrian road**

“Pedestrian roads” are walkways which are wide enough to allow emergency/service vehicles to pass.

Fig.: “Pedestrian road” (e.g. Germany)

**2.9 Trail**

“Trails” are walkways, paths, tracks, or earth roads which are only accessible by pedestrian.

**3 Road name and language code**

Road names and route numbers should be entered according to the street sign in reality (Fig.4)

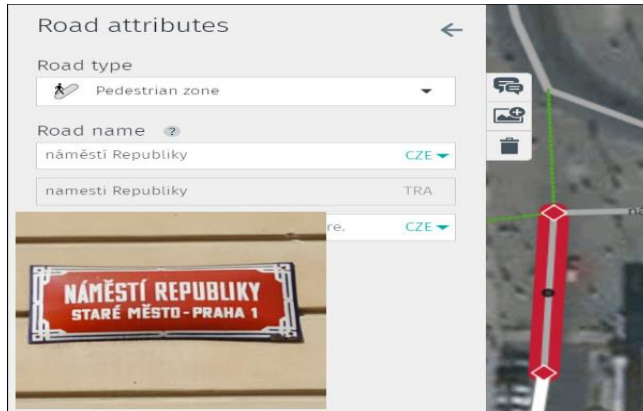


Fig.:4 Road name in reality and implemented in Map Creator (e.g. Czech Republic)

## 4 Speed

Speed information is essential for routing calculations and pre-warnings for speed monitoring. Speed information can be expressed in two ways:

- As a speed limit.
- As an average speed.

Both attributes should be added according to reality.

### 4.1 Speed limit

Speed limits are based on posted speed limit signs in reality. Currently in Map Creator, only general speed limits can be implemented, for example:

- Sign posted speed limits.
- Derived from reference signs according to country-specific driving regulations.

### 4.2 Average speed

The average speed classifies the overall speed trend along a road and is entered as a range (Fig.5). This differs from speed limits, which are



entered based on posted speed limit signs. Therefore it is possible for the speed limit to fall outside of the average speed range.

Average speed ranges are predefined for each road type. You can change the average speed range by clicking on the arrow and choosing a new average speed range which best describes the speed trend of the road.

The screenshot shows a web-based form for editing road data. At the top, there's a dropdown menu set to 'Residential'. Below it is a 'Road name' field with a placeholder 'Type road name or route number here...' and a 'GER' dropdown. The 'Speed' section has two sub-sections: 'A to B' and 'B to A', each with a 'Speed Limit' field set to '50 km/h' and an 'unlimited' checkbox. Below these is a 'What is the avg. speed?' dropdown menu. The menu is open, showing a list of speed ranges in km/h and MPH. A hand cursor is pointing at the '< 50 km/h / 30 MPH' option, which is highlighted. To the right of the form is a map showing a road segment with a red line and a green line.

Fig.5: Changing the average speed

## 5 Direction and lanes

The direction and lane gives an overview of direction of travel (1-way/2-way) and number of lanes.

### 5.1 Direction of travel (1- or 2-way road)

The direction of travel attribute is one of the most important attributes for routing. Take great care when adding or changing direction of travel. Implement 1- or 2-way roads according to sign posted information (Fig.6)



Fig.:6 One way display

## 5.2 Number of lanes

Number of lanes indicates the total number of traffic lanes in a single direction. The attribute provides the general lane trend.

## 6 Structure type

The structure type gives information about the physical works applied to a road segment. Map Creator differentiates three types:

- Open road
- Tunnel
- Bridge
- 

## 7 Surface

### 7.1 Road is paved

A paved road consists of materials which create a solid surface (concrete, asphalt, brick, cobblestone, etc.). If the road is considered unpaved (gravel, dirt, grass, sand, etc.), uncheck the “Road is paved” box.

### 7.2 Poor surface quality

Check this box if most of the road has uneven or broken pavement.

Fig.: “Poor surface quality” (e.g. broken pavement)

### 7.3 Dirt

Check this box if the road is sandy and muddy most of the time.

#### **7.4 Gravel**

Check this box if the road is primarily gravel.

### **8 Vehicular access**

Vehicular access defines vehicle types allowed on a road. This information is very important for routing purposes and should reflect reality. For all road types (except “Residential”), you can only see a subset of access types because Map Creator shows only logical combinations (e.g. a Highway cannot be “Local vehicular traffic only” so that access type is not visible on a Highway). The full set of access types can be seen in “Residential”. The following access types are visible in Map Creator:

#### **8.1 No vehicular traffic allowed**

The checkbox for “No vehicular traffic allowed” is unchecked by default. If you check the box, the road type will change to “Pedestrian road,” which defaults to allow “Emergency vehicles.” If this does not reflect reality (i.e. emergency vehicles are not allowed), change the road type to “Trail.”

#### **8.2 Local vehicular traffic only**

“Local vehicular traffic only” is unchecked by default. Check the box if through traffic is prohibited

## **PLACES AND PLACE STRUCTURE**

Map Creator offers the ability to edit Points of Interest (POIs), also called Places. There are more than 350 Places categories and 90+ editable attributes. Places are point data associated to a road segment. The following chapter provides an overview about the structural elements of a place in Map Creator.

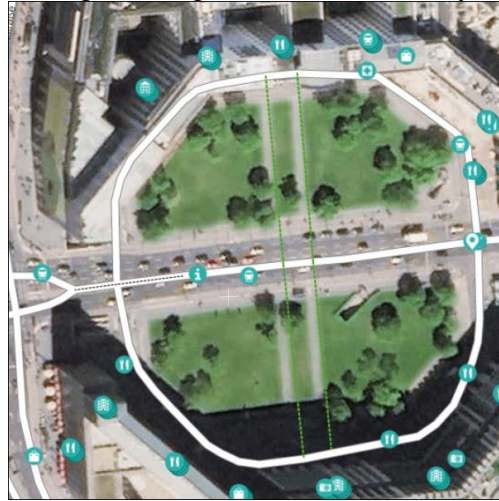
### **1 Place structure**

The Place structure is composed of three elements that define the Place object. Those are the Place icon, the display point and the routing point.

#### **1.1 Place icons**

Places icons are displayed as round icons (Fig. 7) containing a symbol that corresponds to Place category. The icon should be positioned at the entrance of the building or the entrance of an open location (e.g. Park-Recreation) where the Place is visible in reality. For some Place

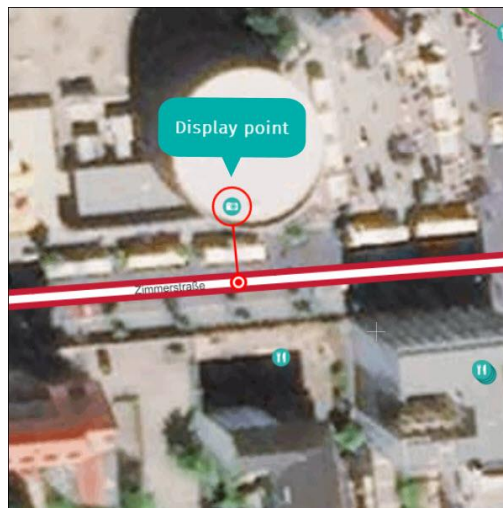
categories, more than one icon can mark a single Place, due to multiple entrances (e.g. Underground Train-Subway).



*Fig.:7 Round icons with various category symbols representing Place locations*

### **1.2 Display point**

The display point, a red circle around the Place icon (Fig. 8), appears when clicking on the Place. It can be moved in all directions to identify the location of the entrance of a building or the entrance of an open area.



*Fig.: 8 Display point*

### 1.3 Routing point

The routing point (Fig. 9) appears as a red dot on the road segment. It can be moved along the road to represent the arrival location or entrance of the Place.

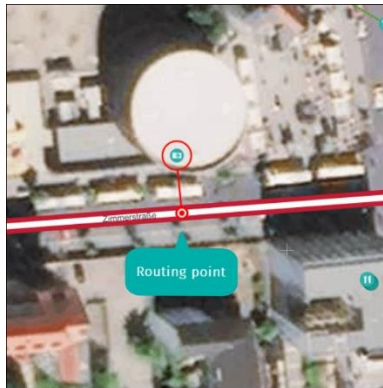


Fig.: 9 Routing point

### 1.4 Stacked places

It is possible that the display point of several Places is located at the same coordinates (Fig. 10). In these cases, you will see the stacked Places icon. Hover over the stacked Places icon to see a list of all Places at the same position.

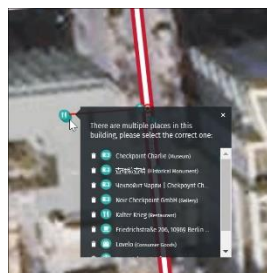


Fig.10: Stacked places icon

## HOUSE NUMBERS AND HOUSE STRUCTURE

House numbers are the individual address data displayed as a point object. A house number object needs to have a house number or a

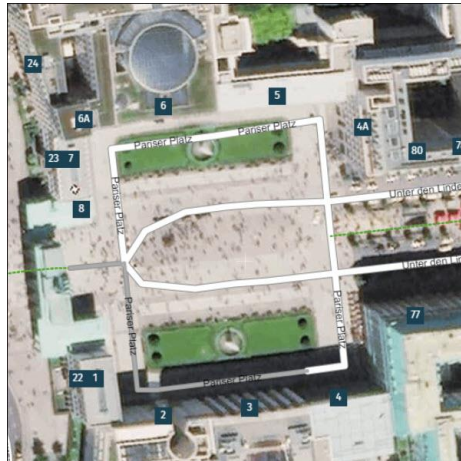
building name included and might have both. The following chapter gives an overview about the structural elements of a house number in Map Creator.

### ***1 House number structure***

The house number structure describes the single elements that define the house number object. Those are the house number icon, the display point and routing point of the house number (Fig. 11).

#### ***1.1 House number icons***

The house number icons are displayed as square icons and include the house number information. They should be located at the entrance of the building where the individual house number can be seen in reality.



*Fig.11: Square icons representing the house number information*

#### ***1.2 Display point***

The display point is represented through the house number icon (Fig. 12) as a red circle and can be moved in all directions to identify the correct location of the entrance of a building.



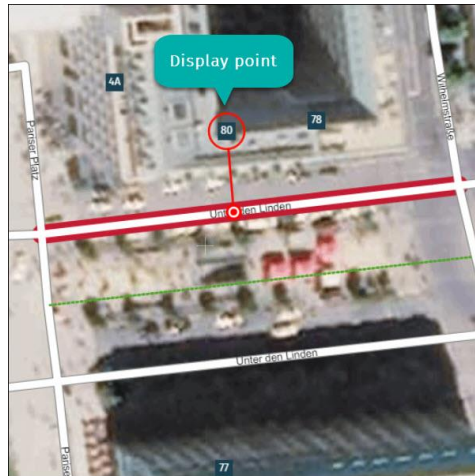


Fig.12: Display point

### 1.3 Routing point

The routing point is displayed by a red dot (Fig. 13) on the road segment and can be moved along the road to represent the correct arrival location at the house number.

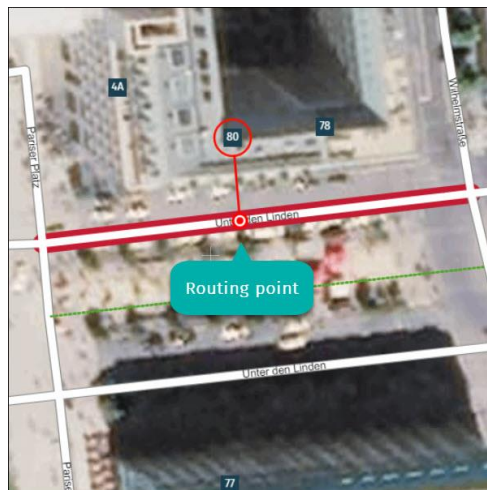


Fig.13: Routing point

## Map Creator usage and some analytics – 2017 total

Number of MAU: 5000+ globally

Number of edits (year-to-date or last year): 24.7M edits, 1.3M added kilometers

- South Asia: 1.4M
- Oceania: 556.000
- North Asia: 394.000
- MEA: 5M
- WEU: 3.1M
- EEU: 5.9M
- NA: 813.000
- SEA: 3.6M
- LATAM: 3.9M

### **Academy use.**

Based on the abovementioned structure and program functionalities Map Creator has plenty of options for usage. HERE has been working with academic communities for years, where there have been setup a real training program around digital mapping (combining theory and practical sessions) together with the teachers. The students mostly work around updating their local area, but can also focus on specific tasks like remote islands (Fiji), speed limits, ...

HERE is also expanding its academic approach with a focus on future developers: students gain practical development experience by working on location related applications using the HERE APIs and SDKs.

3 audiences:

- High schools
- Universities
- Young entrepreneurs (LATAM)

Since 2017, HERE benefit from back-up from the European Union through the Erasmus+ program. HERE also partner with inter(national) organizations like iGEO where digital mapping challenges via Map Creator become part of the official program.

### **Associations**

A variety of associations use Map Creator to update the map in remote or rural areas or to focus on specific attributes. For instance sports associations add bike pathways, NGO's focus on local wheelchair access.



We have more long term agreements with Auto-Moto clubs for continuous imagery collection (using our partner tool Mapillary) and then integration of the detected changes into Map Creator, often also working as ambassadors

### **For tourism**

Making everywhere simple to navigate for tourists and locals alike. For example, in 2017 there were added more than thousand kilometers of trails in the Carpathian mountain.

### **For traffic**

Keeping the 4 out of 5 cars using HERE maps up to date and going in the right direction. Map data for navigation purposes contains more than 350 attributes implemented and split in different products.

### **Partner programs**

HERE has been partnering with 3rd parties to ensure a feedback loop for map users (Ford, BMW and many other), to update the map on specific attributes or to provide edits in restricted areas that are inaccessible for non-authorized persons. Other parties, like insurance companies, use the map data to verify road attributes and correct them if needed through Map Creator, creating a real win-win situation.

### **Local government**

Cooperation with local government to enhance the map for citizens and tourists. Locals update the map with shops, emergency access roads etc. In some cases, they can also use our APIs to create their own application and provide it to the citizens.

### **Reference**

Leavitt, H. J., T. Whisler (1958), [Management in the 1980s](#). *Harvard Business Review*, 11.

<https://mapcreator.here.com> (16.03.2018)