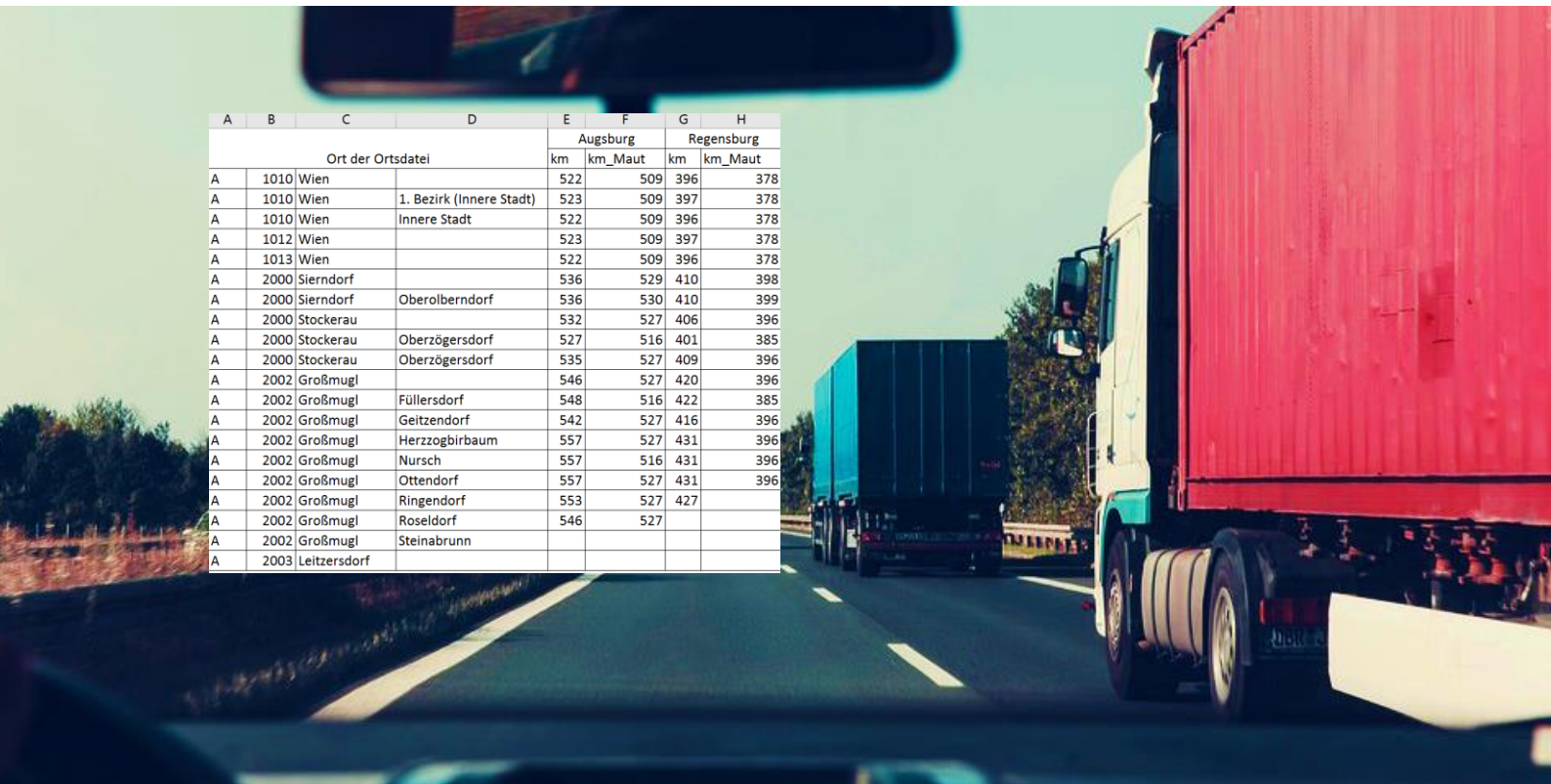


PTV Entfernungswerk Straße
 Distance Matrix Germany & Europe
 R2024_V1.0

A	B	C	D	E		F		G		H	
				Augsburg		Regensburg					
Ort der Ortsdatei				km	km_Maut	km	km_Maut				
A	1010	Wien		522	509	396	378				
A	1010	Wien	1. Bezirk (Innere Stadt)	523	509	397	378				
A	1010	Wien	Innere Stadt	522	509	396	378				
A	1012	Wien		523	509	397	378				
A	1013	Wien		522	509	396	378				
A	2000	Sierndorf		536	529	410	398				
A	2000	Sierndorf	Oberolberndorf	536	530	410	399				
A	2000	Stockerau		532	527	406	396				
A	2000	Stockerau	Oberzögersdorf	527	516	401	385				
A	2000	Stockerau	Oberzögersdorf	535	527	409	396				
A	2002	Großmugl		546	527	420	396				
A	2002	Großmugl	Füllersdorf	548	516	422	385				
A	2002	Großmugl	Geitzendorf	542	527	416	396				
A	2002	Großmugl	Herzogbirbaum	557	527	431	396				
A	2002	Großmugl	Nursch	557	516	431	396				
A	2002	Großmugl	Ottendorf	557	527	431	396				
A	2002	Großmugl	Ringendorf	553	527	427					
A	2002	Großmugl	Roseldorf	546	527						
A	2002	Großmugl	Steinabrunn								
A	2003	Leitzersdorf									



Karlsruhe, 19.12.2023

Contents

1	Introduction	3
1.1	Release notes.....	3
1.2	Release notes archive	4
2	The EWS principle.....	6
2.1	Nodes as representatives of the location file.....	6
2.2	Distance calculation between any locations.....	6
2.3	Notes on location search	7
2.4	Digital street network as basis for calculation.....	8
2.5	Accuracy.....	8
3	Scope of supply of EWS	9
3.1	Scope of delivery of the various EWS versions.....	9
3.2	Number of locations and nodes in EWS Europe (Plus)	10
3.3	Updates.....	11
3.4	The alternative to EWS – creating custom distance lists	11
4	Interface description	12
4.1	Files names and formats	12
4.2	Structure of the location file	12
4.3	Structure of distance matrix	15
4.4	Notes on processing of the EWS matrix.....	16
4.5	The binary file	17
4.6	Reference values.....	17
4.6.1	EWS Germany.....	17
4.6.2	EWS Europe (Plus).....	18

1 Introduction

On January 1, 1994, the validity of the long-distance freight tariff (GFT) in Germany expired. This meant that not only the tariffs no longer existed, but also the previously binding basis for calculating distances when settling freight forwarding services. A new basis of calculations was provided by the Entfernungswerk Straße (EWS), which was originally jointly developed by PTV GmbH, the Federal Central Cooperative for Road Traffic (BZG), Dr. Malek Software GmbH and DST Dresden. From 2012 to 2020, the EWS distance tables were produced by DDS GmbH in cooperation with Dr. Malek Software GmbH. In 2021, PTV GmbH again took the place of DDS GmbH, after DDS GmbH was merged with PTV GmbH, now PTV Logistics GmbH. The cooperation with Dr. Malek Software GmbH still exists.

Although it is not a binding basis, the EWS distance tables have now established themselves as a quasi-standard. Due to the simple EWS data structure, convenient EDP-supported information systems can be easily created or existing systems or databases can be extended.

The EWS is available for Germany and Europe and offers the following features:

- Calculation of realistic distances for truck transportation between all locations in Germany and Europe based on a digitized street network
- Simple and transparent handling
- Excellent accuracy for long-distance transportation
- Regular updates
- Option to integrate EWS Germany to EWS Europe

1.1 Release notes

In EWS Europe, there were small position corrections at inner-city nodes of major cities in DACH, France, Poland and the Netherlands to create a better connection to major roads. Furthermore, there are two new nodes in France.

The underlying map base has been refined in some cases for through traffic in Germany. The map basis is the latest, detailed PTV premium map, which is based on data from HERE Technologies.

In addition to current changes in the postal and statistical offices in Germany, Austria and Switzerland, the locations in Hungary and Romania were updated regarding location and postal code, and a densification was carried out.

1.2 Release notes archive

Changes in release R2023_V1.0

The processing of the EWS has been fundamentally revised this year and now offers even more detailed content. This year's release R2023_V1.0 not only uses the latest PTV development components for distance calculation, it is also based on the latest map material from PTV, respectively HERE Technologies. The combination of extensive map material including closures and precise truck routing results in an EWS that is optimally adapted to long-distance traffic.

Furthermore, a comprehensive revision of the nodes (local representatives) was carried out. On the one hand, existing nodes were checked for their location, especially near the border, and on the other hand, the number of nodes was significantly increased:

- Germany: so far 7,407 nodes → now 10,382 nodes
- Europe: so far 9,953 nodes → now 14,845 nodes
- Austria as a subset of Europe: so far 605 nodes → now 888 nodes
NEW: The nodes in Austria now have their own numbering - different from the European nodes in the same position

The densification of the node network results in a doubling of the number of relations in the distance matrix for Germany and Europe. All nodes receive a new ID once with this release. For a matching between new and old node IDs a lookup table is included. The format of the distance matrix remains the same.

This year, the EWS Toll Austria also takes international routes into account, so that the toll kilometers are based on the road kilometers of the EWS Europe.

Current information from the postal and statistical offices of Germany, Austria and Switzerland in the period from quarter 3/2021 to quarter 3/2022 was taken into account in the location file. For Portugal, a holistic revision of the existing locations with regard to location and postal code as well as a densification was carried out - with the result that over 1700 new Portuguese locations were added.

As announced in release R2021_V1.0, this release sets the location file version with character set codepage850 and 24 character location name length. The location file with utf-8 character set and 60 characters location name length is included in the delivery.

Changes in release R2022_V1.0

In the location file, current information from the postal and statistical offices of Germany, Austria and Switzerland was taken into account, and the postcodes and location coordinates in Greece were updated. Furthermore, node assignments of individual locations were checked and adjusted when necessary.

The country code "NMK" is new. It stands for the country of Northern Macedonia, which was formerly called Macedonia and had the country code "MK".

Street updates were carried out mainly in Germany and Poland, and occasionally in Austria, France and Spain. The Salzbachtal bridge (A 66 near Wiesbaden) was blocked in the EWS because it was taken down. Changes to the street network also cause changes to distances compared to the previous EWS.

See also notes on the previous release.

Changes in release R2021_V1.0

In addition to current changes by the postal and statistical offices in Germany, Austria and Switzerland, the postcodes in Italy have also been updated.

The location file in ods format is available in two versions, now – as always – with character set Codepage 850 and 24 characters location name length and additionally with character set utf-8 (BOM) and 60 characters location name length.

The version with character set Codepage 850 and 24 character location name length is discontinued with release R2023_V1.0.

Likewise, each distance matrix is now also supplied as a binary file (*.bin). Points 3.1, 4.4 and 4.5 of this description are helpful here.

2 The EWS principle

The EWS consists of the location file “PTV Ortsdatei” and a corresponding distance matrix in which the road distances are stored. The location file includes the locations that can be found in the BZG location file available since July 1993. This file was developed jointly by BZG and PTV GmbH. An update of the location file takes place once a year.

2.1 Nodes as representatives of the location file

Due to the high number of available locations, it is not the distances between all locations that are calculated, but only between selected representatives of the location file. These representatives are also referred to simply as nodes. They are selected depending on the population density. Economically significant areas are therefore covered by more nodes.

The remaining locations (non-representatives) are each assigned to the nearest node. This assignment is based on the shortest distances (= road distances) to the nodes.

The nodes do not have to be identical in the different matrices, i.e. a region in Germany is covered by considerably more nodes in EWS Germany than in EWS Europe. The European matrix refers to approx. 15,000 nodes, in Germany it is approx. 10,400 nodes.

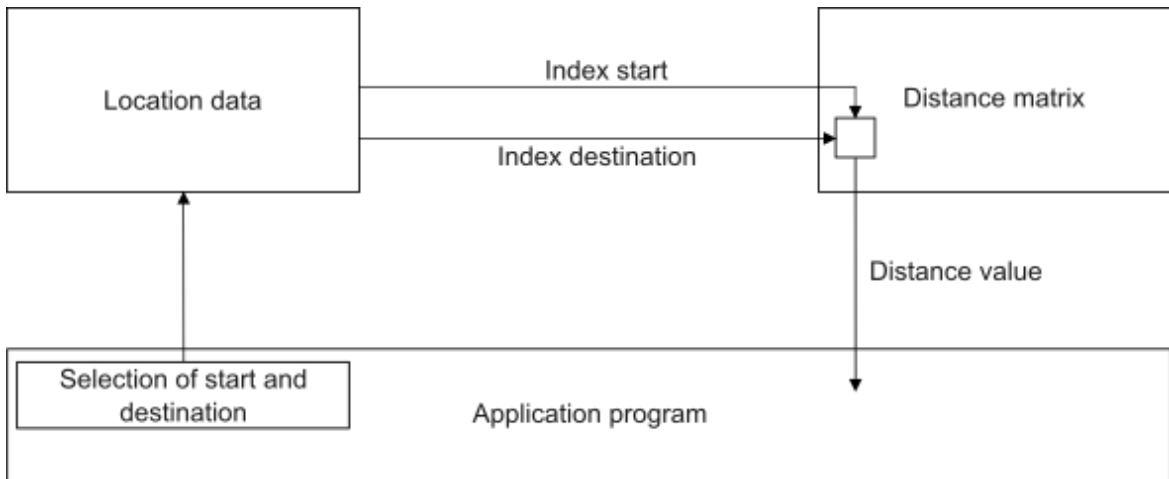
2.2 Distance calculation between any locations

Location file and distance tables are separate databases. To calculate the distance, the start and destination are selected from the location file. Each location entry contains an index that is used to determine the distance value from the matrix.

Example:

Country	Postcode	Name1	Name2	Matrix index
D	01109	Dresden		3
D	01109	Dresden	Klotzsche	4
D	10969	Berlin		937
D	36419	Geisa		3726
D	83435	Bad Reichenhall	Reichenhall	7330

In this example, the distance from 10969 Berlin to 36419 Geisa is found between nodes or matrix indexes 937 and 3726. The distance from node 3726 to node 937 is the same as from node 937 to node 3726 (see also 4.3 Structure of distance matrix).



A distinction is made between main location and district in the EWS location file. Their names are in two separate columns (Name 1 and Name2). The matrix index can be different for each district, even if the postcode and the main location are identical! In the example above, note the different matrix indexes for the locations 01109 Dresden and 01109 Dresden Klotzsche. It is therefore important to also specify the district (if known) to obtain the most accurate distance between two locations.

2.3 Notes on location search

When searching for a location in the location file, main locations and districts should be separated and different or incorrect spellings should be taken into account. In addition, it should be noted that P.O. box postcodes are not included in the location file!

Examples:

- “Dresden-Klotzsche” can be found in the location file with Name1 = “Dresden” and Name2 = “Klotzsche”.
- “Bad Reichenhall” can be found using precisely this spelling in Name1 (“Bad” and “Reichenhall” belong together, with spaces, without hyphen).
- “Villingen-Schwenningen” can be found using precisely this spelling in Name1, because it is the main location name.
- “Villingen Schwenningen” (without hyphen) or “Villingen – Schwenningen” (with spaces before and after the hyphen) would have to be assigned to Name1 = “Villingen-Schwenningen”.
- Umlauts, special characters, etc. must be observed.

In the case of Dutch locations in EWS Europe:

Dutch postcodes consist of four digits and two letters in the format DDDD_LL, a location name can be, for example “1056 HD Amsterdam”. The first two digits indicate the region, the following two digits the village or district. The two letters at the end stand for the neighborhood and the street.

EWS Europe contains about 8,000 Dutch locations with the four-digit postcode. A representation of locations with six-digit postcodes, i.e. at street level, would go beyond

the scope of EWS Europe (this would be over 600,000 location records for the Netherlands).

If a Dutch location with a six-digit postcode is searched for in EWS Europe, only the first four digits of the postcode of the sought location need to be used in EWS Europe.

2.4 Digital street network as basis for calculation

The distance matrices are calculated on the basis of a comprehensive digital street network. This street network includes both roads as well as border crossings and ferries. Each distance results from the calculation of an optimum route. The distance of this route is entered in the matrix field. The vehicle profile of a 40-ton truck is used for routing.

2.5 Accuracy

Due to the assignment and therefore the equation of locations with their respective nodes, there are inaccuracies in the distance. The distances between location and node can be approx. 3 km to 8 km in EWS Germany. This is 10 km to 15 km in EWS Europe. In sparsely populated regions, it can also be more than 8 km or 15 km.

Distances between nodes are precisely calculated. However, it should be noted that EWS only reflects a possible distance between two locations. In determining this distance, the time factor (fastest route) is given a much higher weighting than the distance factor (shortest route). Distances covered by a ferry are not taken into account (distance = 0 kilometers).

The German matrix has 10,382 nodes, resulting in approx. 54 million distances. The number of nodes in the European matrix amounts to 14,845. This results in over 110 million distances.

A distance from Germany to other European countries can be calculated using the European matrix (EWS Europe). However, better results (EWS Europe Plus) are obtained by first reading out the distance from the German starting point to the German border location (using the national nodes) in the German matrix and then determining the distance from the border location to the European destination in the European matrix (using the international nodes). In this case, the border location has to be known.

3 Scope of supply of EWS

Three different EWS versions are available as standard: EWS Germany, EWS Europe and EWS Europe Plus. In addition, an EWS with toll charge kilometers is available for both Germany and Austria. For more information, see separate EWS toll descriptions.

3.1 Scope of delivery of the various EWS versions

EWS-Type	Scope of supply	Memory size
EWS Germany	Location file Germany with 116,370 locations 60 characters, utf-8 (BOM)	approx. 25 MB
	Germany distance matrix based on 10,382 nodes Standard format Binary format	approx. 350 MB approx. 105 MB
EWS Europe	Location file Europe with 558,576 locations (116,370 of which are German locations) 60 characters, utf-8 (BOM)	approx. 120 MB
	Europe distance matrix based on 14,847 nodes Standard format Binary format	approx. 720 MB approx. 215 MB
EWS Europe Plus	Location file Europe with 558,576 locations (116,370 of which are German locations) 60 characters, utf-8 (BOM)	approx. 120 MB
	Germany distance matrix based on 10,382 nodes Standard format Binary format	approx. 350 MB approx. 105 MB
	Europe distance matrix based on 14,847 nodes Standard format Binary format	approx. 720 MB approx. 215 MB
EWS Toll Germany	Location file Germany with 116,370 locations 60 characters, utf-8 (BOM)	approx. 25 MB
	Toll Germany distance matrix based on 10,382 nodes Standard format Binary format	approx. 350 MB approx. 105 MB
EWS Toll Austria	Location file Austria with 20,908 locations 60 characters, utf-8 (BOM)	approx. 5 MB
	Toll Austria distance matrix based on 888 nodes Standard format Binary format	approx. 2.5 MB approx. 0.7 MB

3.2 Number of locations and nodes in EWS Europe (Plus)

No.	Country code	Name	Locations	Locations with postcode*	Nodes
1	A	Austria	20,908	20,801	837**
2	AL	Albania	467	459	63
3	AND	Andorra	41	7	3
4	B	Belgium	4,582	4,395	257
5	BG	Bulgaria	7,143	7,122	84
6	BIH	Bosnia and Herzegovina	909	154	41
7	BY	Belarus	22,445	22,415	133
8	CH	Switzerland	5,912	5,794	350
9	CY	Cyprus	213	101	30
10	CZ	Czech Republic	15,535	15,477	265
11	D	Germany	116,370	115,878	2,442***
12	DK	Denmark	6,412	6,392	225
13	E	Spain	39,872	32,674	1,097
14	EST	Estonia	3,867	3,859	50
15	F	France	54,432	54,217	1,329
16	FIN	Finland	6,210	6,184	127
17	FL	Liechtenstein	23	15	9
18	GB	United Kingdom	50,763	50,704	903
19	GBZ	Gibraltar	6	0	3
20	GE	Georgia	21	6	19
21	GR	Greece	851	836	164
22	H	Hungary	5,365	5,329	170
23	HR	Croatia	4,658	4,601	72
24	I	Italy	29,195	29,124	942
25	IRL	Ireland	2,963	0	90
26	L	Luxembourg	4,166	4,120	43
27	LT	Lithuania	13,426	13,403	56
28	LV	Latvia	12,433	12,412	56
29	M	Malta	74	71	3
30	MC****	Monaco	5	3	2
31	MD	Moldova	1,671	1,659	122
32	MNE****	Montenegro	275	68	12
33	N	Norway	4,608	4,443	99
34	NL	Netherlands	7,922	7,777	531
35	NMK	North Macedonia	2,600	2,591	35
36	P	Portugal	11,358	11,338	226
37	PL	Poland	29,770	29,718	898
38	RO	Romania	12,137	12,117	411
39	RSM	San Marino	11	11	2
40	RUS	Russia	8,063	8,021	844
41	S	Sweden	12,894	12,821	188
42	SK	Slovak Republic	3,997	3,969	89
43	SLO	Slovenia	2,562	2,519	78
44	SRB	Serbia	1,467	733	130
45	TR	Turkey	1,162	1,004	802
46	UA	Ukraine	28,811	28,771	515
47	V	Vatican City	1	1	0
Total:			558,576	544,144	14,847

* postcodes like „-PORT“ or „-NL“ are not counted

** 51 border nodes from neighboring countries have to be added for the Austrian toll matrix

*** in addition there are 10,382 nodes for Germany in EWS Europe Plus

**** these countries have had their own nodes since release R2023_V1.0

3.3 Updates

Regular updates are carried out to account for the permanent, independent further development of the basic street network and location file data records. EWS is published once a year.

The data structure of the EWS has not changed over recent years. If any changes are made in the future, they will be clearly highlighted.

The location identifications (so-called IDs) change from year to year. It is possible that the same location carries a different ID in the current EWS than in a previous version. Also, a location can have a new node number from one version to the next. This is due to the fact that the number of nodes is continuously updated and therefore also the matrix indexes. For these reasons, we do not recommend permanently linking master data (for example customer locations) to locations or nodes. For the same reason, all data should be re-imported during an update.

3.4 The alternative to EWS – creating custom distance lists

As an alternative to the EWS distance tables, it is possible to create individual distance lists. The starting point and/or destination must be specified by the customer here. It is possible, for example, to calculate the distances

- from one starting point to all locations in Europe
- from about 10 starting points in Germany to all remaining locations in Germany
- from all major cities in Germany to all major cities in a neighboring country
- depending on the country and data volume, also from all postcodes / locations to all other postcodes / locations in a country
- for different fleets (cars, trucks)
- taking certain conditions into account.

Further information, prices and delivery formats are available upon request.

4 Interface description

4.1 Files names and formats

Filename	Content
d2024_60_utf8.ods	Location file Germany, 60 characters, utf-8
d2024.dm	Distance matrix Germany
d2024.bin	Distance matrix Germany, binary format
eu2024_60_utf8.ods	Location file Europe, 60 characters, utf-8
eu2024.dm	Distance matrix Europe
eu2024.bin	Distance matrix Europe, binary format

4.2 Structure of the location file

Field	Type	From	To	Length	Contents
1	A	1	3	3	Country code (see legend for content)
2	A	4	12	9	Postcode Not available for every country and every location. In Germany, the 5-digit postcode is entered. Exceptions: a) Border crossings have the country code of the neighboring country as the postcode, preceded by a minus sign (e.g. -F or -CH) b) Ports have the postcode -PORT
3	A	13	72	60	Location name 1; postal name
4	A	73	132	60	Location name 2 Linguistic description, this can be, for example a district, part of a city, or a historical name. However, it can also be the municipality name if it is not the same as the postal name (= Location name 1).
5	A	133	133	1	Set code 1 = Main location 3 = District or historical name 5 = Linguistic description 9 = Border crossing
6	A	134	134	1	Set code addition If the set code from field 5 equals 1 or 3: 0 = Standard 1 = Description in Location name 2 If the set code from field 5 equals 9: 0 = International street crossing 1 = International ferry 5 = National street crossing 6 = National ferry
7	A	135	139	5	GTB/nodes East Germany, only for Germany

					<p>GTB = 5 digits D-East = O followed by 4 digits</p> <p>This field only exists for reasons of compatibility with older versions. It is no longer maintained!</p>
8	A	140	140	1	<p>Cartage class A-Z, only for Germany</p> <p>House freight location class according to the directory by the Federal Association of German Freight Forwarders and Logistics Operators (BSL)</p> <p>This field only exists for reasons of compatibility with older versions. It is no longer maintained!</p>
9	A	141	149	9	<p>Location identification (ID)</p> <p>The identification is a unique key for Germany or a single country. In the case of the European location file, this identification is only unique when the ID is combined with the country code. The ID of a location can change from year to year, it is not a so-called permanent ID!</p>
10	A	150	154	5	<p>Former 4-digit postcode for Germany</p> <p>incl. code for East and West Germany, e.g. O2251 for Usedom or W8991 for Lindau</p> <p>This field only exists for reasons of compatibility with older versions. It is no longer maintained!</p>
11	A	155	163	9	<p>Administrative number</p> <p>Not available for every country and every location. In Germany, the 8-digit municipality code can be entered:</p> <ul style="list-style-type: none"> 1 to 2 digit = federal state 3 digit = administrative district 4 to 5 digit = district 6 to 8 digit = municipality
12	N	164	165	2	Location size class (see legend for content)
13	N	166	174	9	<p>Horizontal coordinate (optional, at extra cost, price on request)</p> <p>If available, a geodecimal WGS84 coordinate with 5 decimal places (\pmG G G N N N N N) is available as standard.</p>
14	N	175	183	9	<p>Vertical coordinate (optional, at extra cost, price on request)</p> <p>If available, a geodecimal WGS84 coordinate with 5 decimal places (\pmG G G N N N N N) is available as standard.</p>
15	N	184	192	9	<p>Index for matrix Germany (for German locations)</p> <p>Reference to distance matrix Germany (relevant in EWS Germany, EWS Germany Toll and EWS Europe Plus).</p> <p>or:</p> <p>Index for matrix Austria (for Austrian locations)</p> <p>Reference to the distance matrix Austria (relevant in EWS Austria Toll). Attention: As of release R2023_V1.0, this index is no longer necessarily equal to the index for the matrix Europe (Field 17).</p>
16	N	193	201	9	Next node in street network GER/AUT (is always filled in with 0)
17	N	202	210	9	<p>Index for matrix Europe (for all locations)</p> <p>Reference for distance matrix Europe (relevant in EWS Europe and EWS Europe Plus)</p>
18	N	211	219	9	Next node in street network Europe (is always filled in with 0)

Legend

- **Type:**
 - A = Alphanumerical (always left-justified)
 - N = Numerical (always right-justified)
- **Location size class:**
 - The location size classes do not refer to the actual number of inhabitants, but to the relative importance of a location/city. They are therefore to be understood as guideline values that serve to roughly classify locations.
 - The population figure is unknown.
 - Each district has its own size class. However, it often happens that all or many postcode districts have the same classes.

0: unknown	8: 5000 <= x < 10000
1: < 100	9: 10000 <= x < 20000
2: 100 <= x < 200	10: 20000 <= x < 50000
3: 200 <= x < 500	11: 50000 <= x < 100000
4: 500 <= x < 1000	12: 100000 <= x < 250000
5: 1000 <= x < 2000	13: 250000 <= x < 500000
6: 2000 <= x < 3000	14: x >= 50000
7: 3000 <= x < 5000	

- **Country code:**

A = Austria	IRL = Ireland
AL = Albania	L = Luxemburg
AND = Andorra	LT = Lithuania
B = Belgium	LV = Latvia
BG = Bulgaria	M = Malta
BIH = Bosnia-Herzegovina	MC = Monaco
BY = Belarus	MD = Moldova
CH = Switzerland	NMK = North Macedonia
CY = Cyprus	MNE = Montenegro
CZ = Czech Republic	N = Norway
D = Germany	NL = Netherlands
DK = Denmark	P = Portugal
E = Spain	PL = Poland
EST = Estonia	RO = Romania
F = France	RSM = San Marino
FIN = Finland	RUS = Russia
FL = Liechtenstein	S = Sweden
GB = Great Britain	SK = Slovakia
GE = Georgia	SLO = Slovenia

GR = Greece
GBZ = Gibraltar
H = Hungary
HR = Croatia
I = Italy

SRB = Serbia
TR = Turkey
UA = Ukraine
V = Vatican

4.3 Structure of distance matrix

The first row contains the number of matrix rows and columns.

The distance matrix is stored row by row in the matrix. Each matrix row in the distance matrix starts with the number of the mapped matrix row. Each matrix row is broken down after 12 values, i.e. a matrix row can consist of several text rows. Each matrix row ends with the character string "0000". The following matrix row starts in a new text row.

The matrix values represent the distance in km. A few matrix values can have the value "0". This occurs with nodes that are close together and connected to the same road segment.

Row 24 starts with the row number and the first 12 values, then a new text row starts with a further 11 values and the row termination 0000. Each entry is 6 digits long and is right-aligned within these 6 digits. They are preceded by spaces.

Since the distances are all symmetrical, i.e. the route from A to B is as long as from B to A, the ASCII matrix is constructed as a triangular matrix. If you want to read out the sought distance directly from the matrix, the larger index must always stand for the line and the smaller index must always stand for the column.

The distance from index 8 to index 14 is read out as follows in the example below: The larger index is 14 and represents the row number. Row 14, position 8 (column) contains the sought value of 14 kilometers.

Example:

24 Matrixzeile (n), 24 Matrixspalte (n)

```

1  0000
2  8  0000
3  8  3  0000
4  7  12  15  0000
5  5  12  12  4  0000
6  10 34  17  29  16  0000
7  4  11  10  10  9  9  0000
8  9  16  13  15  13  13  5  0000
9  13 19  17  19  17  6  8  10  0000
10 19 13  6  23  22  45  15  20  27  0000
11 11 18  15  17  16  14  8  3  8  22  0000
12 9  8  11  10  11  32  12  17  20  18  19  0000
13 16 22  14  21  20  32  14  9  16  11  11  27
    0000
14 23 17  17  27  27  49  26  14  22  9  17  23
    6  0000
15 18 12  12  23  22  45  22  22  30  5  25  18
    14 9  0000
16 10 13  16  7  8  27  14  18  32  24  20  11
    33 28 23  0000
17 12 8  6  21  16  21  15  17  24  5  19  16
    8  8  9  21  0000
18 13 7  15  16  17  38  16  20  24  12  23  9
    29 24 19  17  17  0000
19 19 13  13  23  23  45  22  27  30  11  29  19
    27 23 18  24  15  9  0000
20 27 21  21  31  30  53  30  34  38  18  36  16
    35 30 25  32  23  10  8  0000
21 20 30  30  40  24  33  16  11  19  23  13  36
    6  11 22  41  14  37  36  43  0000
22 42 36  36  46  46  68  45  50  54  34  52  28
    50 46 41  31  39  21  24  15  59  0000
23 30 24  25  35  34  57  34  38  42  22  40  23
    38 34 29  36  27  17  11  7  47  9  0000
24 34 28  28  38  37  60  37  41  45  25  43  33
    42 37 33  39  30  25  16  17  50  11  12  0000

```

4.4 Notes on processing of the EWS matrix

A 10,000 * 10,000 matrix uses approx. 350 MB. It may not be possible to load this matrix directly, depending on the memory capacity. Efficient storage can be achieved if all distance values (without matrix diagonals "0000") are written one after the other into a one-dimensional field, a continuous sequential series.

For the above example, the field would look as follows:

Position	1	2	3	4	5	6	7	8	9	10	11
Value	8	8	3	7	12	15	5	12	12	4	10

The position "pos" of a distance value for the indexes "a" and "b" is then calculated using

$\max(a, b)$ = the greater value of a and b

and

$\min(a, b)$ = the smaller value of a and b

divided by:

$\text{pos} = ((\max(a, b) - 1) * (\max(a, b) - 2)) / 2 + \min(a, b)$

Example

```
a = 3      b = 5
pos = ((max (5, 3) - 1) * (max (5, 3) - 2)) / 2 + min (5, 3)
pos = ((5 - 1) * (5 - 2)) / 2 + 3
pos = 9
```

The distance value for 3 → 5 is therefore at position 9 and results in 12 km.

If a = b (start node = destination node), then the distance is 0 km and the above formula must be ignored because the 0 values (matrix diagonals "0000") are not read into the one-dimensional field. The application program should then simply return 0 km.

4.5 The binary file

The above-described possibility of generating a one-dimensional field can, depending on the development environment, lead to the field "overflowing" at some point due to the amount of data.

This could be remedied by writing the individual distance values into a **binary file** (the binary file will be only about 110 MB in size, in contrast to a standard matrix ASCII file with 350 MB).

The above example from point 4.4 in HEX format:

Position	1	2	3	4	5	6	7	8	9	10	11
Value (2 bytes)	08 00	08 00	03 00	07 00	0C 00	0F 00	05 00	0C 00	0C 00	04 00	0A 00

The above formula from point 4.4 can then also be applied to determine the location of the sought distance value in the binary file.

4.6 Reference values

There follows some distance information from the new EWS to check your application.

4.6.1 EWS Germany

Starting point				Destination				Distance
Postcode	Name1	Name2	Index_D	Postcode	Name1	Name2	Index_D	km
76131	Karlsruhe		6602	12045	Berlin	Neukölln	945	677
33106	Paderborn	Sande	3370	19053	Schwerin	Dwang	1668	381
20095	Hamburg		1778	80331	München		7013	775
24103	Kiel		2123	01067	Dresden	Altstadt	1	569

4.6.2 EWS Europe (Plus)

Starting point				Destination				Distance
Postcode	Name1	Name2	Index_Eu	Postcode	Name1	Name2	Index_Eu	km
(D) 76131	Karlsruhe		3773	(A) 1010	Wien		2	701
(D) 76131	Karlsruhe		3773	(GB) E10 5	London		7414	763
(NL) 5626	Eindhoven	Acht	10327	(CH) 8064	Zürich		1691	704
(F) 75001	Paris		6965	(I) 80100	Napoli		9345	1615