Internet of Things & Linked Open Data

Nicola Cortesi

A more appropriate name for "Internet of Things" (IoT) is "Network of Things" or "Network of Objects"

DEFINITION OF IOT

IoT is a network of **physical objects** with sensors, processors and/or software. Each object has a **unique identifier**
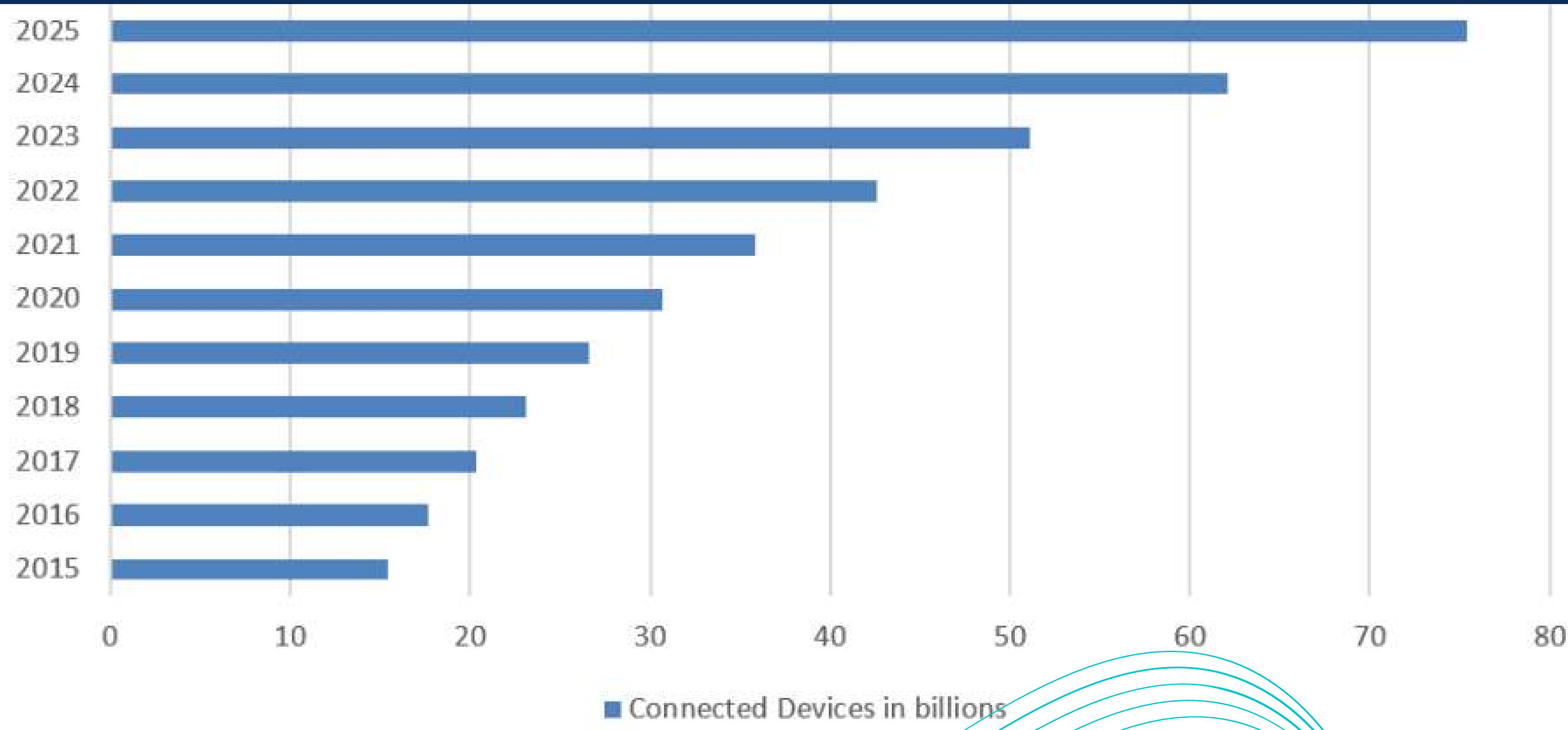
DEFINITION OF IOT

They connect and exchange data between them, over the Internet or other networks

NUMBER OF CONNECTED DEVICES

The number of connected devices is increasing exponentially

APPLICATIONS OF IOT

IoT is mainy used in the industry for monitoring industrial systems and equipment (e.g: predict when maintenance is needed, finding small items)

IoT is also used in medicine, to monitor patients outside hospitals (e.g: elder people or chronicle diseases like diabetes)

IoT combines with Artificial Intelligence to monitor the number of vehicles and change traffic lights accordingly to minimize congestions

IoT can also be used to create apps with real-time maps of available parkings (smart parking)

And also to monitor and control lighting, heating, air conditioning, media systems and security systems (Smart Homes)

In many houses the reading of the electricity meter or the gas meter is already done from remote

Mesh systems bring wifi connection to every corner of the house

They are better than a simple wifi extender because they communicate between them, sharing the same network and passwords

5G wireless network was designed to connect a large number of IoT devices, even when they are on the move

5G should finally solve the issue of low or null downloading speeds when many tourists are in the same location

All benefits of Smart Homes are also available for
Smart Hotels

- Swith off lights when no one is present in the room
- Open/close window curtains
- AI regulates temperature and it remembes guests' preferences
- TV welcomes guests with their own names. They can automatically access Netflix / Spotify with their own account
- Play your favourite music

Electronic key cards can be sent by the hotel on the guests' smartphones to open the room directly without wasting their time in the reception

- The hotel's app also allows the guests to make restaurant reservations, book spa appointments, and order additional activities within the hotel

The voice assistant of the hotel is installed on the room's speakers and it listen to guests' needs through voice commands and accomplish them instantly and quickly.

In restaurants, sensors can alert restaurant staff to the arrival of a customer and automatically provide the correct table number

AirTag is a small device connected to a smartphone that allows its owner to locate important objects (wallet, bag, keys, suitcase, backpack, car, etc.)

Airplanes could be equipped with sensors that capture and track passengers' body temperature, heart rate and anxiety level to offer help in case of emergency

Many flight companies are also introducing free onboard wifi connection thanks to satellite megaconstellations

Starlink is a network of thousands of satellites in low-orbit that delivers ultra-broadband connection all over the world

Starlink 550km

Thanks to it, flight companies are removing the seatback screens on commercial flights, as many people already bring their own devices that connect to the plane's wifi

Smart Trains collect data from thousands of sensors to control all the operations in an efficient and reliable way
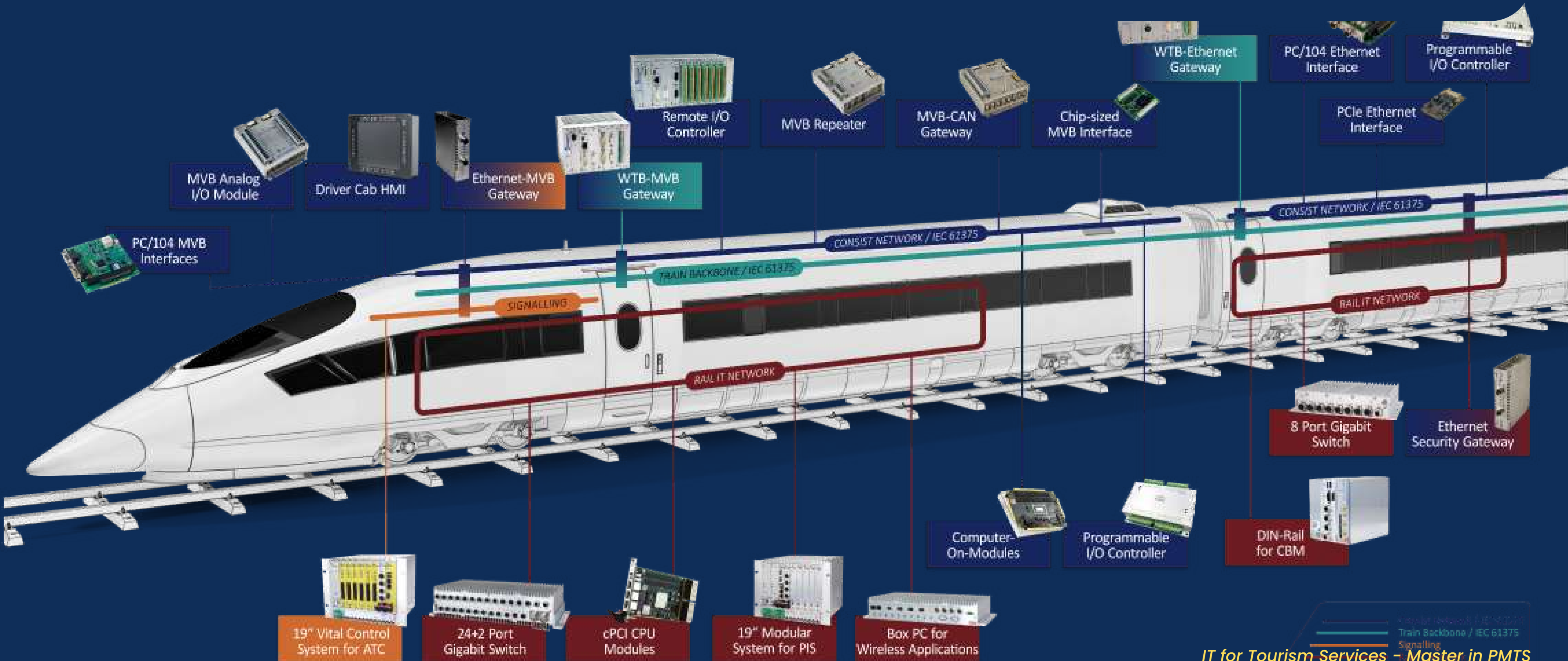
Small devices called beacons that send to the smartphones of the tourists specific information, when they are close to a particolar location.

Beacons need a bluetooth connection to work and can send messages to all users in a range of 60-100 m

Imagine you are doing shopping and you google the word "jacket" on your smartphone

The app checks if there are nearby beacons from shops that sell jackets. If yes, the app sends you a notification
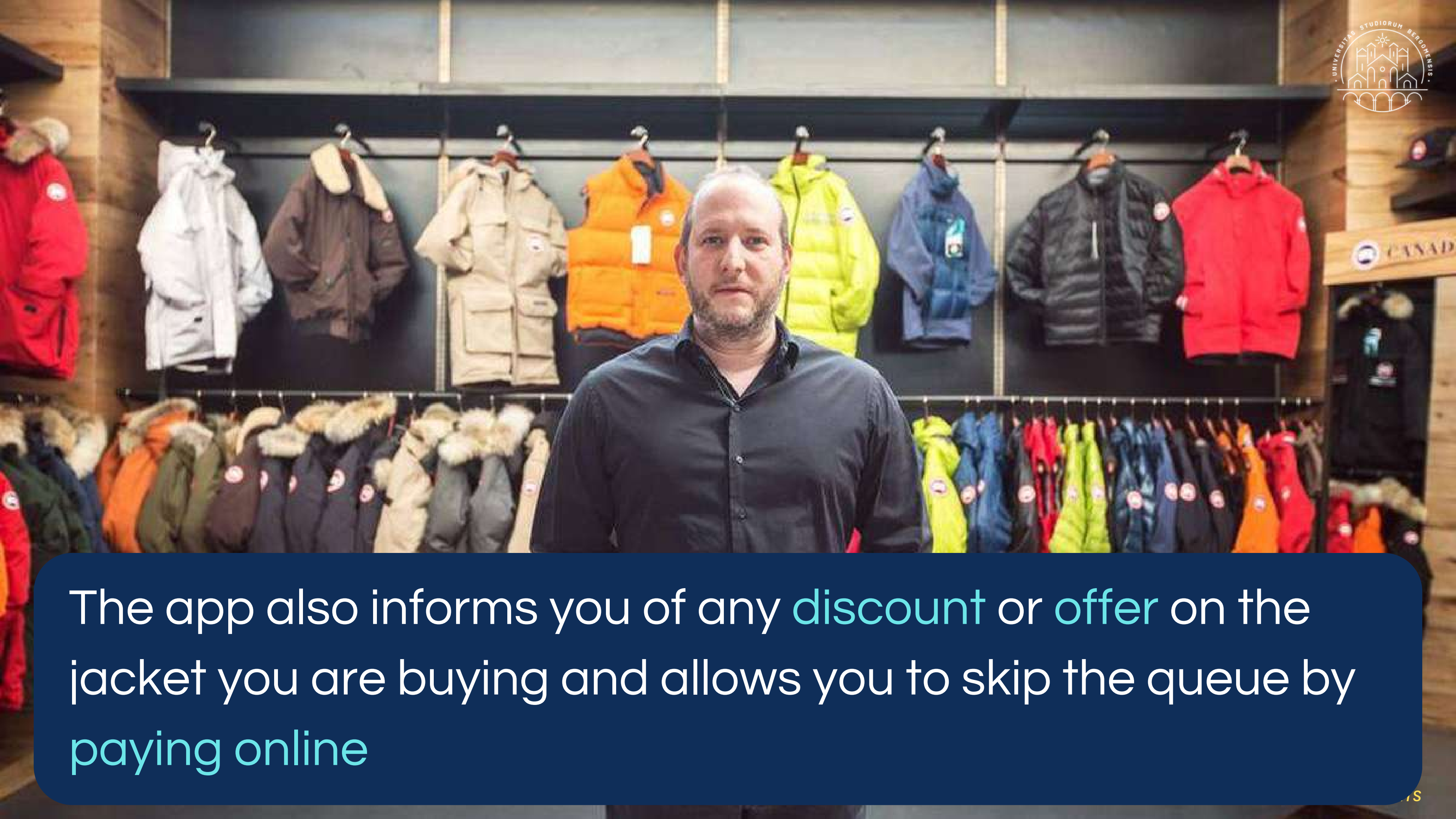
While you are guided to the shop by the app, it also contacts the shop to warn of your arrival and that you're looking for a jacket

When you arrive there, a shop employee is already waiting for you and ready to show you jackets of your size

The app also informs you of any discount or offer on the jacket you are buying and allows you to skip the queue by paying online

Beacons could also be used to block Whatsapp and Instagram use of students while at school and to detect if they are in class
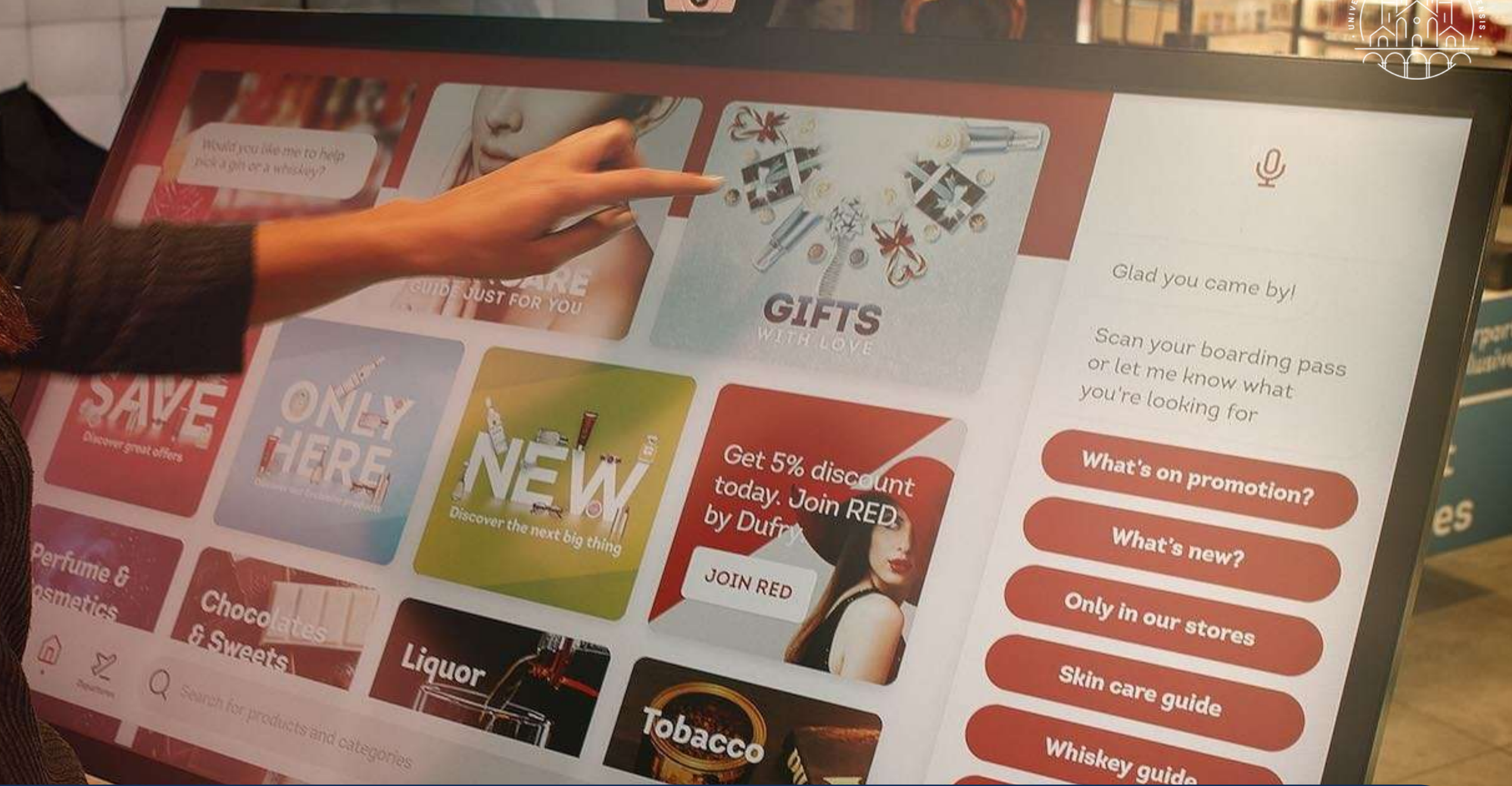
Beacons also tell you when a bus is arriving to your bus stop
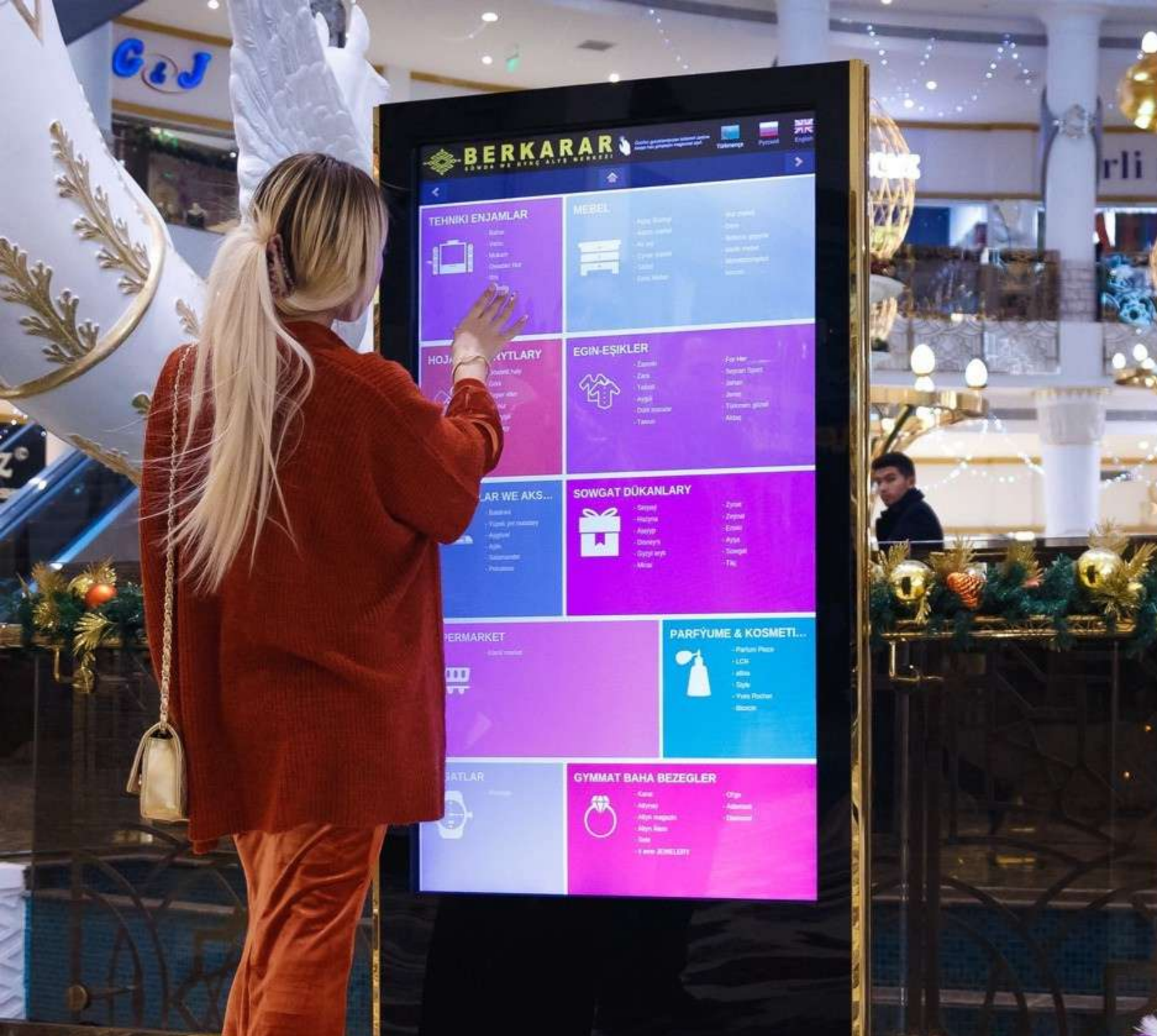
Digital kiosks or Totems are standalone screens that passersby or customers can interact with on the spot

Totems allow customers to complete purchases, to guests to check in by themselves, or enable visitors to look up answers to their questions on their own

They **automate many mundane tasks** that your staff don't really need to be spending any more efforts
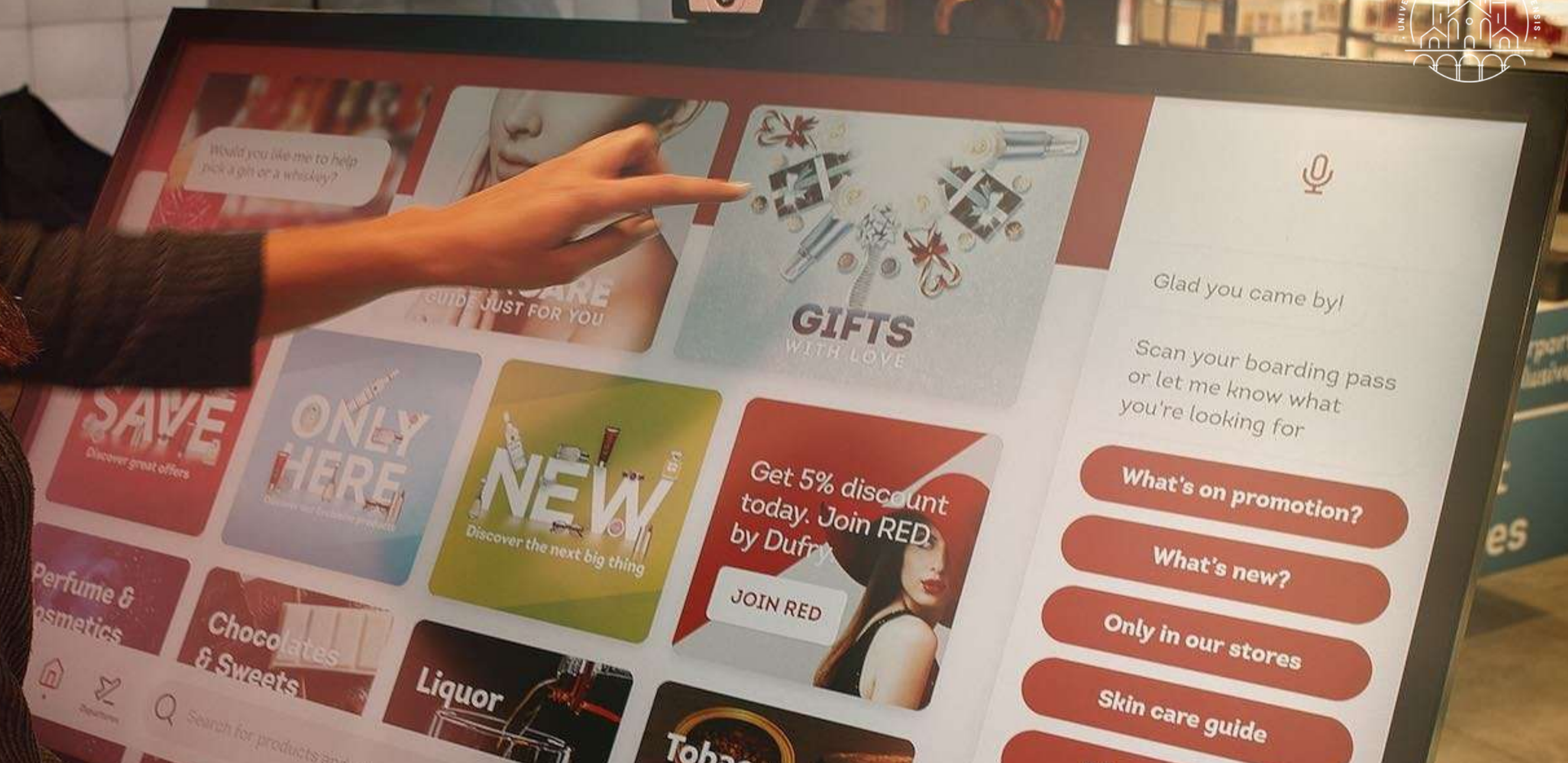
This allow to schedule fewer employees per shift, thereby reducing the operating costs. Clients don't have to wait in line to speak with an employee when they have a question

Big data is usually generated by all the sensors of IoT.
Big data is then used for Artificial Inteligence, Smart
Destinations, Smart Cities, etc. So IoT is the main
technology behind all these innovations
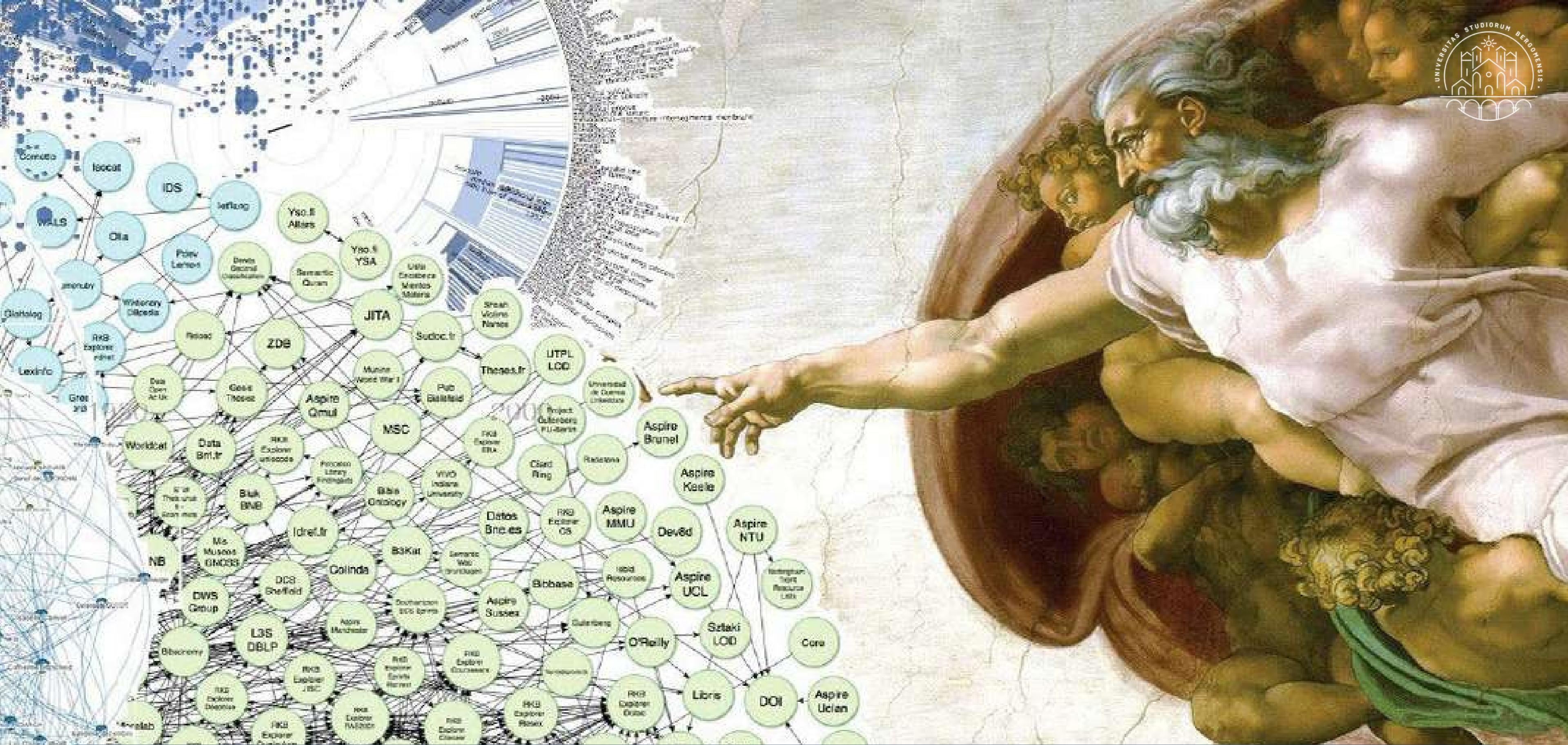
Linked Open Data

To find the answer to many questions of our times we don't need new discoveries or new instruments, but only to exploit the data we already have

At present most of the data in the Web is not really in form of data, but in form of hypertext of images or video

Hypertexts are only useful to read them or to follow their links, while with dataset computers can do much more things
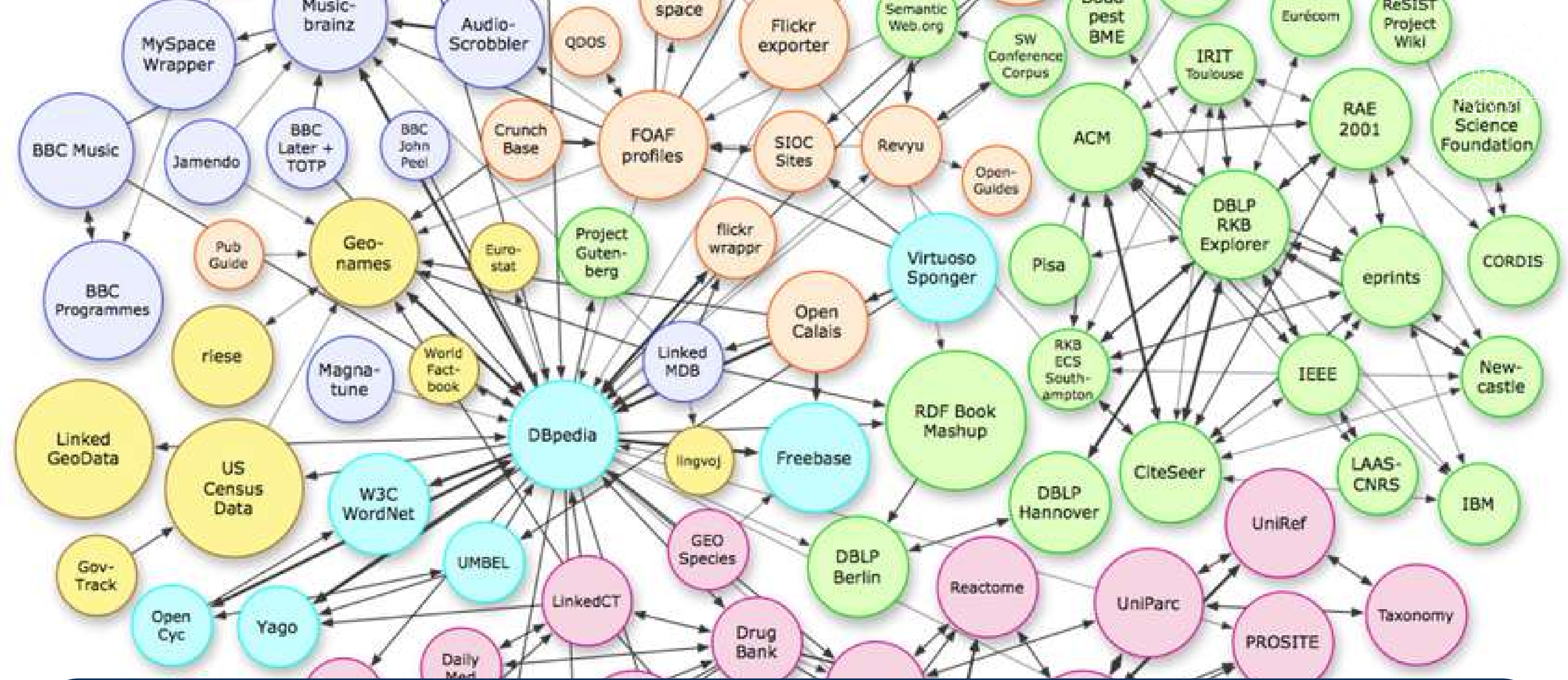
Open Linked Data is just another Web made up by linking datasets between them instead of hypertext, a dataset made up by pages that are not read by humans but by computers

Search bar: How many tourists visited Bergamo in may 2017 and visited Brescia i

Tutti   Notizie   Immagini   Maps   Video   Altro   Strumenti

Circa 89.200 risultati (0,50 secondi)

https://en.wikipedia.org › wiki › Tourism_in_Italy

Tourism in Italy - Wikipedia

Rome is the 3rd most **visited** city in Europe and the 12th in the world, with 9.4 million arrivals in **2017** while Milan is the 27th worldwide with 6.8 million ...

https://heretotravel.com › bergamo · Traduci questa pagina

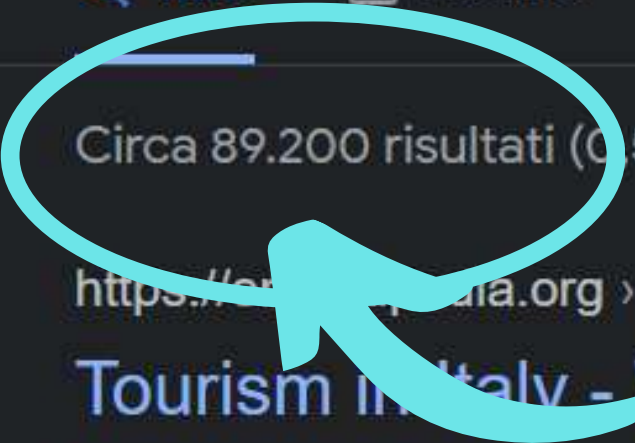Bergamo, Italy: 6 Reasons Why You Should Visit

If you're **visiting** Milan and the wider Lombardy region, you should also **visit Bergamo**. Here are six reasons why **Bergamo** is such a great city to **visit**.

E.g: googling "How many tourists visited Bergamo in may 2017 and also visited Brescia in 2018?", this search provides 89.200 answers but no one is right

Search bar: How many tourists visited Bergamo in may 2017 and visited Brescia i

Tutti Notizie Immagini Maps Video Altro Strumenti

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Bergamo, Italy: 6 Reasons Why You Should Visit

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If Google were searching inside Linked Open Data instead, the **exact answer** would have been found immediatly because it'd have found the datasete with the relevant information by performing a **semantic query**

That's why the Web of Linked Open Datasets is also called Semantic Web (definition by Tim Berners-Lee)

World Wide Web

The WorldWideWeb (W3) is a wide-area hypermedia information retrieval initiative aiming to give universal access to a large univers

Everything there is online about W3 is linked directly or indirectly to this document, including an executive summary of the project, M

What's out there?
    Pointers to the world's online information, subjects , W3 servers, etc.
Help
    on the browser you are using
Software Products
    A list of W3 project components and their current state. (e.g. Line Mode ,X11 Viola , NeXTStep , Servers , Tools , Mail robot ,
Technical
    Details of protocols, formats, program internals etc
Bibliography
    Paper documentation on W3 and references.
People
    A list of some people involved in the project.
History

The first web page

He is the english informatic that invented both the World Wide Web in 1991 and the Semantic Web in 2001

He also gave a good speech at TED Talk, like this one of the Semantic Web:

https://www.youtube.com/watch?v=OM6XIICm_qo&t=322s

If data are also licensed under an open license, then they are called Linked Open Data

Most of human knowledge is now in the form of databases stored in private computers and servers that are not shared with the rest of the world
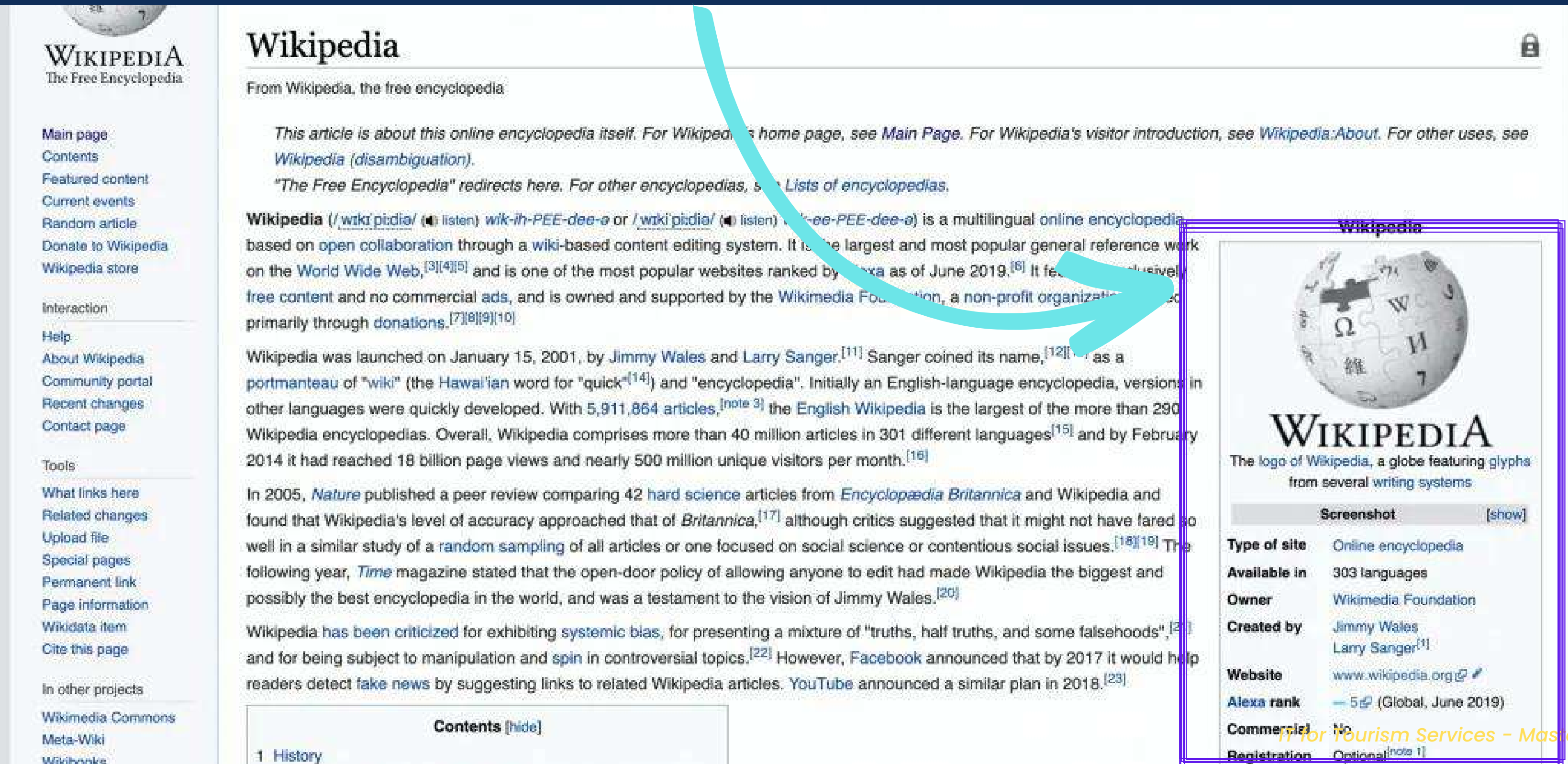
You have no idea of the number of excuses people come up with to hang on to their data and not giving it to you even if you paid for it with your taxes
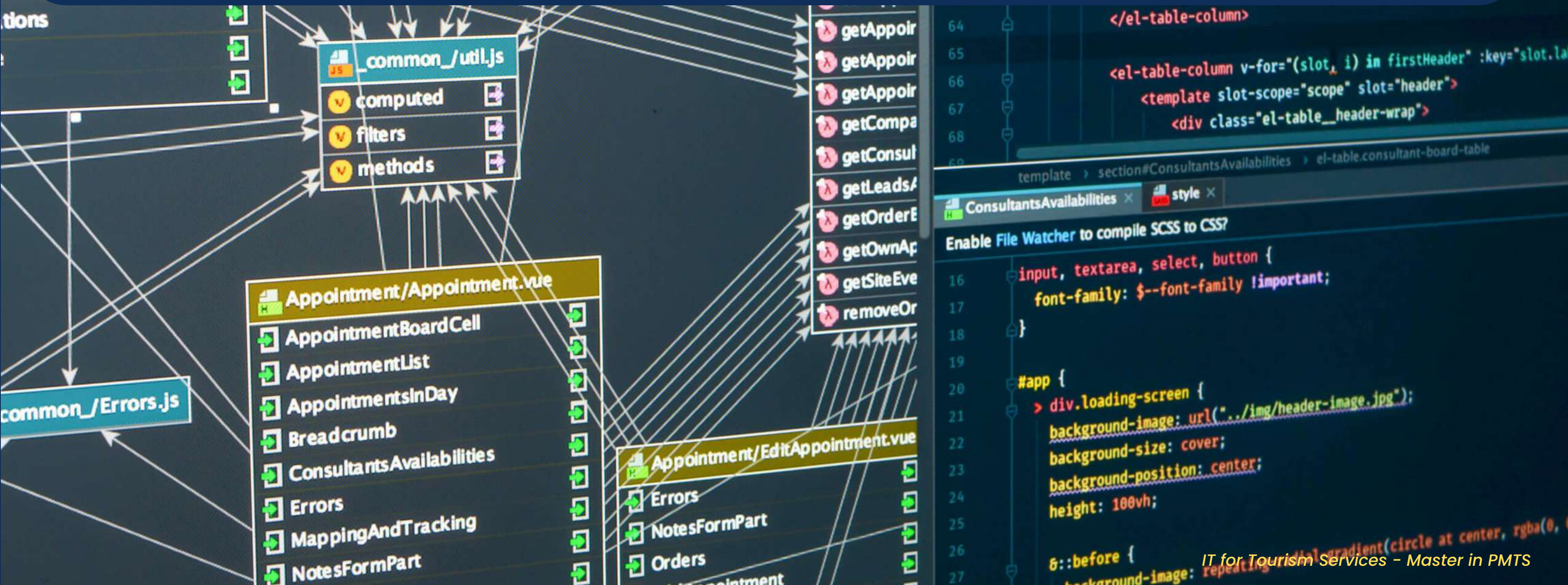
The more data are connected between them, the more powerful they become. It doesn't happen with hypertext

E.g: all the info boxes at the right side of the Wiki pages now form a Linked Open Data called DBpedia

It was born in 2007 when only a few others Linked Open Data were available:

Linked Open Data in 2022

Unfortunately, most of the tourism data are still closed and with few Linked Open Datasets available

The Linked Open Data Cloud

Legend
- Cross Domain
- Geography
- Government
- Life Sciences
- Linguistics
- Media
- Publications
- Social Networking
- User Generated
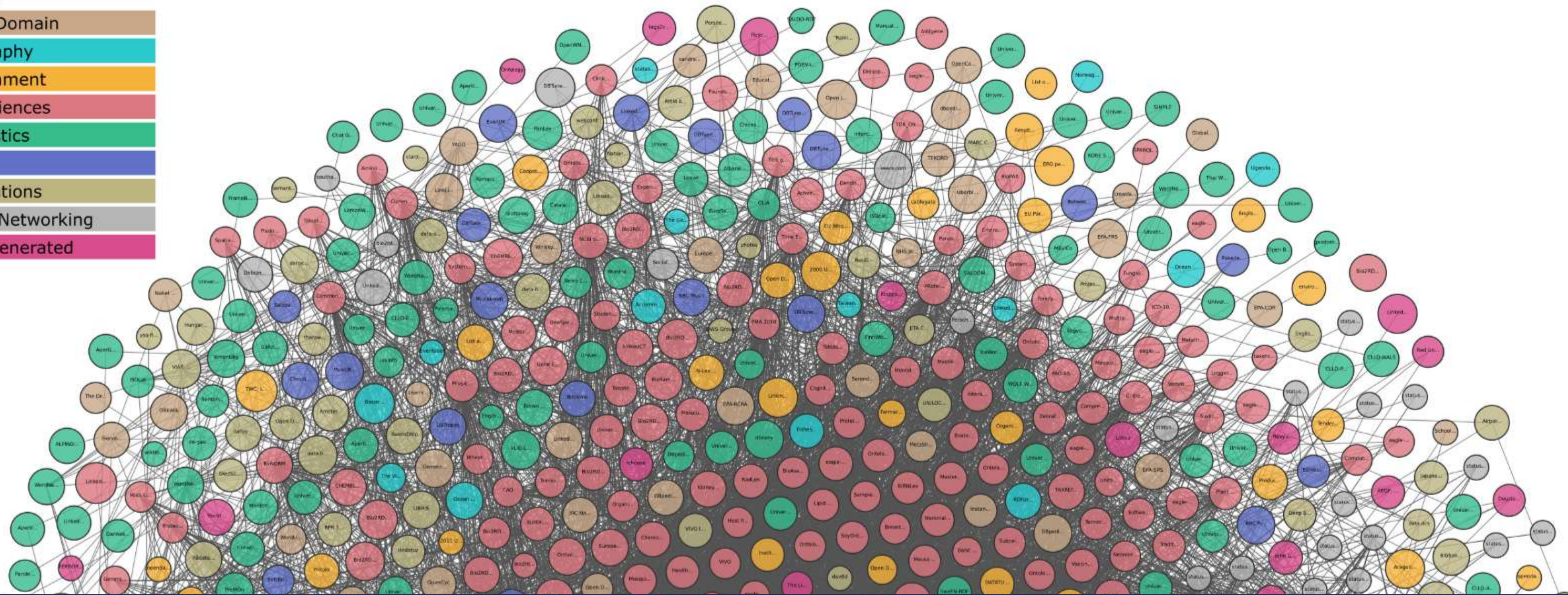
The types of Linked Opened Datasets available at present are mainly geographical, scientific and administrative

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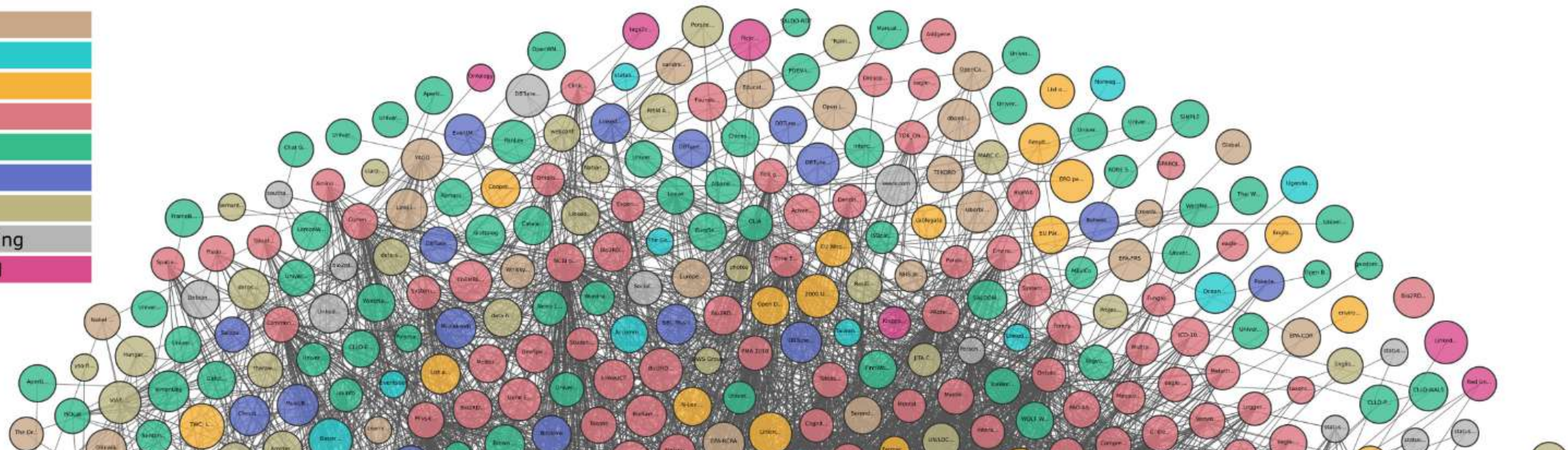
If many tourism datasets were available, we could get answers to important questions like: "Does the war in Ucraine influence the travelling behaviour of German tourists within Europe?"

The Linked Open Data Cloud

Legend
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Or even: "Do mass-tourism arrivals to Spain impact the environment of the host country?"

Austrian National
Tourist Office
www.tourmis.info

CITY
DESTINATIONS
ALLIANCE

EUROPEAN
TRAVEL
COMMISSION

MODUL
UNIVERSITY
PRIVATE UNIVERSITY VIENNA

Welcome to TourMIS!

TourMIS is a Marketing-Information-System for tourism managers. The major aim of TourMIS is to provide information and decision support for tourism managers and scholars. T provides on-line tourism survey data, as well as various tools to transform data into precious management information.

Since 2000 this initiative has provided the tourism industry with predominantly free access to overall data and functions of TourMIS (registration is required).

TourMIS is open to all authorized tourism organizations, societies, tourism consultants, companies, tourism training centres, pre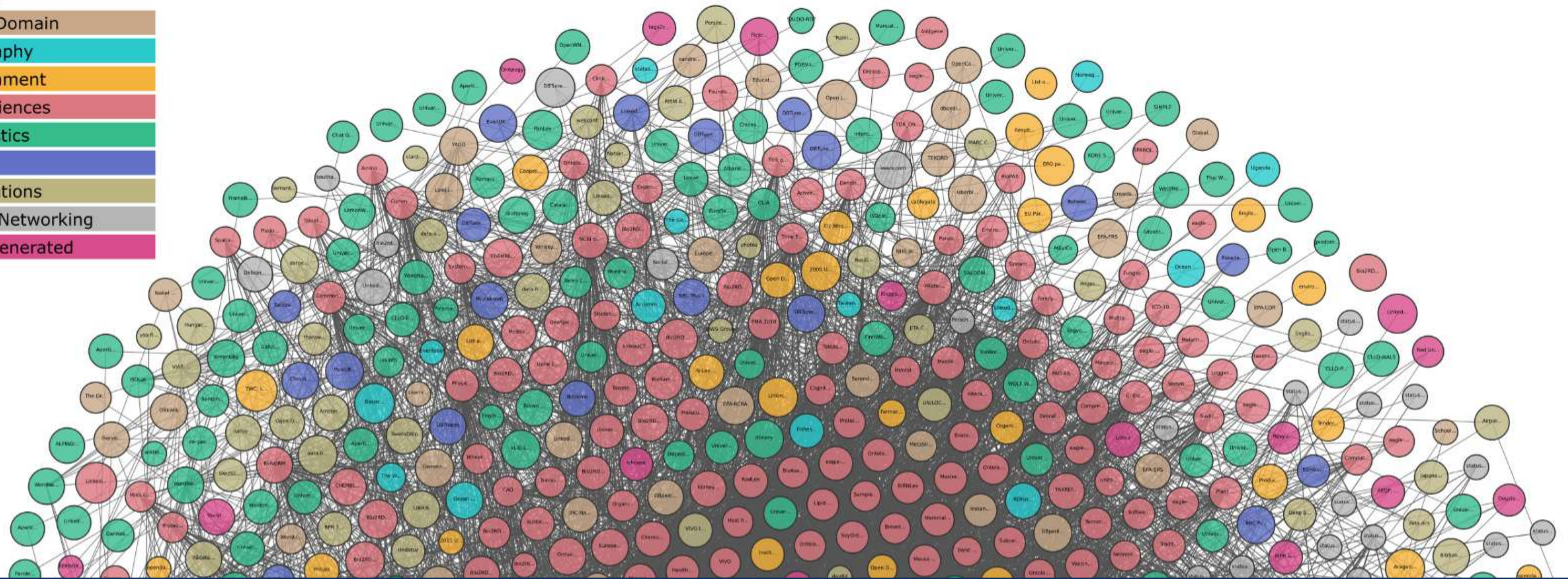ssure groups, etc. in Austria and abroad. By cove maintenance costs, a consortium of the most important initiators of market research projects in Austria and Europe guarantee the continuous updating of the comprehensive data

The programme modules contained in the method-base are developed according to the specific requirements of tourism managers at the Department of Tourism and Service Man University Vienna led by Prof. Dr. Karl Wöber.

The development of TourMIS is financially supported by the Austrian National Tourist Office and the European Travel Commission.

Technical Components

Data in TourMIS is maintained in form of a relational database. Inserting and maintaining data is done by means of a web-based user interface. All pages in TourMIS are generate TourMIS is located on a virtual server and managed by a team of tourism research experts at Modul University Vienna (1190 Vienna, Am Kahlenberg 1, Austria, Europe).

Software

TourMIS has been developed with various software products:
Database server: MS SQL Server
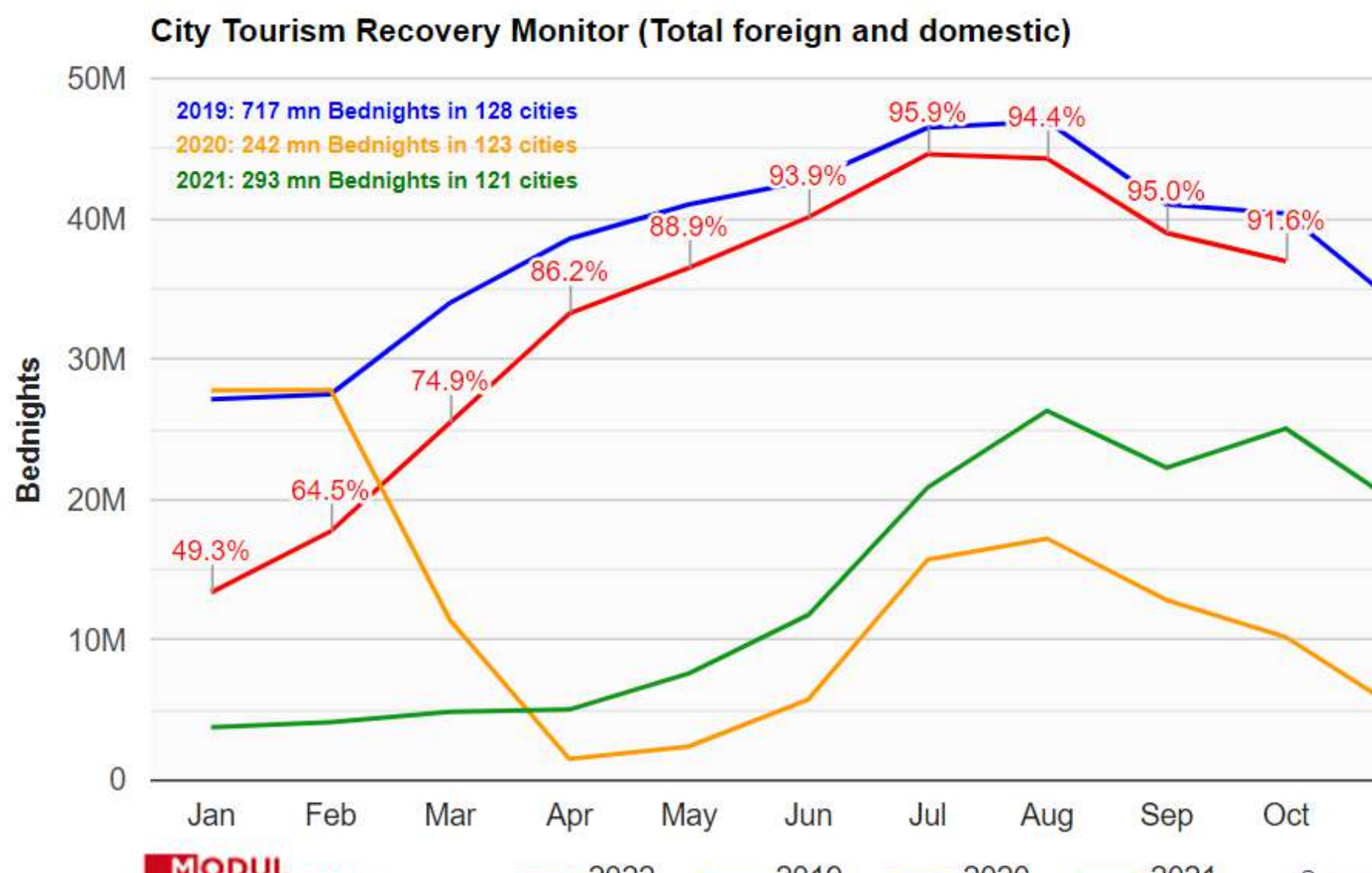Web server: MS Internet Information Server
Application: Strawberry Perl.

The first Linked Open Dataset for Tourism was created in 2003 by the Austrian Tourist Office and it is called TourMIS

▸ About TourMIS
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▸ Supporters
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▸ Related links
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▸ TourMIS white paper
▸ TourMIS Manual
▸ Eurocity Manual
▸ Definitions in city tourism
▸ Excel form for ETC
▸ Excel form for CityDNA

▸ Next TourMIS Workshop
▸ CityDNA Benchmarking R.
▸ TourMIS Charts API

European Countries			
Trends in Important Markets January - September 2022			
Market	Arrivals (1)	Bednights (1)	(2)
Austria	126.7	131.1	13/16
Canada	503.6	426.7	13/15
Switzerland	131.5	144.4	14/18
China	307.3	255.1	12/15
Germany	119.5	110.5	14/18
Denmark	183.7	193.6	14/17
Spain	184.0	178.4	14/18
France	136.9	162.5	14/18
India	493.3	306.9	11/14
Italy	171.7	143.1	14/18
Japan	316.9	296.9	12/15
Netherlands	135.5	161.9	14/18
Norway	458.1	432.2	13/16
Poland	116.2	96.6	13/15
Sweden	255.6	242.8	14/16
Russia	141.4	122.2	12/16
United Kingdom	513.0	449.3	14/18
United States	312.1	274.6	13/16
Australia	1043.2	1058.3	13/16
Brazil	557.7	441.7	12/14
Trends in Total Europe January - September 2022			
Market: Total foreign			

City Tourism Recovery Monitor (Total foreign and domestic)

2019: 717 mn Bednights in 128 cities
2020: 242 mn Bednights in 123 cities
2021: 293 mn Bednights in 121 cities

It includes data from over 100 European cities. Its dataset consists of bednights spent at a destination, arrivals at accommodations, capacity and occupancy rates
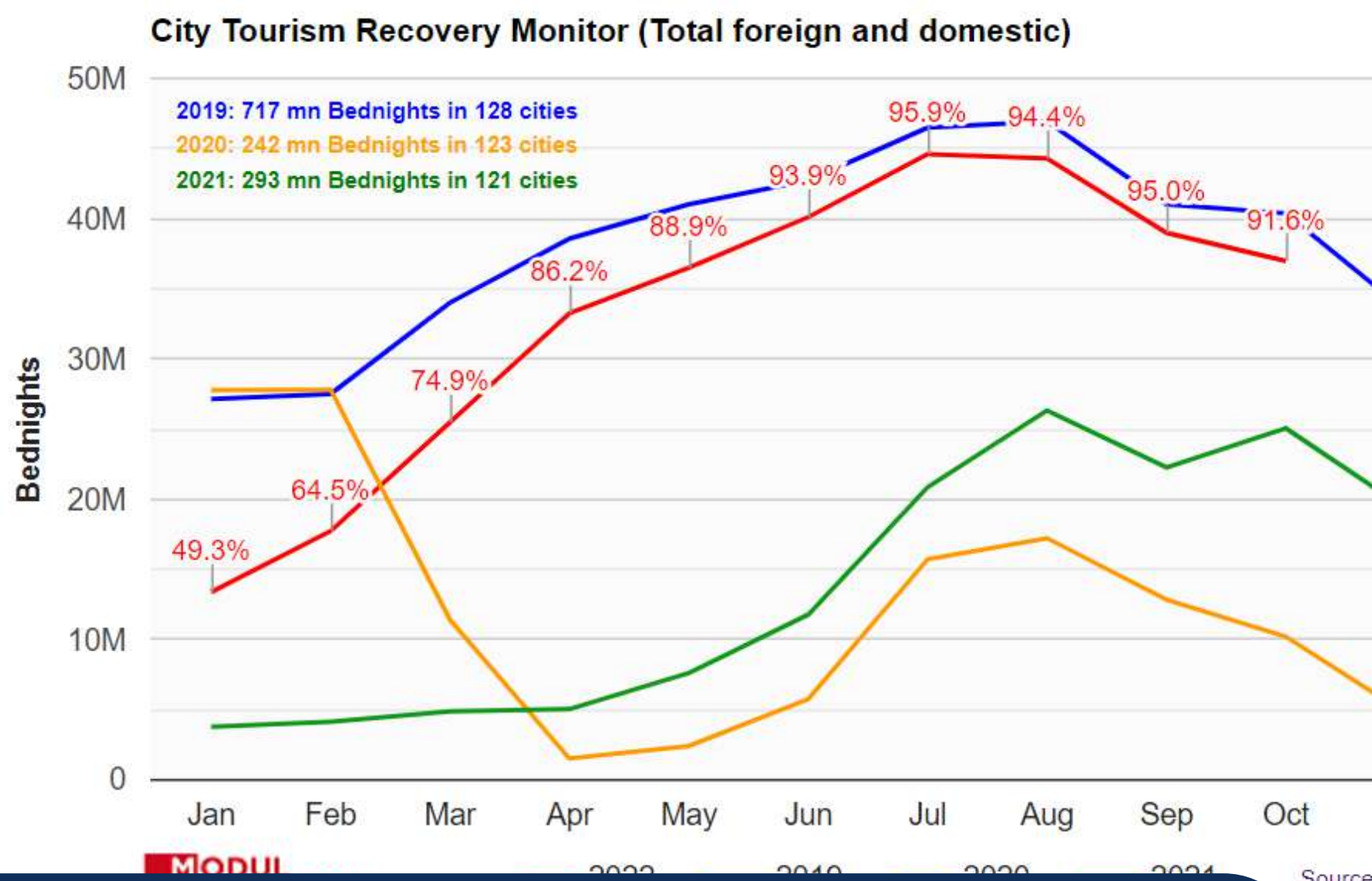
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(chart values shown: 95.9%, 94.4%, 93.9%, 95.0%, 91.6%, 88.9%, 86.2%, 74.9%, 64.5%, 49.3%)

Y-axis: Bednights — 0, 10M, 20M, 30M, 40M, 50M
X-axis: Jan Feb Mar Apr May Jun Jul Aug Sep Oct

MODUL

Source 2022-1

TourMIS was linked to other Linked Open Datasets on economy and sustainability, creating the first online tourism decision support system to answer more complex questions

IT for Tourism Services – Master in PMTS

Jesus Somonte

Best results are obtained combining Linked Open Data with Blockchain, to form a decentralized semantic web that is able to detect hidden relationships across all the open datasets of the world

You may be able to ask: "Siri, please find where it's better to open a restaurant in Lombardy". "Alexa, I'd like to go to Paris one week but I'm on a budget. Could you try to book an accommodation for less than 500 euro and it is in the view of Tour Eiffel?"

If this IT exists and it is mature enough to use, why it is not mainstream yet?

Also the first million web pages were published with considerable effort, and the benefits were close to zero

Only when the tools improved, time and costs went down. Web content platform like WordPress and Social Media reduced the costs to publish to zero

Linked Data is at a similar inflection point. A new set of tools is emerging to publish a Linked Open Dataset without having to become an expert

SEMANTIC WEB

Tools for publishing Linked Open Datasets are on their way. Web searches are done in a language called SPARQL, that is very close to SQL

The impact of Linked Open Data on Tourism is still limited, but in the near future may become as useful as the introduction of the google search engine in 1996

BIBLIOGRAPHY

In the Moodle there are two articles:

- Amin Verma et al. (2021) Convergence of IOT in Tourism Industry: a Pragmatical Analysis
- Azar et al (2016) Linked Open Data Search Engine

And the link to the speech of Tim Berners-Lee on the Semantic Web:

- https://www.youtube.com/watch?v=OM6XIICm_qo&t=322s