

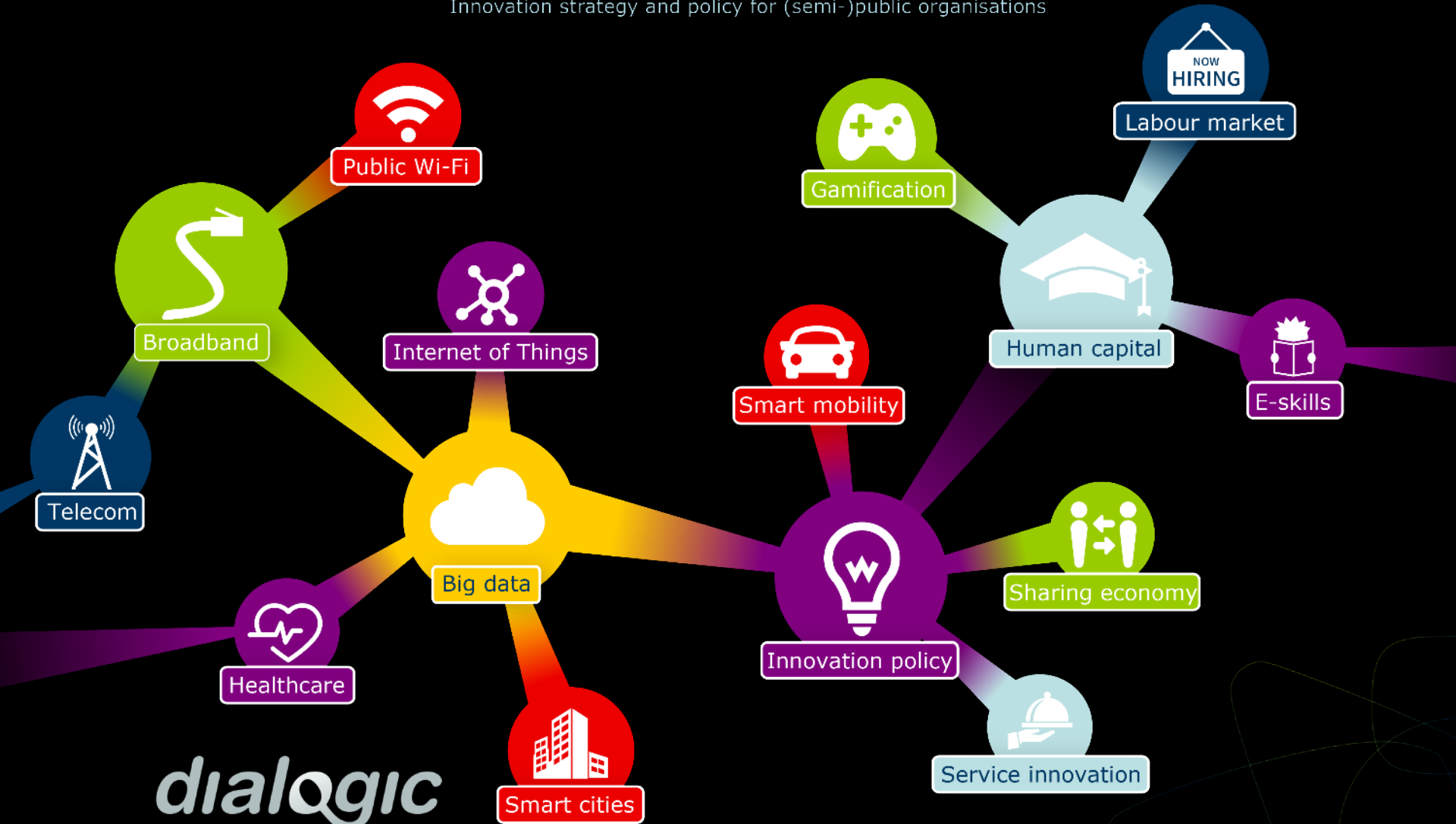
Geo-analysis + telecommunications

Tommy van der Vorst

April 25, 2016

dialogic

Innovation strategy and policy for (semi-)public organisations



dialogic
innovatie • interactie

In this presentation



1. Obligatory spam about my employer (check)



2. Quantitative geo analysis for telecom



3. Tools for quantitative geo analysis



4. How to solve real-world problems yourself

Quantitative geo analysis in telecom

Or: what is this Dialogic guy doing anyway?



What is quantitative geo analysis?

Any kind of quantitative analysis that (at least partially) uses geographic data.

Geography: all relevant characteristics of an area or location

Geometry: circles, squares, points, ...: the mathematical representation of geography.

→ You can only do quantitative analysis on geometry. You could also do qualitative analysis on geography (but also with error).

→ Most certainly, your geometry is wrong in some way with respect to the geography. You need to know how wrong!

Geography and telecommunications

Geography plays a **huge** role in telecommunications market dynamics:

- **Availability of connectivity** (is there a connection at all?)
- **Redundancy** (where is my line?)
- **Competition** (what operators can I choose between?)
- **Quality** (how fast is my connection?)
- **Financing** (is it economically feasible to deploy a network?)
- **Strategy** (what are the options in a particular place?)

destaadvantelecom.nl

NEDERLAND ICT

INLEIDINGINFRASTRUCTUURGEBRUIKIMPACTCONCLUSIE

Infrastructuur

in f t

De telecom- en internetinfrastructuur vormt samen de digitale infrastructuur van Nederland.

Digitale aorta

Investeringen

Buurlanden en sectoren

Huishoudens

Bedrijven

Objecten

Mobiel

Conclusie

↓ GEBRUIK

- Glasvezel als digitale aorta**

Door heel Nederland loopt een dicht netwerk van 91.743 km. Deze lengte staat gelijk aan de lengte van 2,2 keer de omtrek van de aarde. Deze glasvezel verbindt het telecom- en internetnetwerk met elkaar en vormt daarmee een cruciaal onderdeel van de digitale infrastructuur.

Wat zien we op deze kaart?

Glasvezelnetwerk als fundament
- Datacentra
- Internetknooppunten

Nederland ict-koploper in Europa

Nederland is koploper in Europa met het investeren in telecom en internet. In de infrastructuur is vorig jaar voor 525 euro per huishouden geïnvesteerd, wat neerkomt op bijna 4 miljard euro, zeggen onderzoekers van Nederland ICT.

De branchevereniging publiceert voor het eerst het onderzoeksrapport De Staat van Telecom over onder meer de uitgebreide toegang van huishoudens in Nederland tot breedbandinternet. Meer dan 90 procent heeft snel internet.

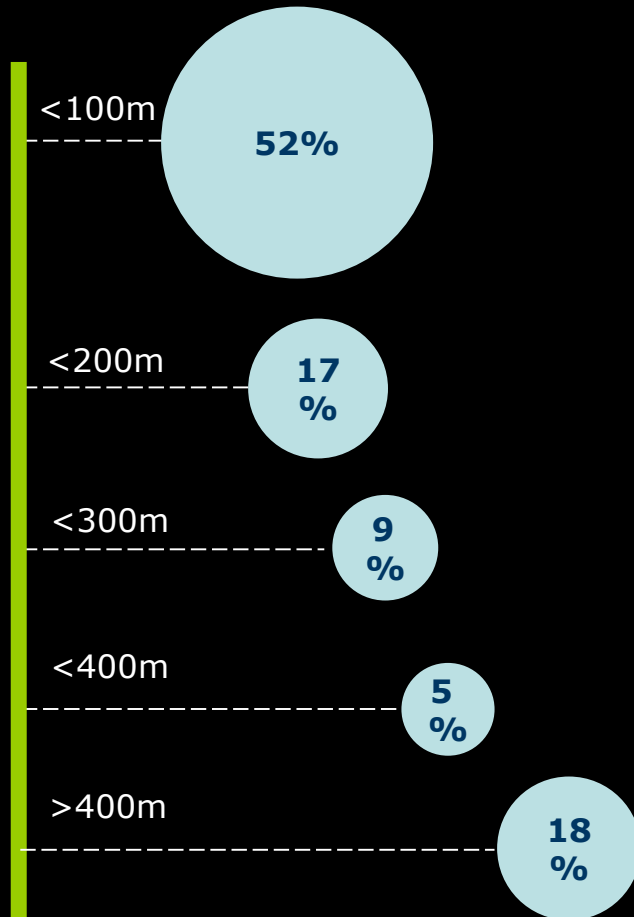
Ook is er in nagenoeg het hele land toegang tot mobiele netwerken. Begin dit jaar werden er 10,4 miljoen smartphones en 790.000 laptops en tablets geteld.

volgende nieuws verkeer sport

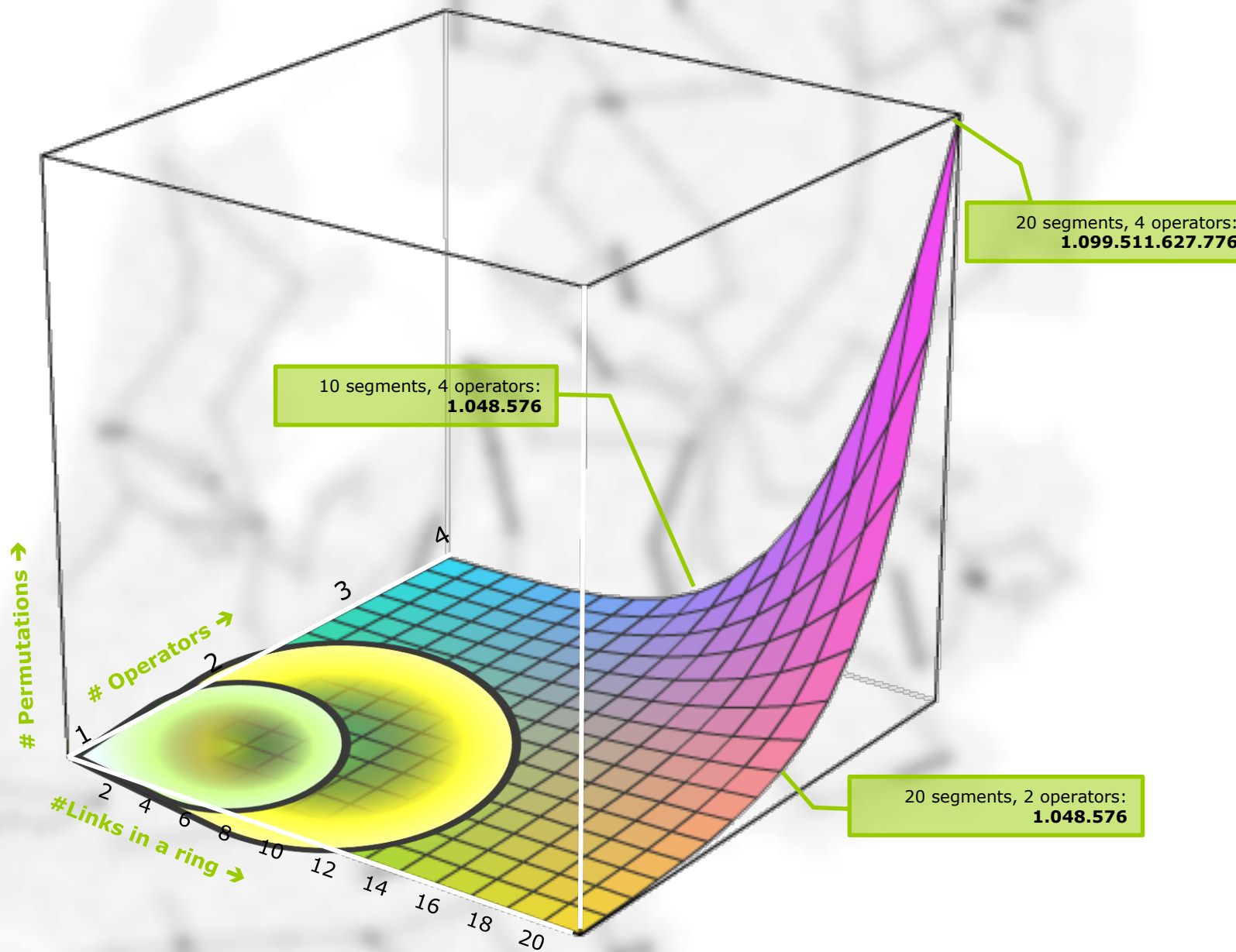


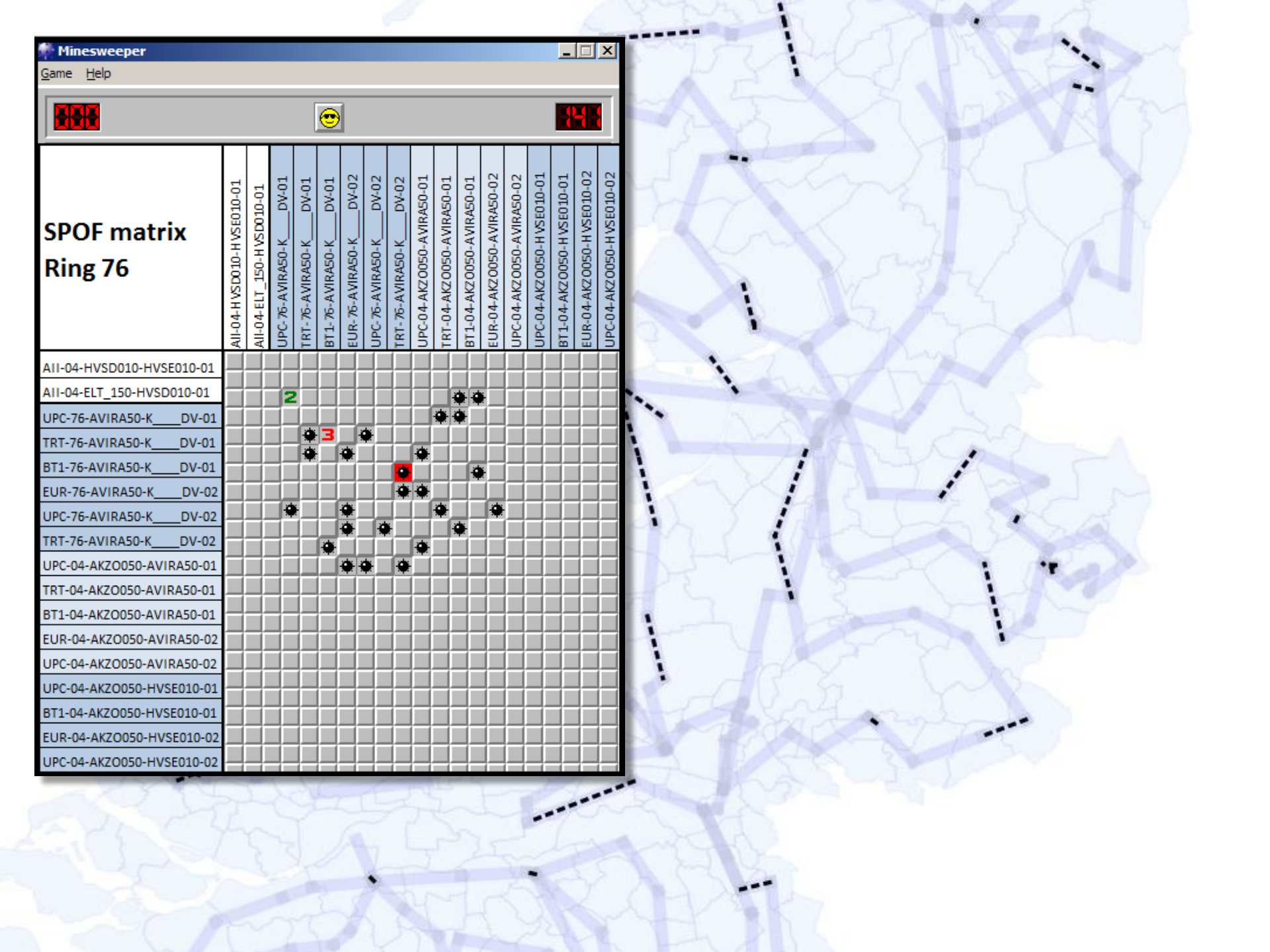
ACHIEVEMENT UNLOCKED

The Dutch Digital Aorta



More than half of commercial/industrial addresses is within 100 metres of a backbone. 80% of the addresses is within 400 metres.

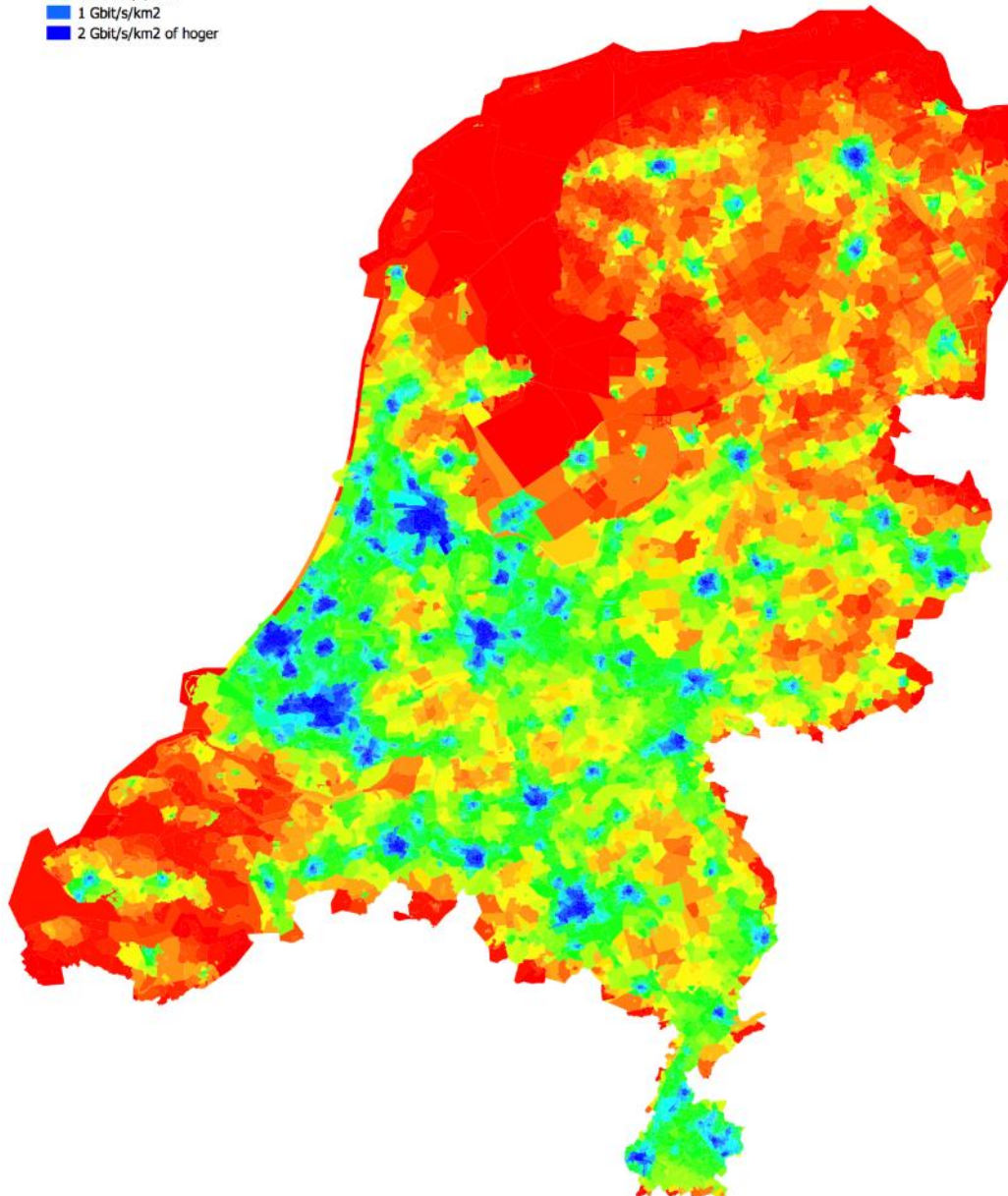




Totale capaciteit mobiele netwerken in Nederland

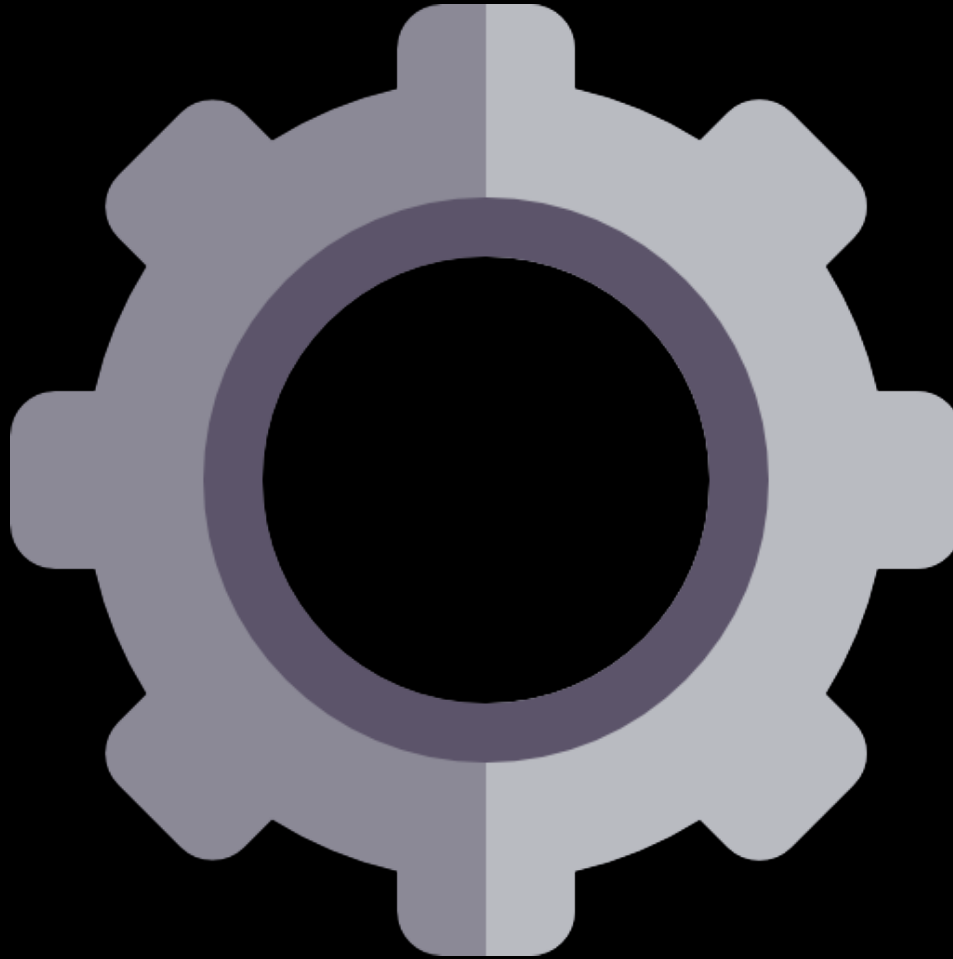
Februari 2016

- 16 Mbit/s/km² of lager
- 100 Mbit/s/km²
- 450 Mbit/s/km²
- 1 Gbit/s/km²
- 2 Gbit/s/km² of hoger



Tools of the trade

Or: what should I download?



My First Geo Analysis

Ingredients:



Geo data
sources



Storage
tools



Analysis
tools



Visualisation
tools

Open geo data sets



Many governments have 'opened' their data sets, and many include geo data sets:


1. CBS: Wijk- en buurtkaart [\[cbs.nl\]](https://cbs.nl) , 50x50m rasterdata
2. PDOK: Nationaal Georegister [\[nationalegeoregister.nl\]](https://nationalegeoregister.nl) has all sorts of nice data sets, including areal pictures of the Netherlands
3. BAG: Basisregistratie Adresgegevens [\[nlextract.nl\]](https://nlextract.nl)
4. OpenStreetMap [\[geofabrik.de\]](https://geofabrik.de)

Also, geodata may be 'hidden' in a lot of places (zip codes, IP addresses, CAD files, EXIF metadata, etc.).

Enriching geo data

- Trick of the day: use a web crawler to gather data using the geo dataset as a base data source.
- Get ZIP codes from BAG, request availability of fibre from KPN's 'zip code check' page.

They do not always like this...



Welke pakketten en voordelen krijg jij?

Vul je postcode en huisnummer in, dan tonen wij de beschikbare pakketten voor jouw adres.

Postcode Huisnr. Toevg.

☒ Huidig adres ☐ Toekomstig adres

Bekijk beschikbaarheid

Shape files



- Geo data is usually stored in *shape files* (ESRI, .sh*)
- Basically: a table with an extra column 'geometry'
- Geometry can be:
 - Point
 - Polygon
 - Linestring
 - Multipoint, Multipolygon, Multilinestring
 - Geometry (any of the above, mixed)
 - NULL (missing)
- Dimensions: XY, XYZ, XYM, XYZM
- Pay attention to the Coordinate Reference System (CRS) used!

Geo databases



Geo data is huge! We are typically dealing with files 1-2GB for a regional analysis, 3-4GB for analysis spanning the Netherlands. The BAG is about ~10GB and OpenStreetMap ~50GB.

Our workflow:

- Store *source data* in **PostGIS** (<http://postgis.org>). This database supports storing very large geo datasets and is fast to query
- Use **Spatialite** (<http://gaia-gis.it>) to work locally on *smaller extracts*. Just a single .exe!
- If necessary, talk to both from inside **QGIS**, and automate it all using a QGIS **Python** plug-in.
- To import data to postgis, use **shp2psql**. To export and make shapefiles, just use QGIS.

Geo visualisation



- QGIS is the best. Note that it can directly read from both Spatialite and PostGIS, so quick reloads!
- You don't always *have* to visualise geo data sets as maps. Alternatives to consider:
 - Network visualisation (e.g. Visone)
 - Histogram (of closeness, density)
 - Good old tables and charts for aggregates (Excel)
- If you have RD coordinates, you could use Excel with a scatter plot as 'poor mans GIS'. Works quite well for interactive models (but becomes slow really quickly)!

Geometry = math

But what does the calculator look like?



Common geometry operations: points



Point (X, Y, Z, M)



Distance(a, b)
→ number

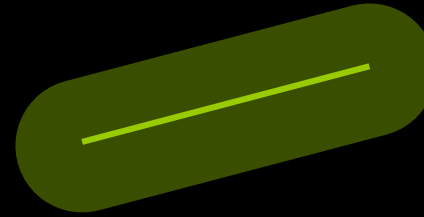


Buffer(point, distance)
→ Circle (polygon)

Common geometry operations: lines



Make Line(pt1, pt2)
→ Line



Buffer(line, distance)
→ Polygon

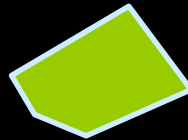


Length(line)
→ number

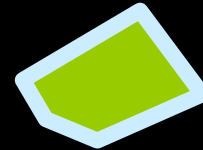
Common geometry operations: polygons



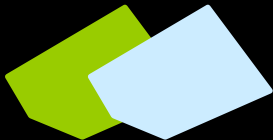
Area(polygon)
→ number



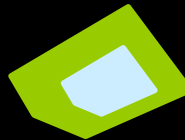
Perimeter(polygon)
→ number



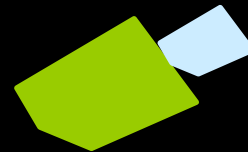
Buffer(polygon)
→ Bigger polygon



Intersects(poly1, poly2)
→ Yes or no

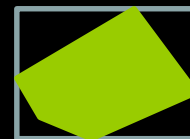


Contains(poly1, poly2)
→ Yes or no



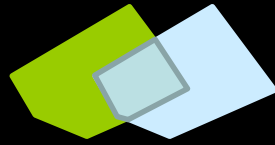
Touches(poly1, poly2)
→ Yes or no

→ Can also test: does polygon
contain point/line?

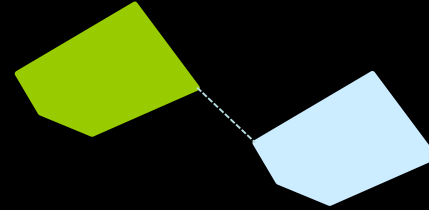


Envelope(geometry)
→ Rectangle (polygon)

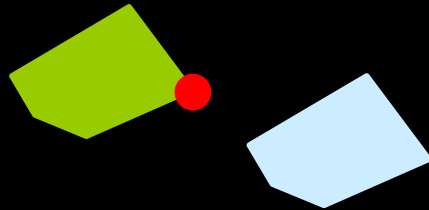
Common geometry operations: geometry



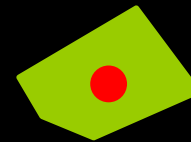
Intersection(a,b)
→ Polygon



Distance(a,b)
→ Number (shortest)

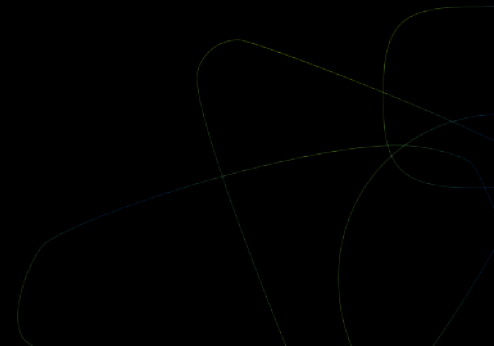
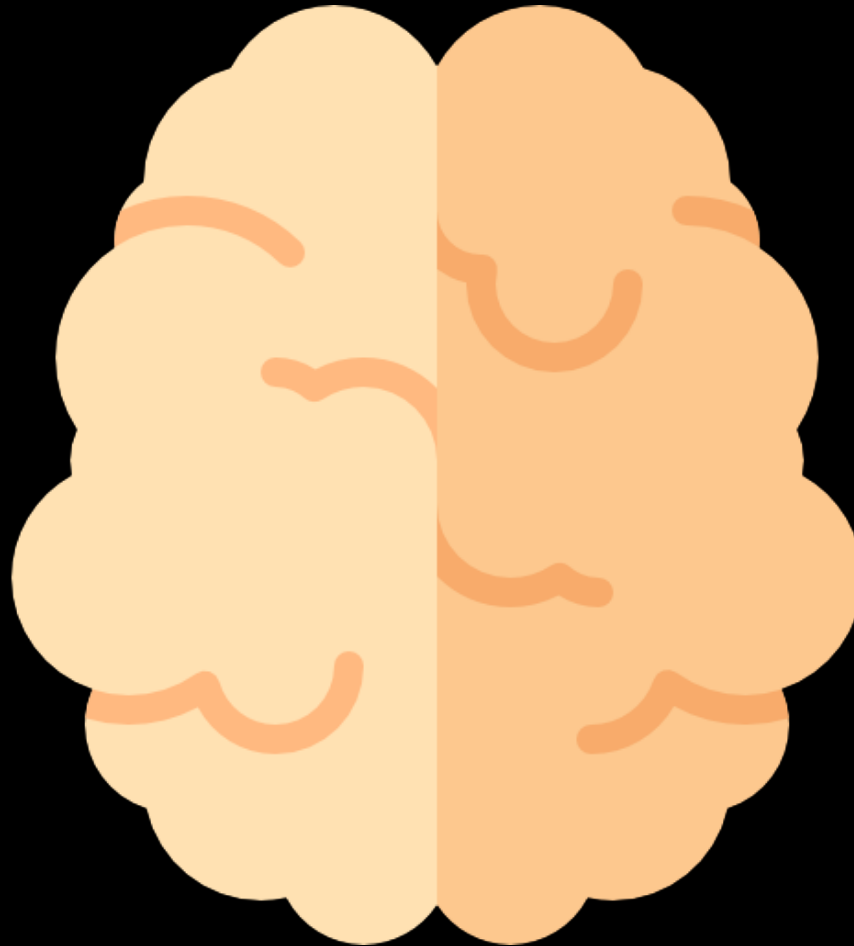


ClosestPoint(a, b)
→ POINT



Centroid(x)
→ POINT

Solving some real problems



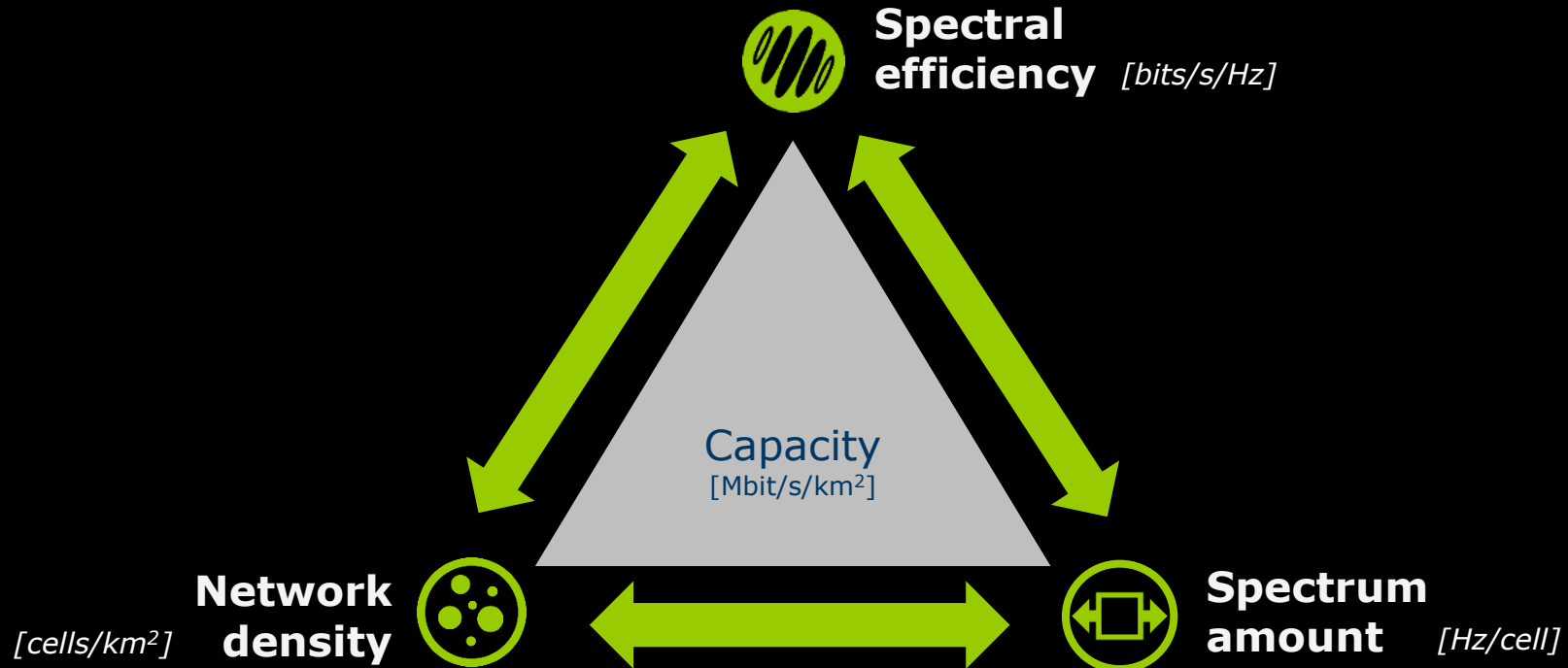


Agentschap Telecom
Ministerie van Economische Zaken

How much capacity do mobile networks provide (by location in the Netherlands)?



Mobile network capacity



How much capacity do mobile networks provide?

The general idea of our model:

1. From open data, find out where the antennas are
2. From expert, determine max capacity of antenna per MHz
3. From spectrum licenses, find the spectrum size
4. Estimate which antenna is responsible for which area
5. Capacity = spectrum * efficiency / area



Geo data
sources



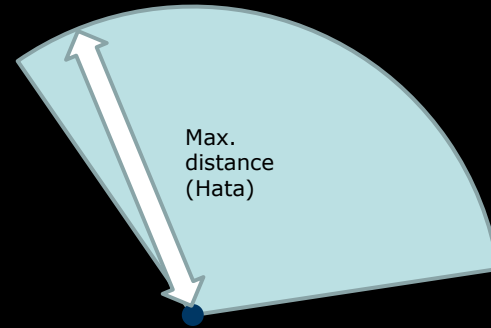
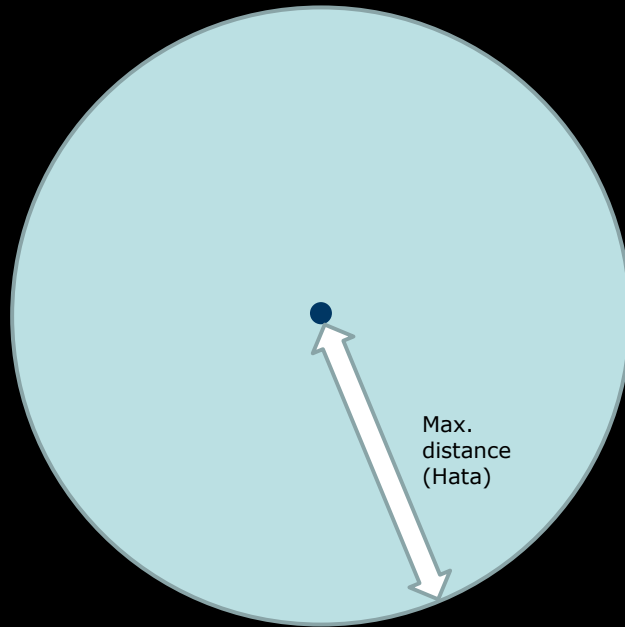
Storage
tools



Analysis
tools



Visualisation
tools

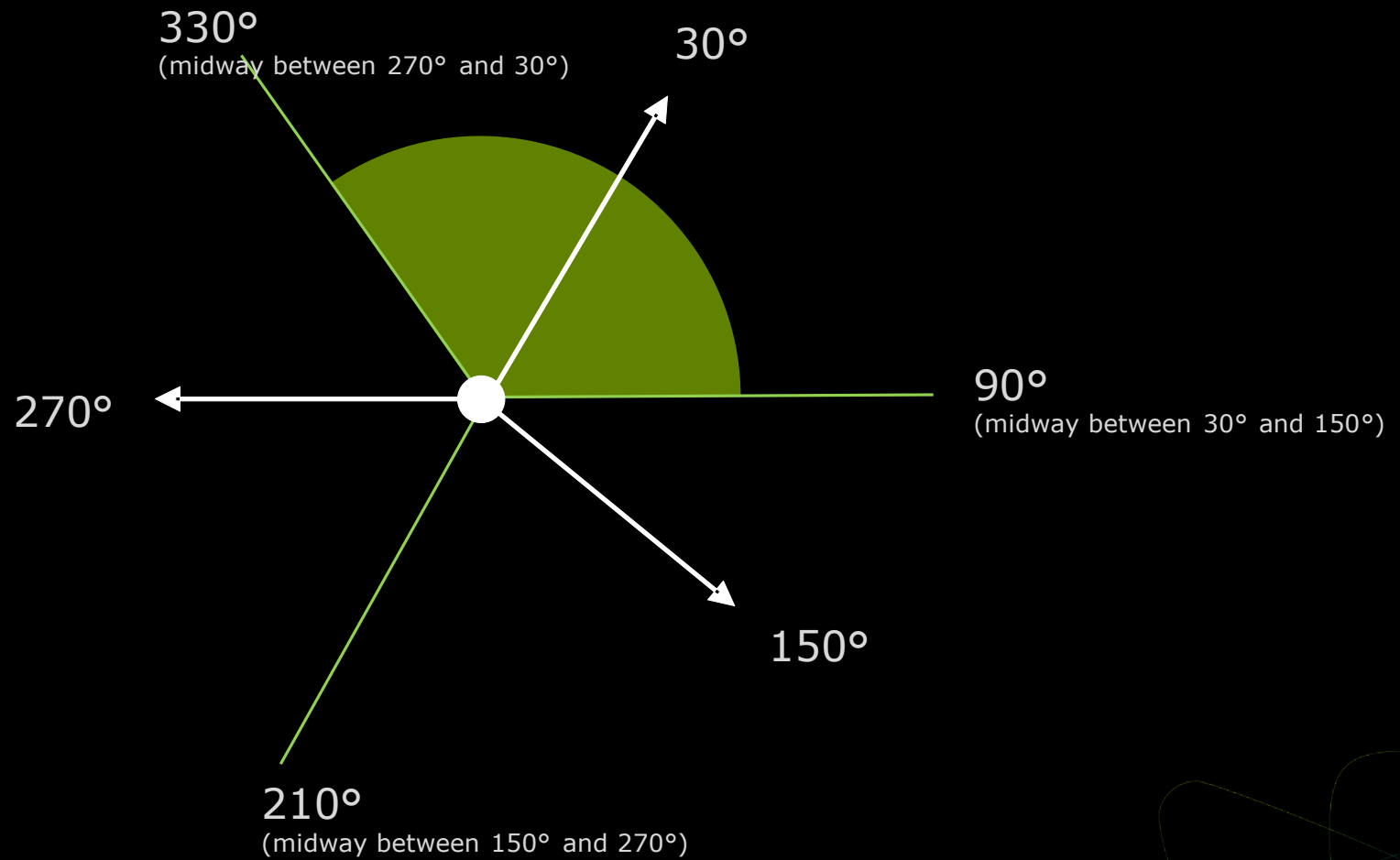


$$L = \underbrace{46.3 + 33.9 * \log f - 13.82 * \log h_B - a(h_R)}_{\text{Antenna-specific}} + \underbrace{[44.9 - 6.55 * \log h_B] * \log d + C}_{\text{Distance- and environment specific}}$$

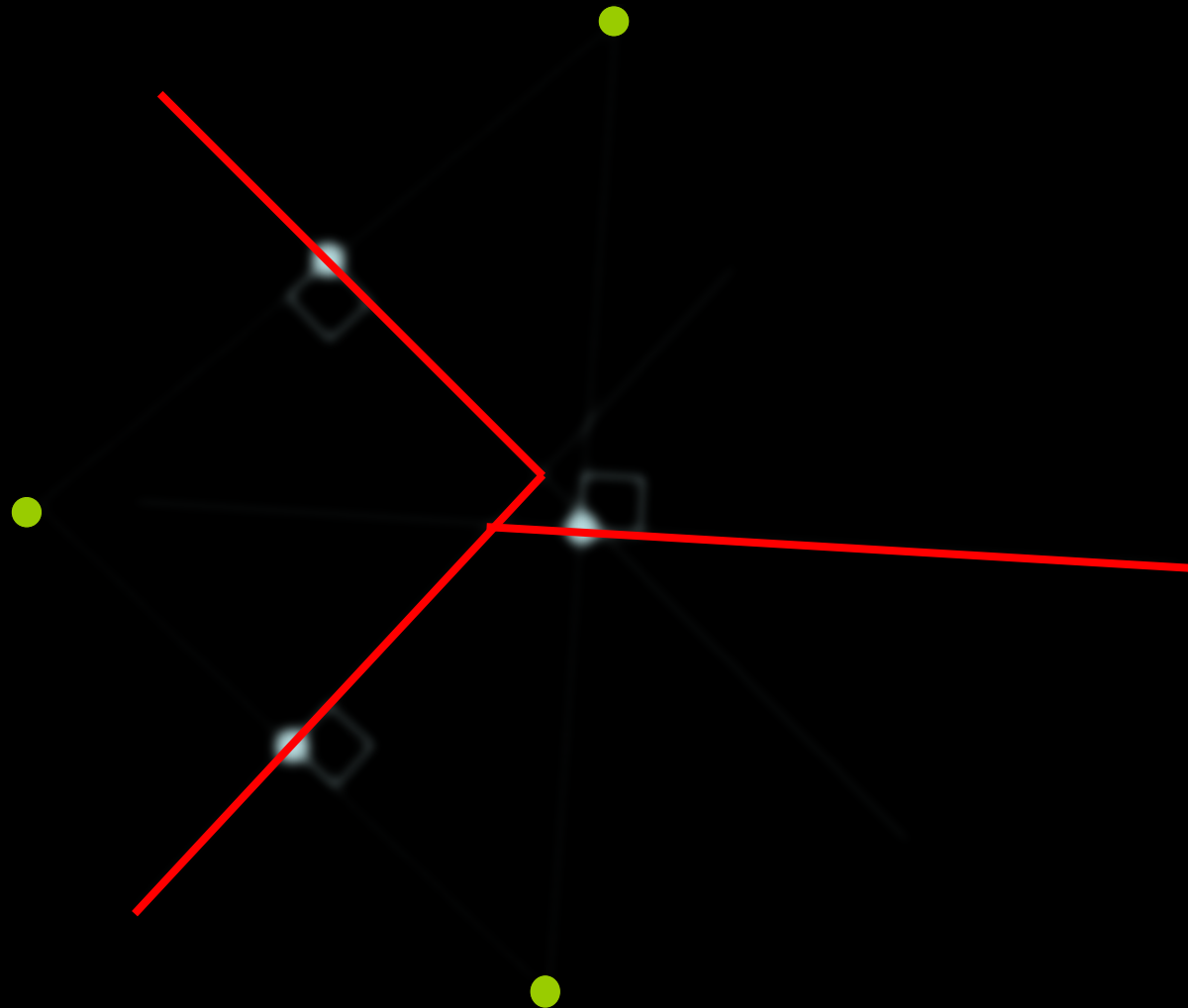
$$a(h_R) = (1.1 * \log f - 0.7) * h_R - (1.56 * \log f - 0.8)$$

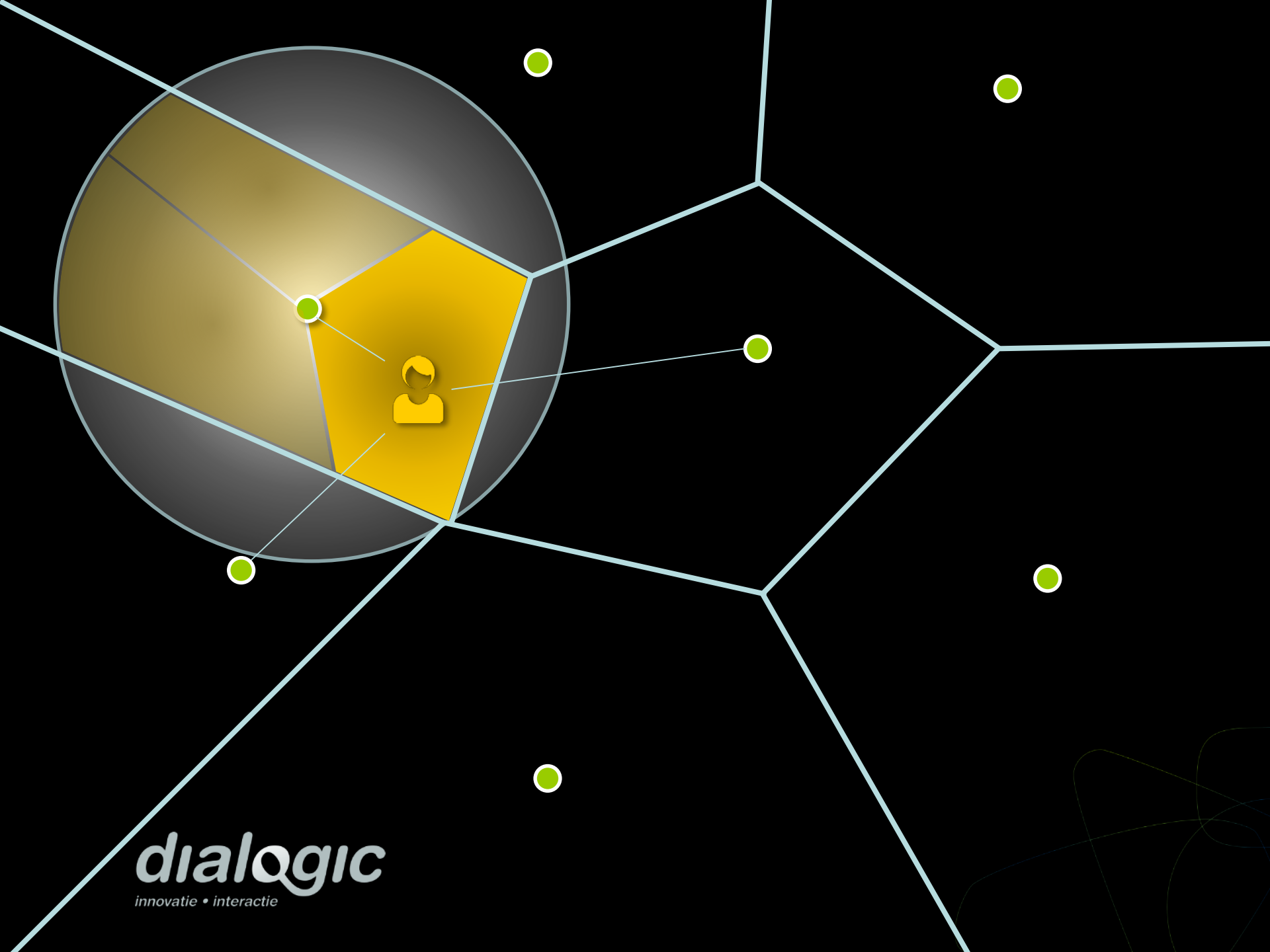
$$C = \begin{cases} 0 \text{ dB for medium cities and suburban areas} \\ 3 \text{ dB for metropolitan areas} \end{cases}$$

Cell sectors

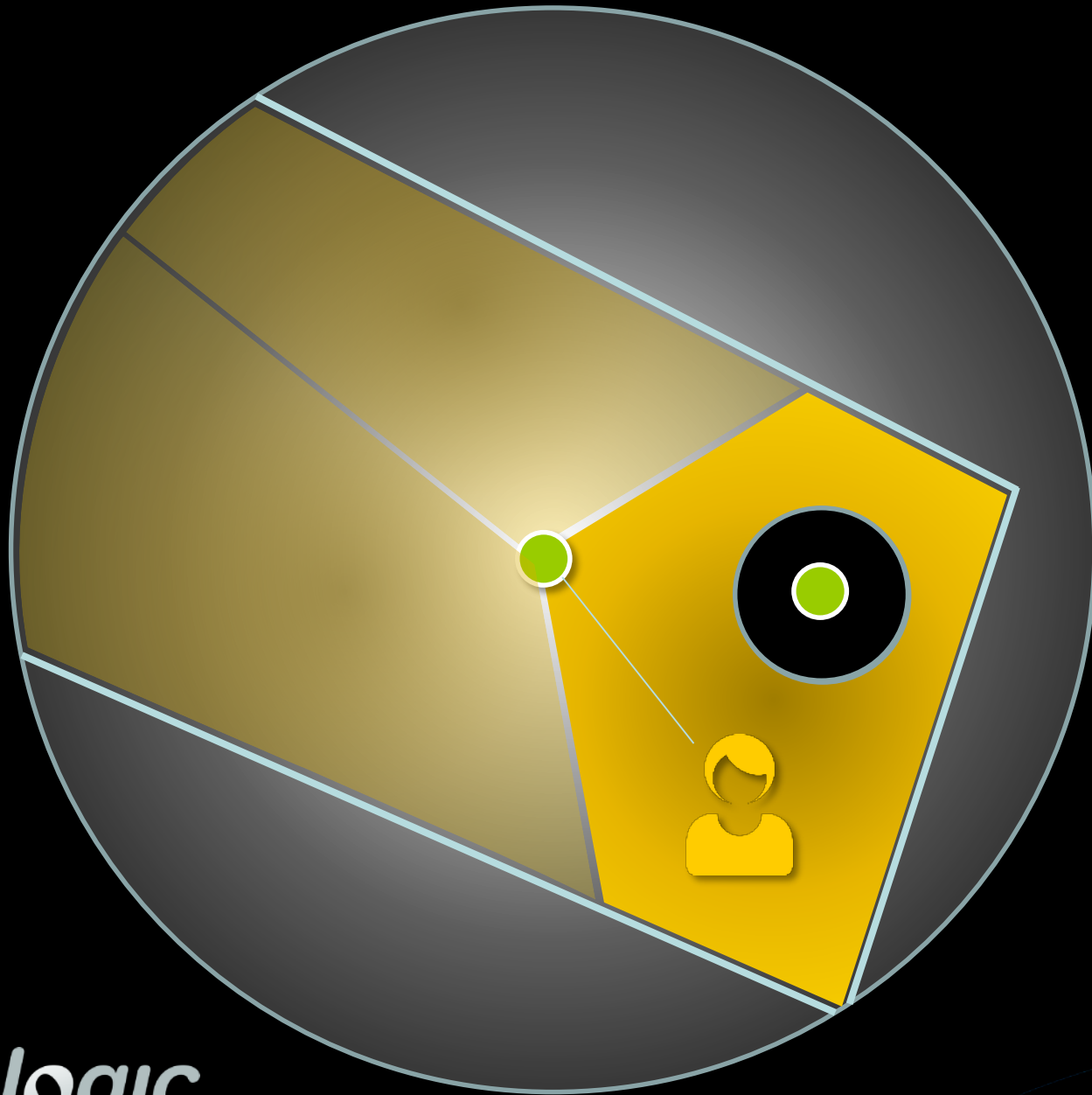


Network structure: macro cells

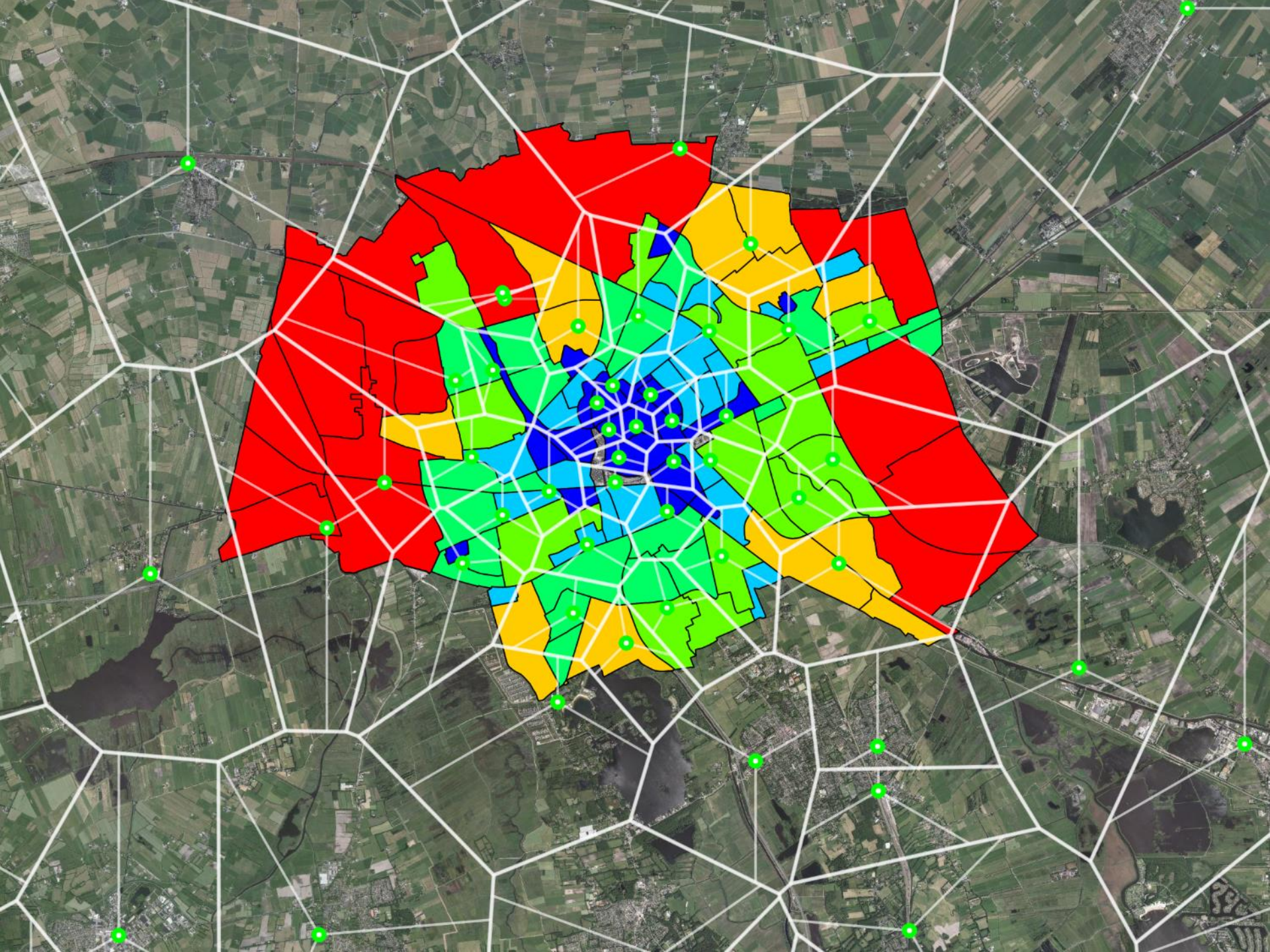




dialogic
innovatie • interactie



dialogic
innovatie • interactie



Q & A

Tommy van der Vorst
vandervorst@dialogic.nl
+31 6 55543708
+31 30 21505 93