

# How to start your own Internet Resiliency Club

Using crisis engineering to prepare for loss of communication

Valerie Aurora, Bow Shock Systems

<https://bowshock.nl>

# Valerie Aurora, Bow Shock Systems

- Consulting systems software engineer
- Specializing in Linux, file systems, networking, and any problem no one else can solve
- Former special rapporteur for two Cyber Resilience Act standards
- Founder of the Amsterdam Internet Resiliency Club



*Submarine cables at Museu das Comunicações in Lisbon, Portugal*

# Outline

- Why we should worry about a long-term communications outage
- State of internet and telecomm resiliency in the Netherlands and Europe
- What Crisis Engineering says we can do about it now
- What I did about it: started the Amsterdam Internet Resiliency Club
- Technical comparison of Meshtastic and MeshCore
- What you can do to prepare for loss of communications

# Disruption is the new normal for Europe

- Russia is still invading Ukraine
- NATO head says all of Europe should prepare for war
- Russian modem-wiper attack on Ukraine also took out German wind turbines
- US threatened to invade Greenland
- 10+ hour Iberian peninsula blackout
- Amsterdam is preparing for weeks without power
- Ships just can't keep their anchors up when crossing undersea communications cables...



*Newnew Polar Bear,  
suspected of causing  
Balticconnector cut*

*Credit: Alf van Beem*

# What if we lose internet AND power?



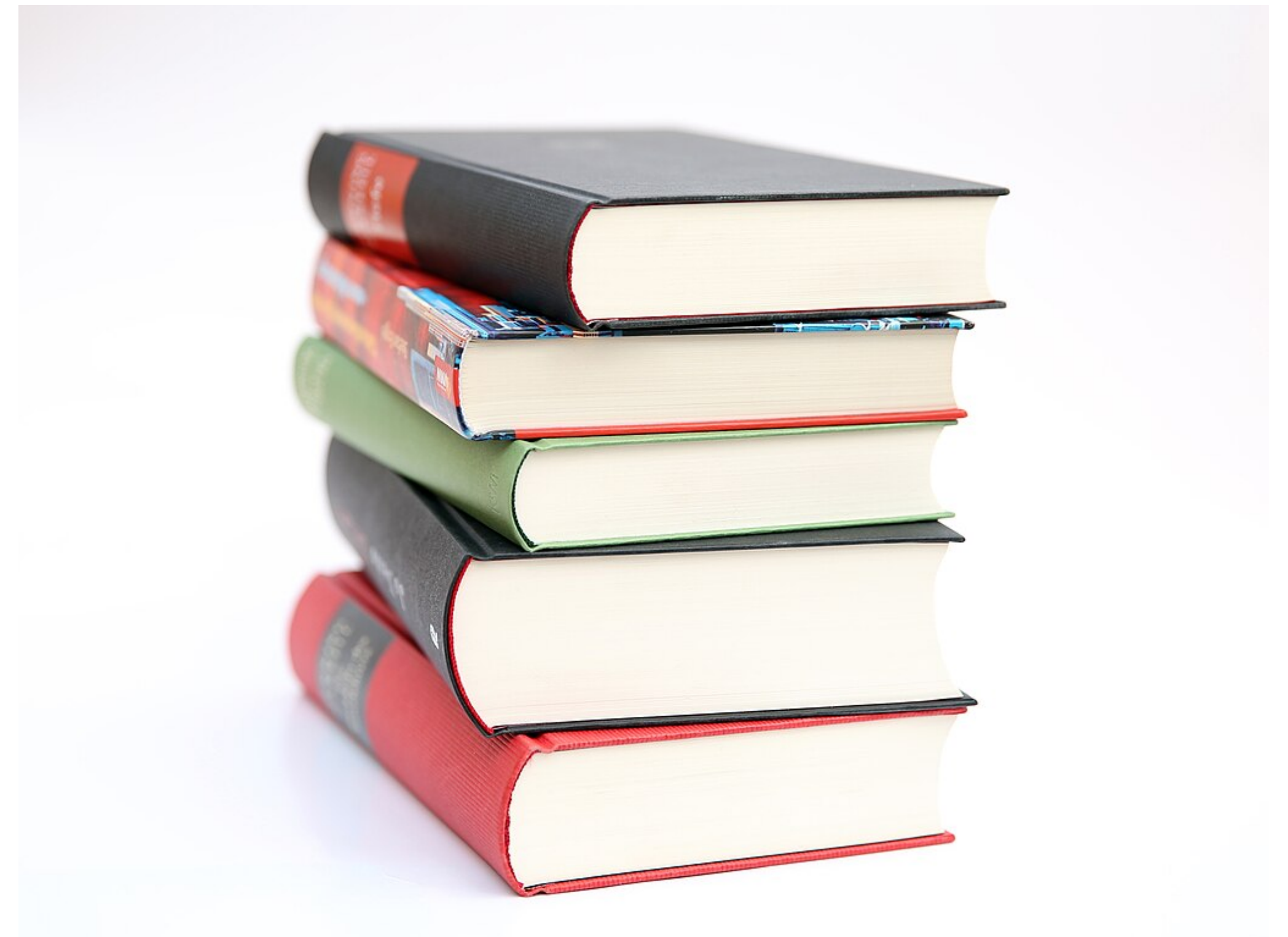
*Repairing damage from Russian attacks in Ukraine*  
Source: <https://ripe90.ripe.net/archives/video/1582/>

# My nightmare scenario

- I wake up one morning and have no internet or cellular connection...
- and all the people who can fix it also have no connection...
- and no emergency comms plan...
- and most of them have been outsourced outside of Europe anyway...
- and there isn't enough backup hardware...

# What is Europe doing to prepare?

- ENISA published lots of good recommendations to improve security and resiliency of communications infrastructure
- Unfortunately, most member states have not implemented the recommendations
- When governments do have plans to improve security and resiliency, they won't be in place for several years



# What is Europe doing to prepare?

- **Ukraine is leading the way on both implementation and knowledge sharing**
- Ukrainian IXP IX-1 has concrete advice for network operators to improve resiliency
- Finland, Estonia, Latvia, Lithuania all doing better than average
- Is there a pattern?



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Source: <https://www.thescottishsun.co.uk/news/1995321/russia-secretly-practised-full-scale-invasion-of-europe-with-bombing-raids-on-germany-during-vladimir-putins-military-drills/>

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# What is the Netherlands doing to prepare?

- The Netherlands is doing, uh, the opposite of preparing...
- If the Dutch government has a plan for restoring the internet during catastrophic loss of communications, it's a well-kept secret
- Dutch telecoms are outsourcing technical roles to countries outside Europe
- Dutch technology firms in general are moving to US-owned clouds
- And look what they did to the Dutch national emergency communications system (NCV)...

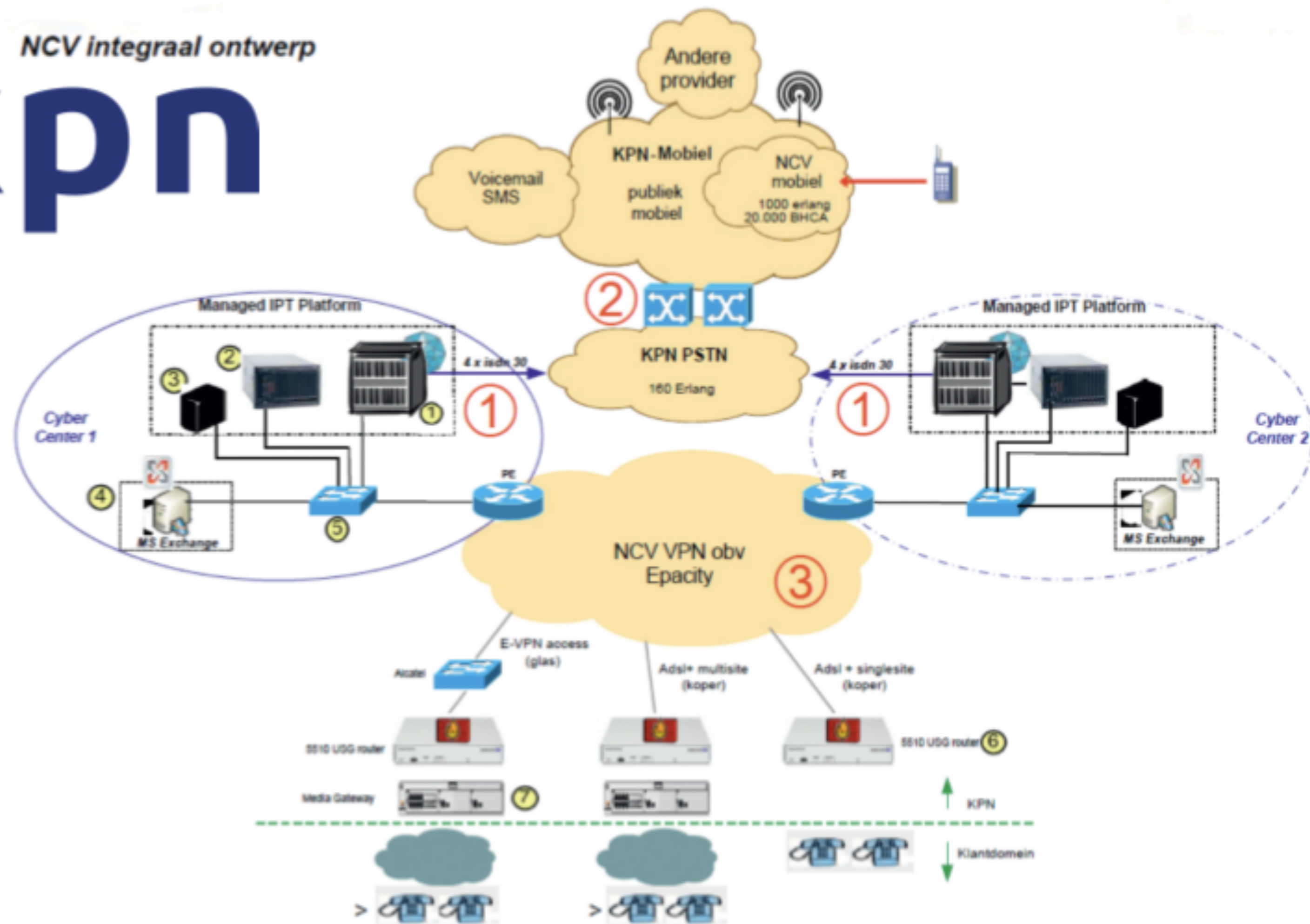
# Before: redundant, hardened, wired



# After: cloud cloud cloud cloud cloud cloud c



NCV Integraal ontwerp  
**kpn**



NCV Integraal Ontwerp.



# We can't prevent crises but we can use them

- **Crisis engineering** is the study of structural transformation of organizations during crises that threaten their core functions
- Organizations usually avoid risky or expensive changes when things are working, like changes necessary to prepare for crises
- But when a crisis happens, a few people prepared with tools and plans can carry out major change very quickly
- <https://crisisengineering.layeraleph.com/crisis-engineering-the-book/>



# My big idea: Internet Resiliency Club

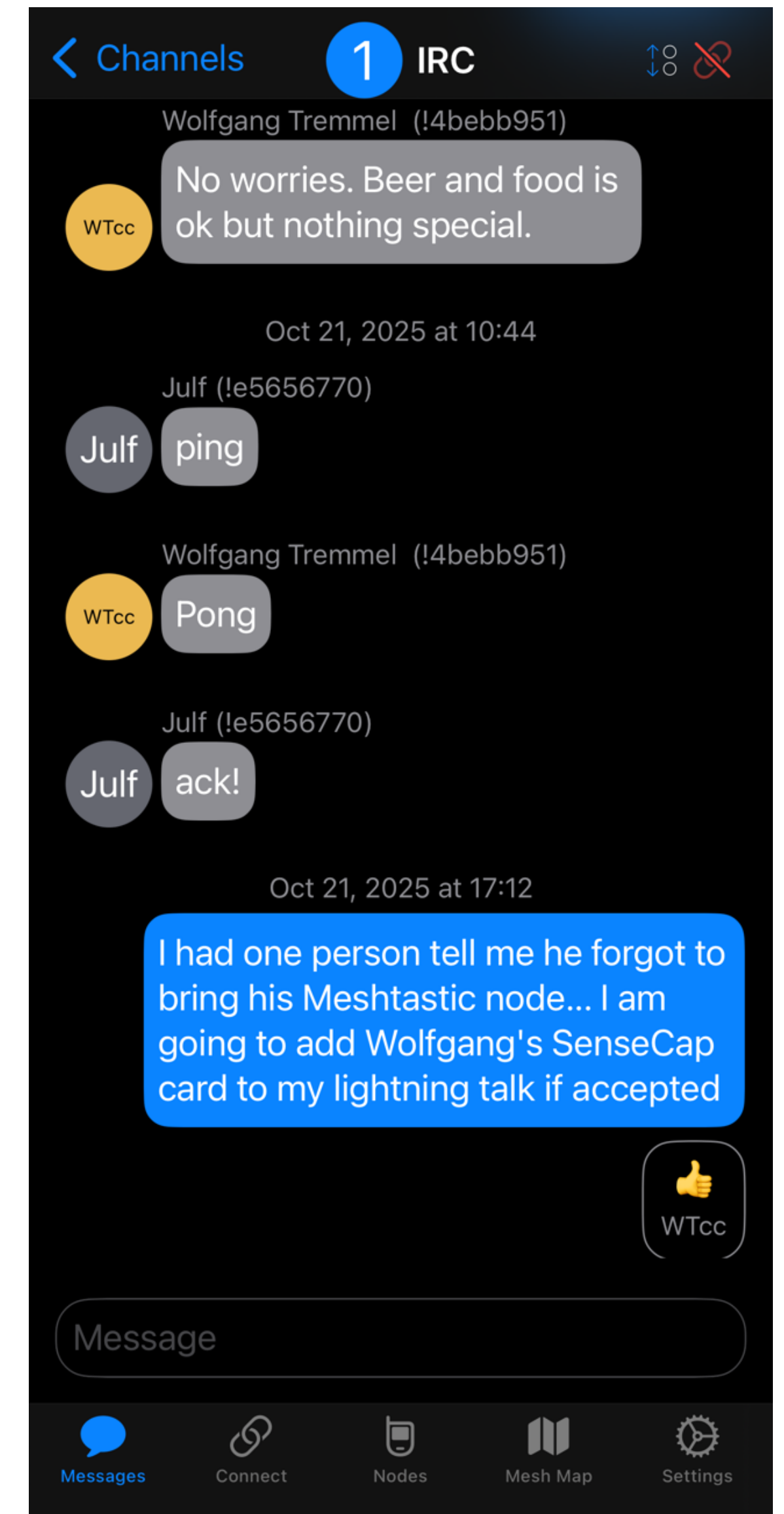
- Crisis engineering says the government won't do anything until the crisis is here
- What if I could set up an ad hoc emergency communications network between internet experts that could bootstrap recovery efforts?
- Everyone would be a volunteer, so it has to be easy, cheap, and fun
- Must be able to communicate for days with any centralized infrastructure, including power
- Ham radio needs too much power and requires too much training

# LoRa and mesh networking to the rescue!

- LoRa (Long Range) radios can send text messages over line-of-sight
- LoRa radios are cheap (€20), low power (< 1 W), don't need a license
- Meshtastic open source firmware sends text messages over LoRa (why not MeshCore? keep listening)
- Uses simple flood-forward protocol
- Uses Bluetooth or WiFi to connect to phone/computer
- Allows multiple encrypted channels to separate traffic

# Current Amsterdam IRC status

- Have regular monthly in-person meetings
- Almost 40 members, many of whom can definitely fix the internet :)
- ~40% not men (both co-founders are women)
- Have actually sent each other messages over our private Meshtastic channel
- Are collaborating with the city government (!!!) and a non-profit to roll out more mesh nodes



# Current Amsterdam IRC status

- Waag Futurelab joined forces with us
- Members applied for €65K in grants, some already successful
- City of Amsterdam had some extra € and is now running a pilot with a local community center near Waag Futurelab
- Three news articles (English, French, German) and two in progress (Dutch, more French)



*Gijsboerwinkel, CC BY-SA 4.0, edited*

# How we got there

- Founder with large network (human kind)
- Co-founded with Sasha Romijn
- Added two more leaders a few months later
- Lots of direct personal invitations
- Organized in-person meetups with Doodle
- Kept it fun and pleasant
- Didn't allow unpleasant people to join or stay



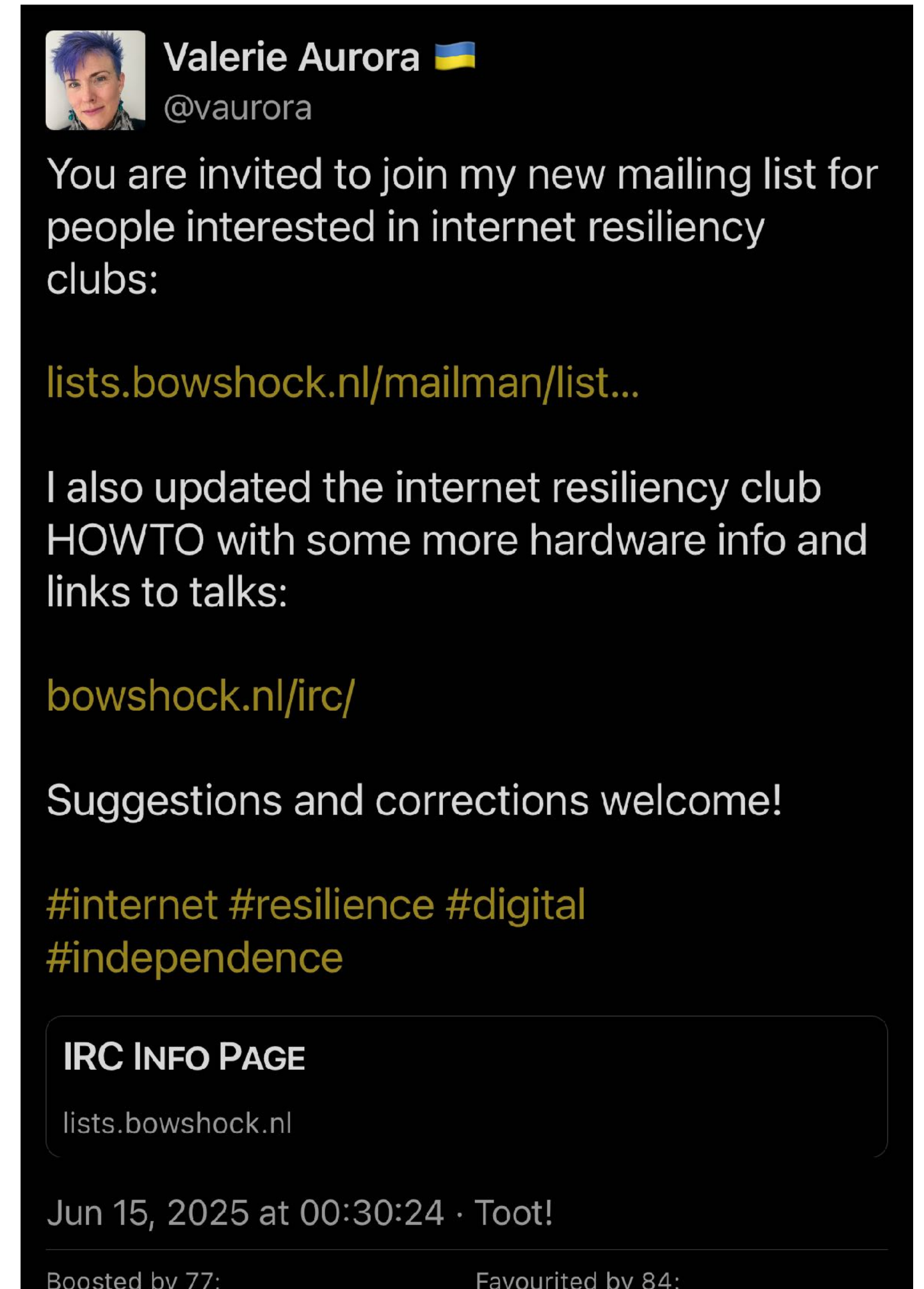
# How we got there

- Set up recurring monthly meeting
- Talks at RIPE 90, T-DOSE, RIPE 91, Koppelting
- Gave interviews to reporters for New Scientist, Numerama, German MIT Technology Review
- IRC member Ot van Daalen mentioned us in his book “Voorbereid” on how to prepare for the top possible disasters in the Netherlands
- Delegated as much as possible to members



# How we got there

- Web page with quick start info: <https://bowshock.nl/irc/>
- Mailman mailing list: <https://lists.bowshock.nl/mailman/listinfo/irc>
- “Private” Meshtastic channel for IRC
- Signal group chat for organizing and debugging
- Backup Matrix room (Matrix is too hard to use)
- [Posting on the fediverse](#)



A screenshot of a social media post on a dark background. At the top left is a small profile picture of Valerie Aurora. To its right, the name 'Valerie Aurora' is displayed with a Ukrainian flag emoji, and below it is the handle '@vaurora'. The main text of the post is white and reads: 'You are invited to join my new mailing list for people interested in internet resiliency clubs:'. Below this is a yellow link: 'lists.bowshock.nl/mailman/list...'. The next line of text says: 'I also updated the internet resiliency club HOWTO with some more hardware info and links to talks:'. This is followed by another yellow link: 'bowshock.nl/irc/'. The text continues: 'Suggestions and corrections welcome!'. Below that are four yellow hashtags: '#internet #resilience #digital #independence'. At the bottom of the post is a rounded rectangular box with a dark background and white text that says 'IRC INFO PAGE' and 'lists.bowshock.nl'. Below the box, the date and time 'Jun 15, 2025 at 00:30:24 · Toot!' are shown. At the very bottom, it says 'Boosted by 77:' and 'Favourited by 84:'.

Valerie Aurora 🇺🇦  
@vaurora

You are invited to join my new mailing list for people interested in internet resiliency clubs:

[lists.bowshock.nl/mailman/listinfo/irc](https://lists.bowshock.nl/mailman/listinfo/irc)

I also updated the internet resiliency club HOWTO with some more hardware info and links to talks:

[bowshock.nl/irc/](https://bowshock.nl/irc/)

Suggestions and corrections welcome!

[#internet](#) [#resilience](#) [#digital](#) [#independence](#)

IRC INFO PAGE  
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# Fronting a little cash money

- Deciding which LoRa node to order and actually clicking “Buy” is the hardest part
- I recommended a small number of nodes
- I bought a lot of LoRa nodes for people, intending to donate them, and almost everyone paid me anyway
- I pay the bill at in-person meetups and usually make a slight profit
- I pay €5/month for the mailing list



# “Why Meshtastic when MeshCore is better?”

- IT DEPENDS ON YOUR USE CASE
- MeshCore: more reliable but less resilient
- Meshtastic: less reliable but more resilient
- Want to send small text messages reliably over long distances while the power is on and everything is normal? Use MeshCore
- Want a resilient network for disaster recovery purposes? Use Meshtastic
- Or have both! No one is stopping you!

# “Why Meshtastic when MeshCore is better?”

- Meshtastic's core architecture is usually a true mesh network: every node participates in forwarding messages unless configured to be silent
- MeshCore is a partially centralized network with designated “repeaters” that forward/route messages
- Parts of MeshCore are closed source
- Meshtastic is 100% open source
- MeshCore is ported to slightly less hardware than Meshtastic
- MeshCore is not as easy to use and less welcoming as a community

# “Why Meshtastic when MeshCore is better?”

- MeshCore in the Netherlands is dealing with congestion problems already
- A small management group is now directing architecture decisions and trying to coordinate mass network migrations
- Repeater announcements are not scalable (nothing is scalable but it's scaling up anyway)
- Loss of repeaters (e.g. a blackout) causes remaining parts of the network to experience a flood
- Centralization of routing through remaining repeaters will burn up their battery and air time more quickly in MeshCore than in Meshtastic

# More cash money needed

- Meshtastic in Amsterdam is unreliable, but we weren't sure why, until...
- Members at WHY hacker camp reported Meshtastic worked great there!
- Conclusion: we need a higher density of Meshtastic nodes in Amsterdam
- What we really need is full-time monitoring of the network



# More cash money needed

- Amsterdam city government and Waag Futurelab are working together using cash money to buy more nodes and train citizens to use them
- Grants also in progress to improve the Meshtastic ecosystem
- The solution to all our Meshtastic problems is: money



Public domain [openclipart.org/302455](http://openclipart.org/302455)

# Hardware recommendations

- Heltec V4 is only ~€20
- Seeed Solar P-1 Pro: ready-to-go solar-powered enclosure ~€90
- “Tracker” nodes: thick credit card ~€40  
SenseCAP Card Tracker 1000-E
- The T-Deck keyboard breaks easily :(
- Hardware gets better every month!



*(c) Wolfgang Tremmel, used with permission*

# Things I wish I had done

- Spoken at NLNOG Day 2025
- Understood how much European governments like giving grants sooner
- Asked for help organizing sooner
- Set up fallback Matrix room sooner
- Picked a repeating monthly meetup date sooner



# Lessons learned

- Running an Internet Resiliency Club requires:
  - 1-2 hours per week
  - ~ €200 of cash that you will get most of back
  - A large personal network
  - Frequent use of <https://doodle.com/>
- In person meetups are chaotic, either a few people or too many people
- Meshtastic is the worst software for mesh networks except for all the others

# You can start an Internet Resiliency Club too

It's worth it just to make friends with cool people living near you!

If you have a LoRa node, please raise your hand

Ask your employer to give LoRa radios and mobile phone power banks to interested staff members

Detailed instructions and non-Amazon European links to purchase hardware:

<https://bowshock.nl/irc/>