



**Hanzehogeschool  
Groningen**

University of Applied Sciences

# 5G en slim vest

**Jos Bredek**

**share your talent.  
move the world.**

**SURF Security- en Privacyconferentie**



<https://www.rtvnoord.nl/video/885463/hanze-student-ontwerpt-veiligheidsvest>

5G en slim vest

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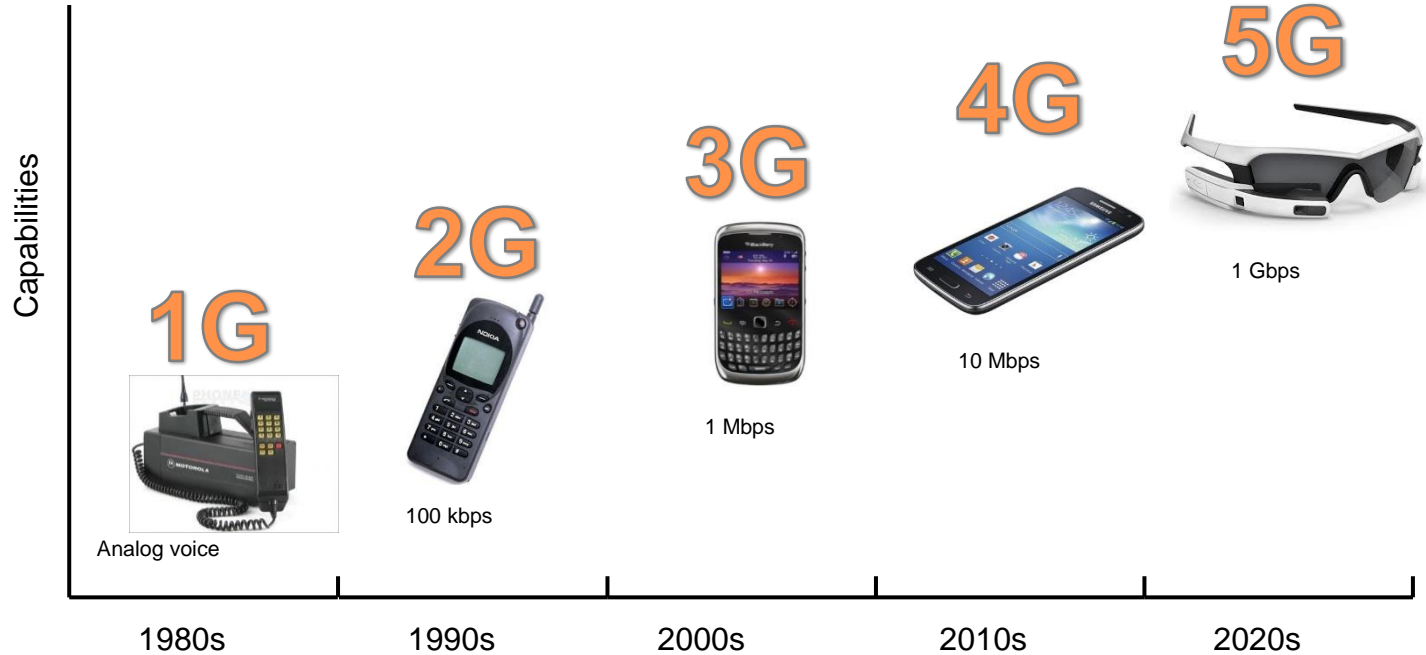
# Even voorstellen

- Jos Bredek
- Hanzehogeschool, HBO-ICT
- Docent-onderzoeker
- 5G
- Docent van het jaar 2022 - Hanze



**share** your talent. **move** the world.

source:



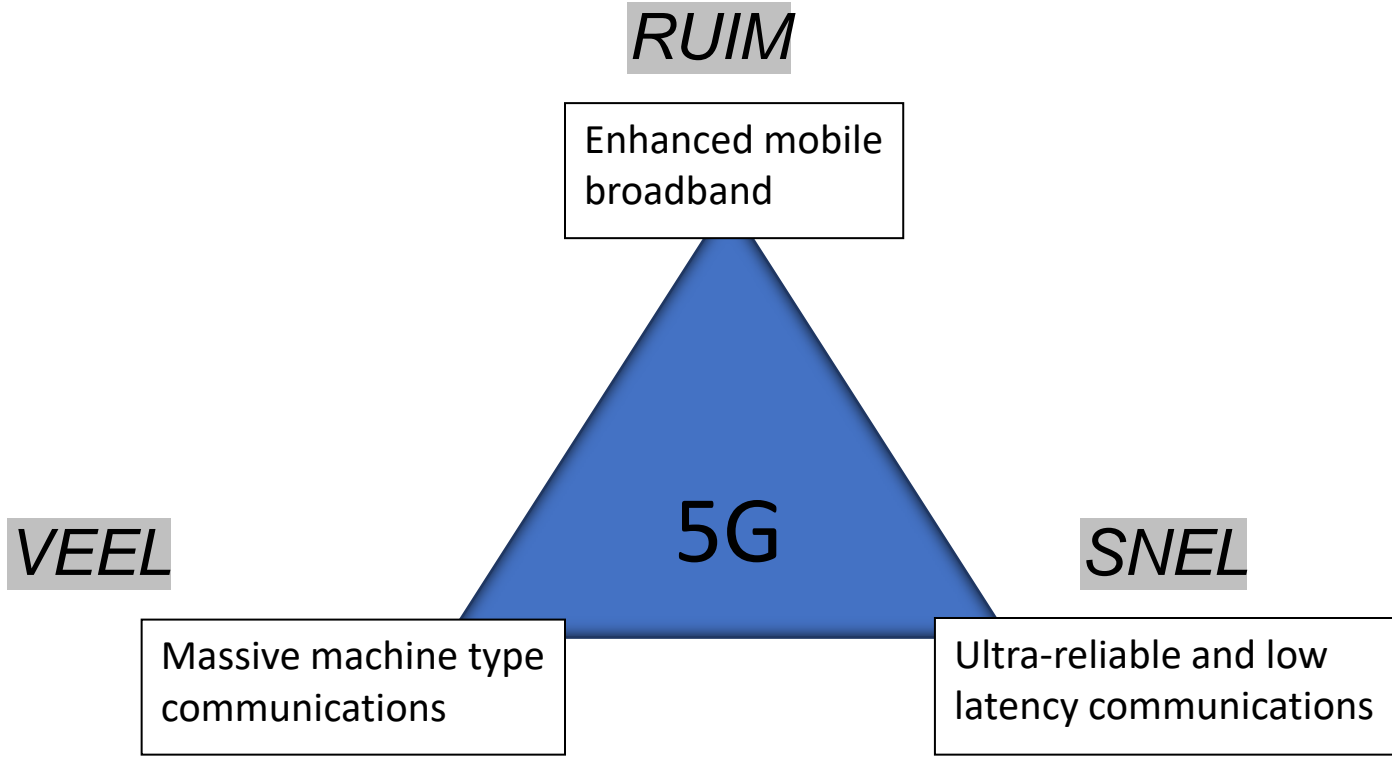
5G en slim vest

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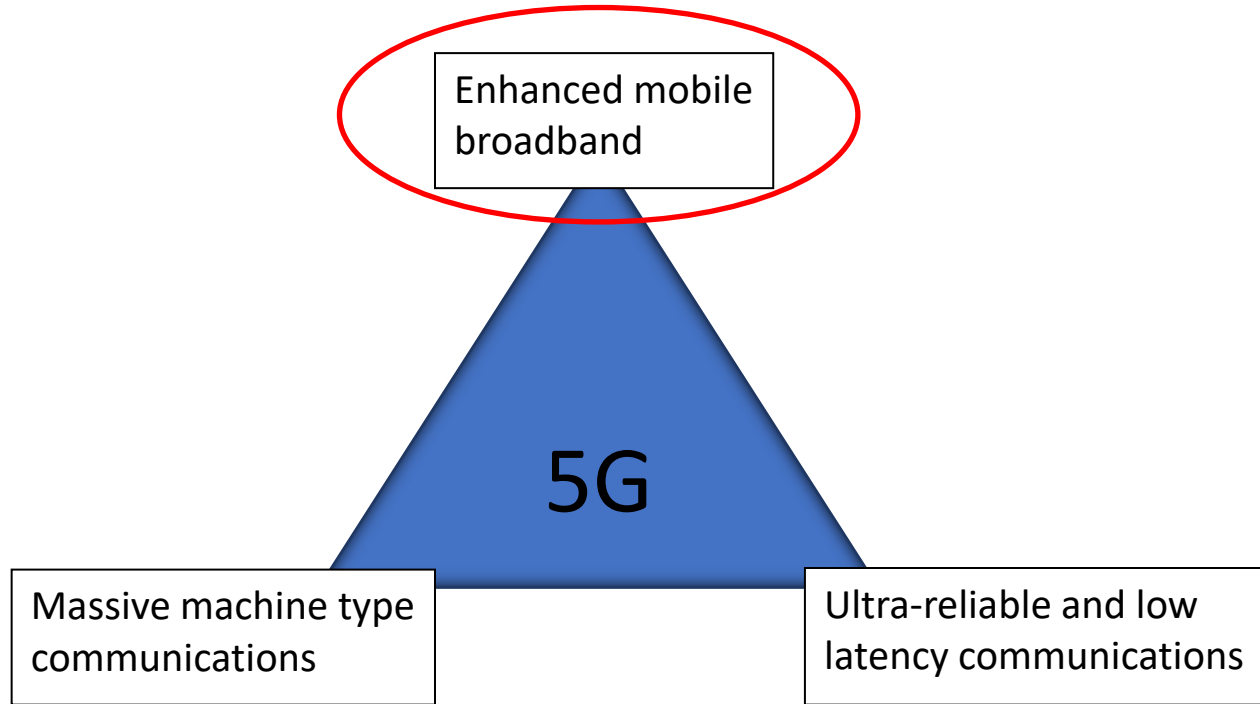
## Founding Fathers 5Groningen





# Snelheid ??

Capaciteit - vertraging

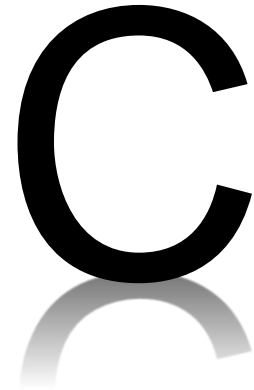
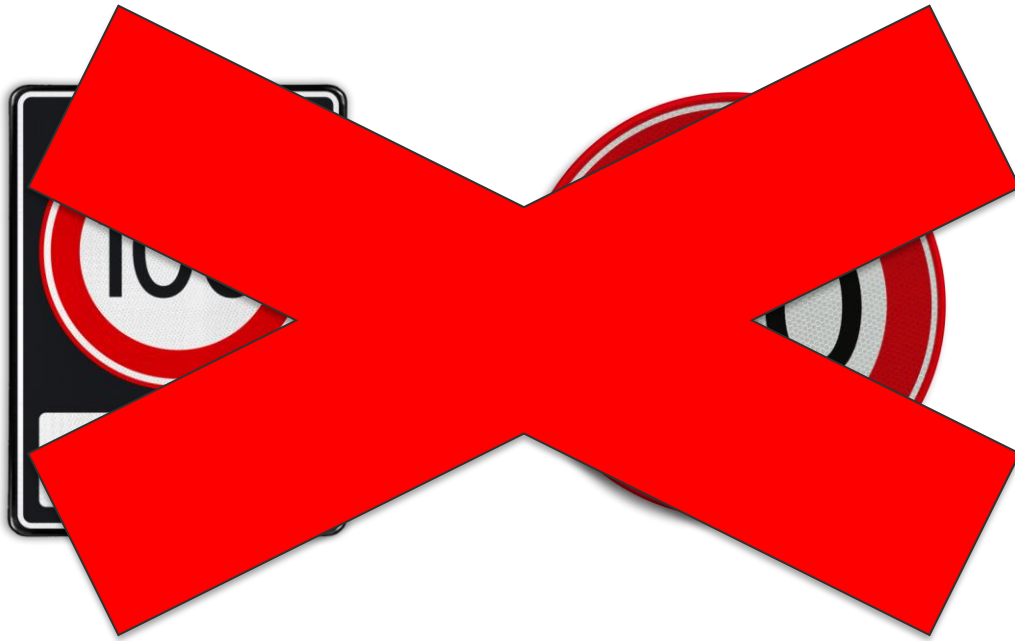




# Enhanced mobile broadband - capaciteit



# Vergroten capaciteit (1)



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# Vergroten capaciteit (2)



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# Vergroten capaciteit (3)



## Snel 5G via 3,5 GHz-band weer uitgesteld

1 september 2021 10:03 Min leestijd



De veiling voor de 3,5GHz-frequentieband, die belangrijk is voor een sneller 5G-netwerk, zal niet in april 2022 plaatsvinden, zoals eerder was gepland. De komst van een echt snel 5G-netwerk wordt daarom uitgesteld tot een later moment, schrijft demissionair staatssecretaris Maria Keijzer (Economische Zaken) in een brief aan de Tweede Kamer.

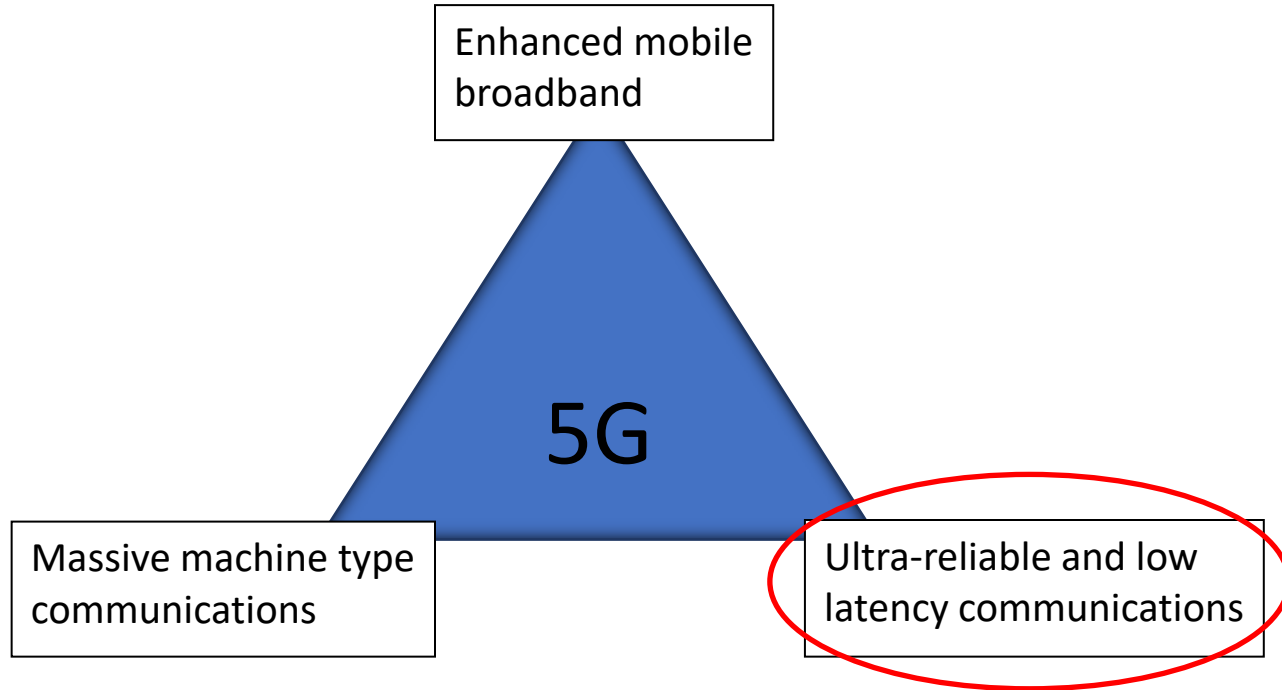
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```
pi@raspberrypi:~/Politievest/rpi $ iperf3 -c 10.230.20.61 -u -b 0 -p 554
Connecting to host 10.230.20.61, port 554
[ 5] local 192.168.1.4 port 36371 connected to 10.230.20.61 port 554
[ ID] Interval           Transfer     Bitrate      Total Datagrams
[ 5]  0.00-1.00   sec    74.3 MBytes    623 Mbits/sec    53770
[ 5]  1.00-2.00   sec    77.4 MBytes    649 Mbits/sec    56050
[ 5]  2.00-3.00   sec    77.3 MBytes    649 Mbits/sec    56000
[ 5]  3.00-4.00   sec    77.1 MBytes    647 Mbits/sec    55820
[ 5]  4.00-5.00   sec    77.0 MBytes    646 Mbits/sec    5740
[ 5]  5.00-6.00   sec    77.3 MBytes    649 Mbits/sec    5990
[ 5]  6.00-7.00   sec    77.6 MBytes    651 Mbits/sec    6160
[ 5]  7.00-8.00   sec    77.4 MBytes    649 Mbits/sec    56060
[ 5]  8.00-9.00   sec    77.6 MBytes    651 Mbits/sec    56200
[ 5]  9.00-10.00  sec    77.6 MBytes    651 Mbits/sec    56170
- - - - -
[ ID] Interval           Transfer     Bitrate      Jitter    Lost/Total Datagrams
[ 5]  0.00-10.00  sec    770 MBytes    646 Mbits/sec    0.000 ms    0/557960 (0%) sender

iperf Done.
pi@raspberrypi:~/Politievest/rpi $
```

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## Latency ?

**Hoe lang duurt** het (gemiddeld) om van iets een **antwoord** te krijgen

vertraging

# Latency

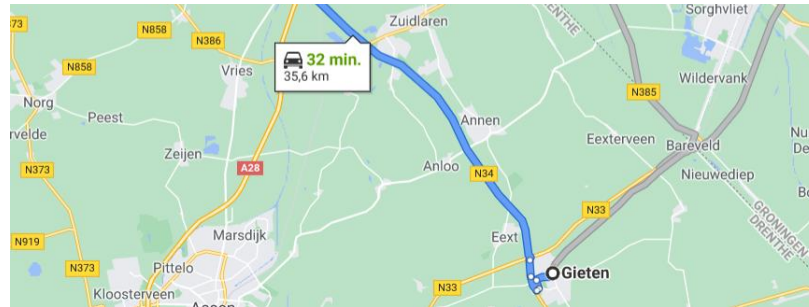


via N34 en A28

**32 min.**

Snelste route, normale verkeersdruk

35,6 km

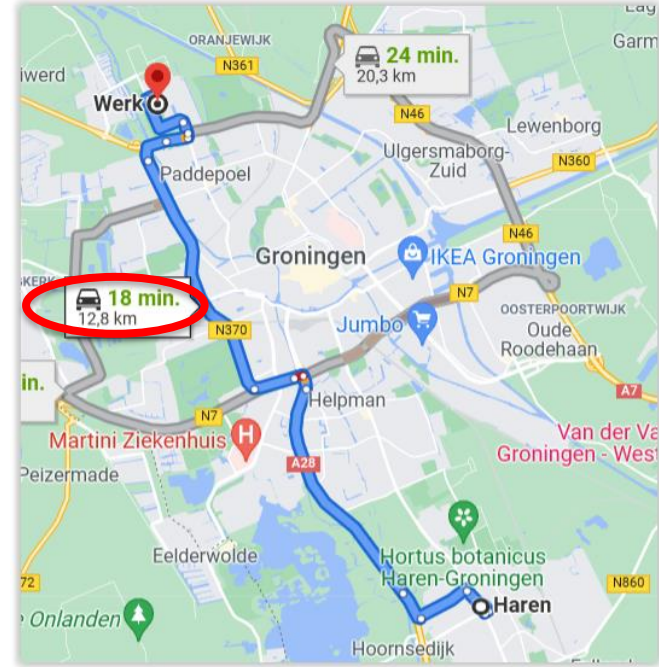




# (Verkleinen) latency - 1



# Verkleinen latency - 2



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# Verkleinen latency - 3



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# Latency – aantal knooppunten

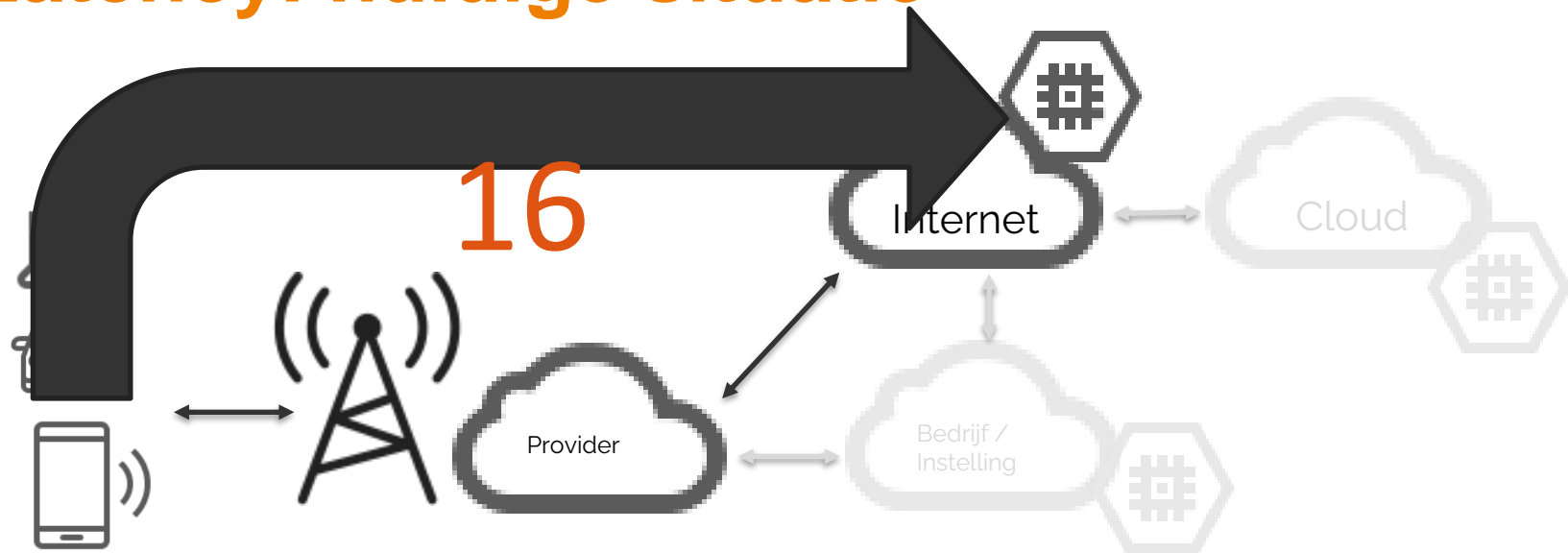
```
C:\Users\jos>tracert -d google.nl

Tracing route to google.nl [216.58.212.227]
over a maximum of 30 hops:

  0  3 ms   2 ms   2 ms  192.168.5.175
  1  7 ms   5 ms   5 ms  192.168.1.1
  2 11 ms   7 ms   5 ms  192.168.178.1
  3  *      *      *     Request timed out.
  4 19 ms  26 ms  20 ms  213.51.195.177
  5 21 ms  18 ms  54 ms  213.51.158.20
  6 19 ms  15 ms  23 ms  213.51.64.58
  7 119 ms 17 ms  20 ms  213.46.182.22
  8 21 ms  16 ms  19 ms  108.170.241.225
  9 22 ms  21 ms  19 ms  108.170.241.236
 10 20 ms  16 ms  17 ms  216.239.43.27
 11  *     29 ms  *     108.170.234.119
 12 25 ms  56 ms  29 ms  64.233.175.112
 13 37 ms  23 ms  23 ms  108.170.246.161
 14 28 ms  25 ms  24 ms  216.239.63.219
 15 48 ms  26 ms  23 ms  216.58.212.227
```

Hop	Count	IP	Name	Avg
1	53	192.168.5.175	192.168.5.175	4,2
2	53	192.168.1.1	unknown	8,6
3	53	192.168.178.1	192.168.178.1	10,7
		-		
5	53	213.51.195.177	asn-rc0002-cr101	16,9
6	52	213.51.158.20	asd-rc0001-cr101	21,3
7	52	213.51.64.58	nl-ams14a-ri1-ae	23,1
8	52	213.46.182.22	10ge-1-4.cr1.ams	20,3
9	52	108.170.241.161	108.170.241.161	20,0
10	29	108.170.241.172	108.170.241.172	18,6
11	27	209.85.255.197	209.85.255.197	19,0
12	18	108.170.237.243	108.170.237.243	24,9
13	26	216.239.57.206	216.239.57.206	26,0
14	52	74.125.242.65	74.125.242.65	26,2
15	52	142.250.215.125	142.250.215.125	27,9
16	52	142.250.178.3	google.nl	31,0
	52		Round Trip (ms)	31,0

# Latency: huidige situatie



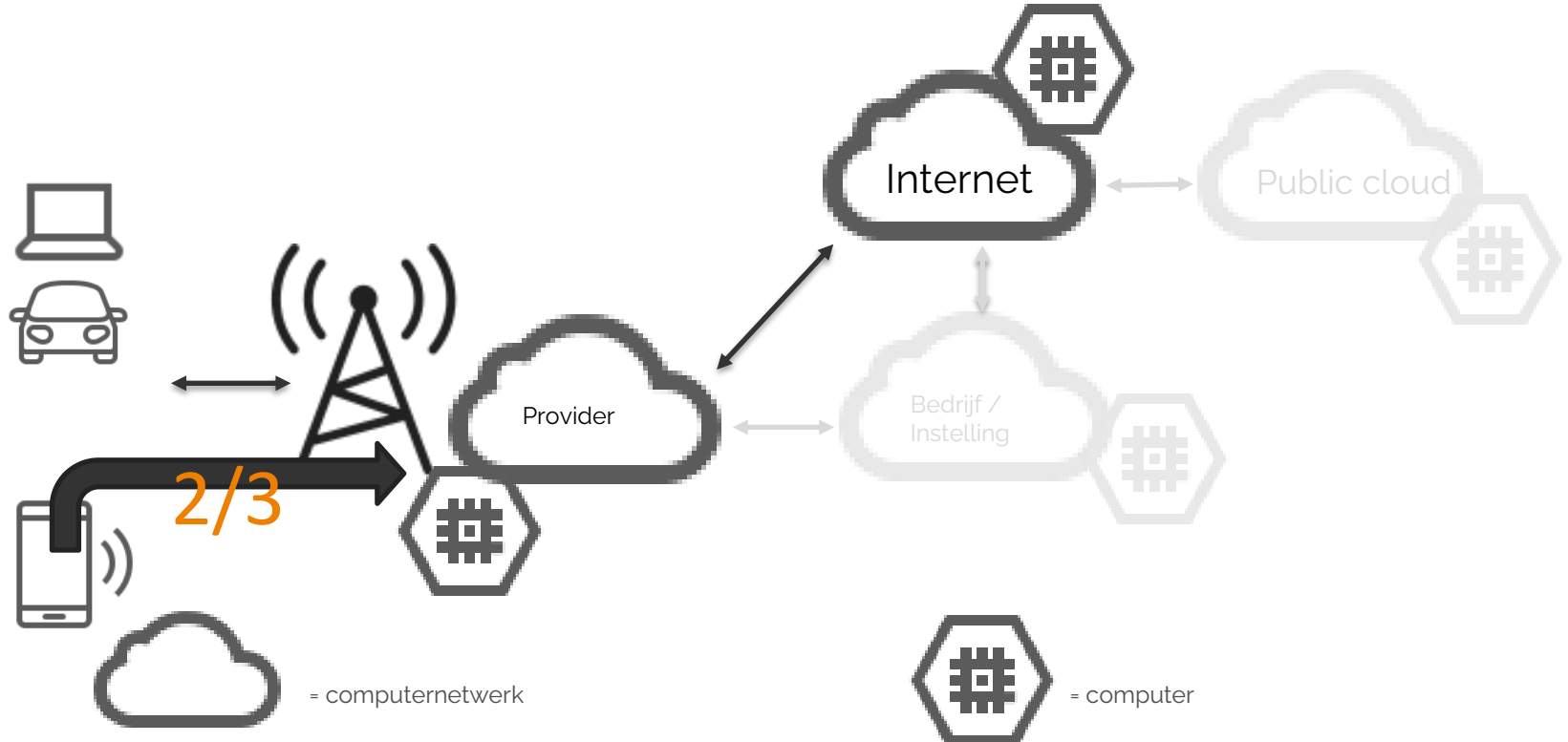
= computernetwerk



= computer

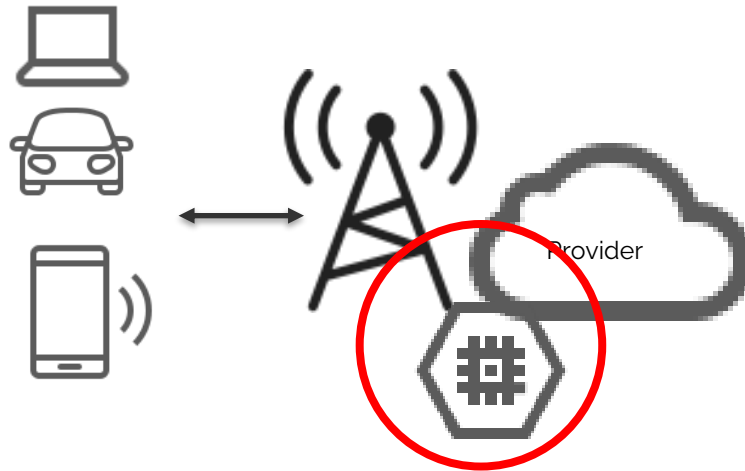
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# Low latency... hoe dan?



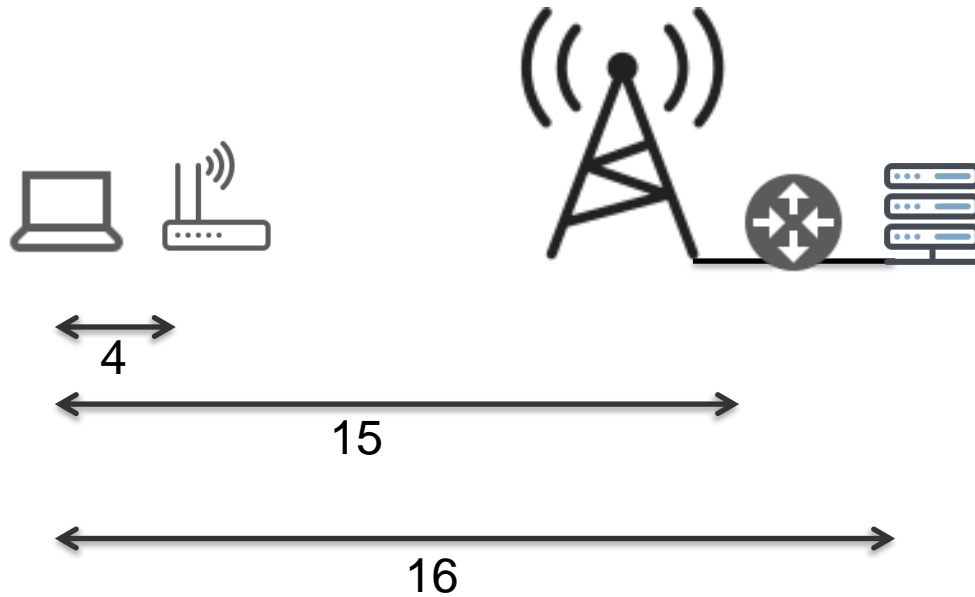
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# Edge computing



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Hop	Count	IP	Name	Avg
1	244	192.168.1.1	mywebui.net	3,9
2	244	10.45.0.1	10.45.0.1	14,6
3	244	10.230.20.61	10.230.20.61	15,8
	244		<b>Round Trip (ms)</b>	15,8



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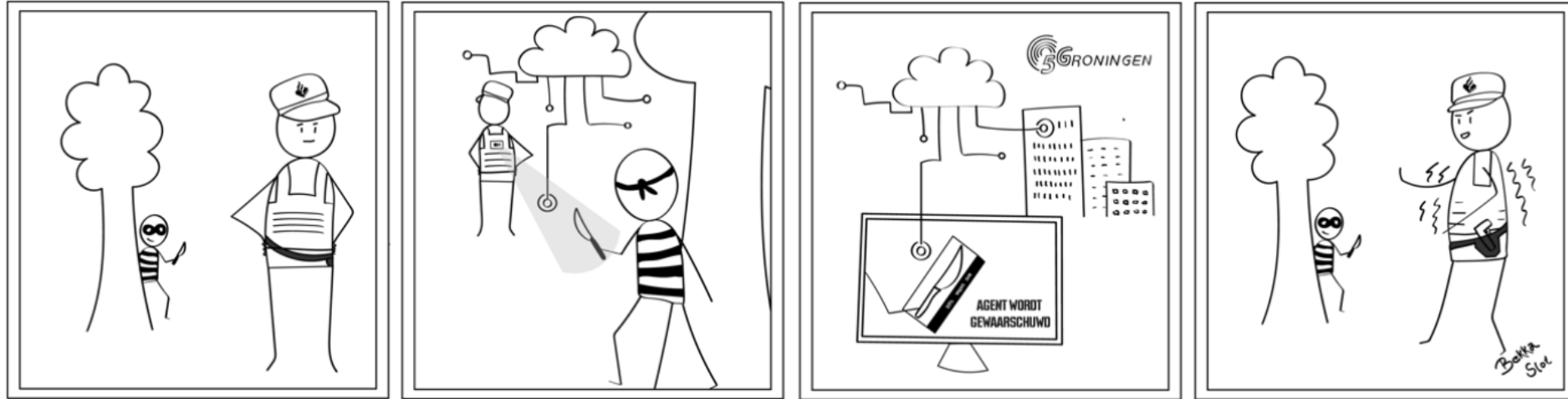




←—————→  
8 á 9

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# Slim vest



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# Slim veiligheidsvest voor politie winnende idee 5G Student Battle

Door Omroep het Hogeland 16 november 2020 16:44



# Slim vest

Beperkingen, door weinig ruimte

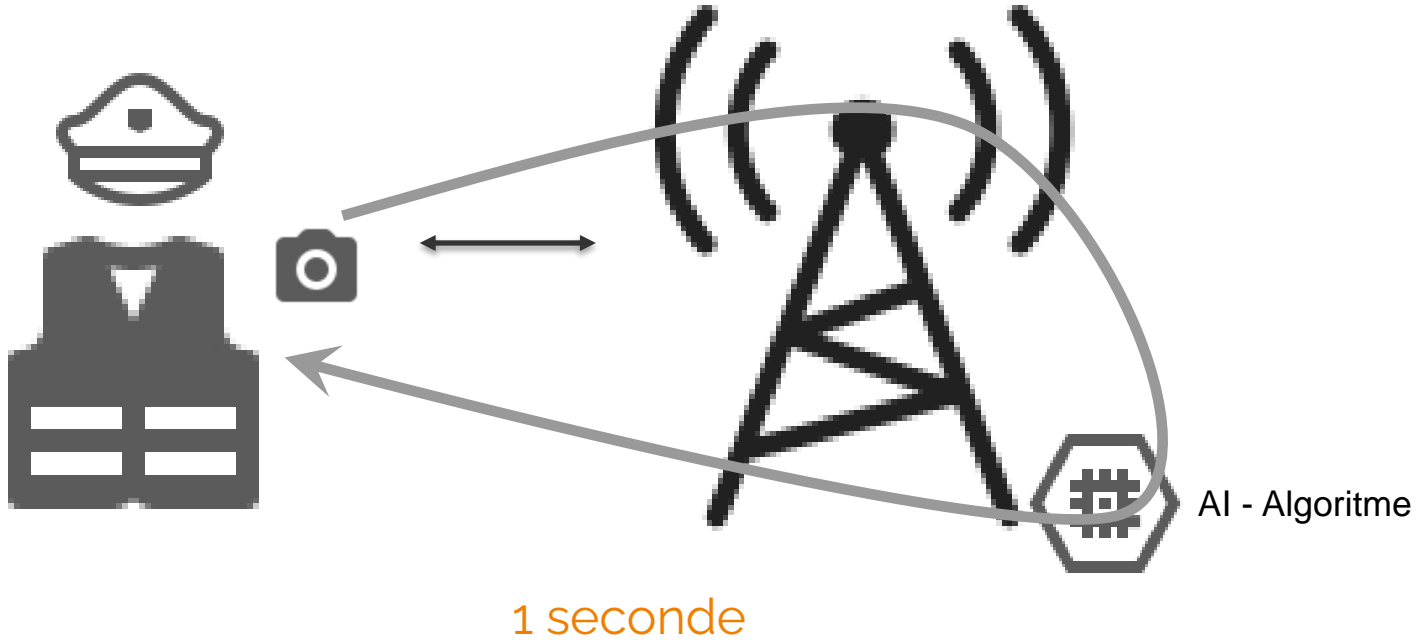
- Beperkte accu
- Weinig rekenkracht

Eisen:

- Herkenning van wapens
- Snelle beslissing + “alarm”



# Slim vest - keten



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# Slim vest



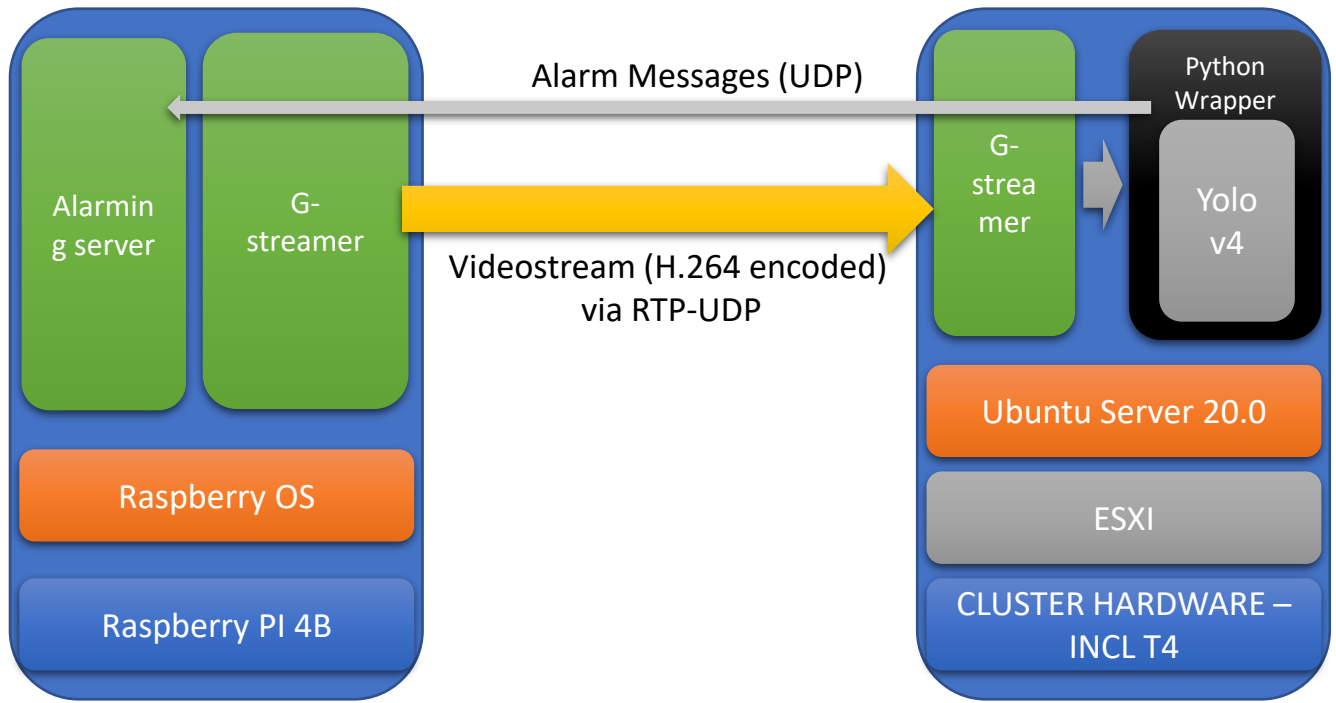
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for life

vmware®

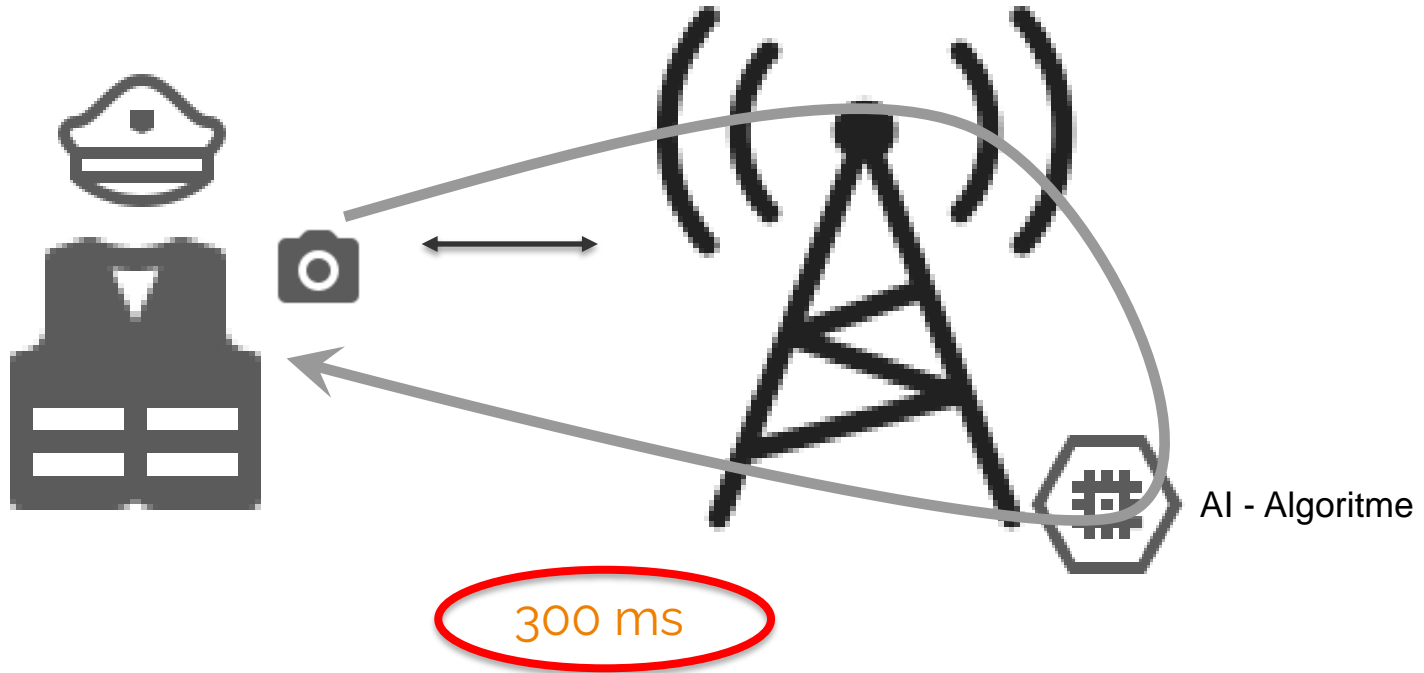


samenwerking  
**noord** 10 jaar  
we unite

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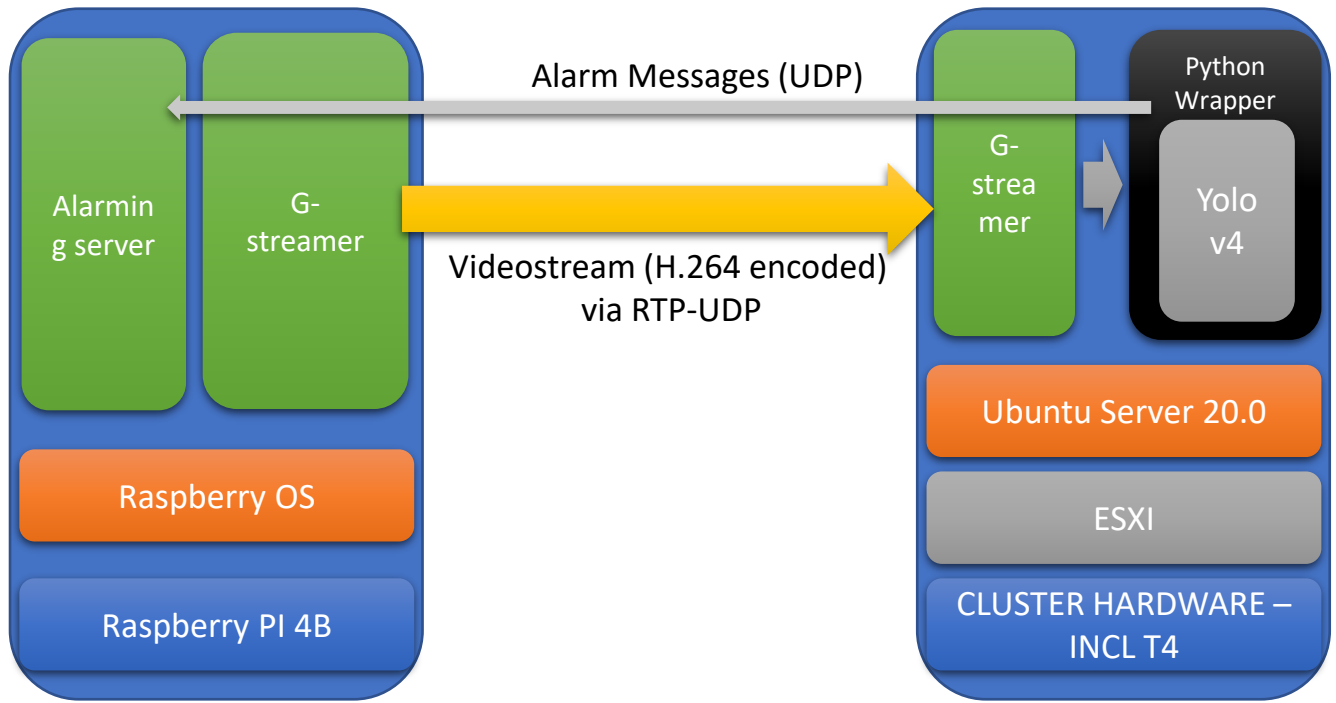


# En?



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# Slim X



1000



750



200

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**5G en Slim vest– SURF Security- en Privacyconferentie**

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