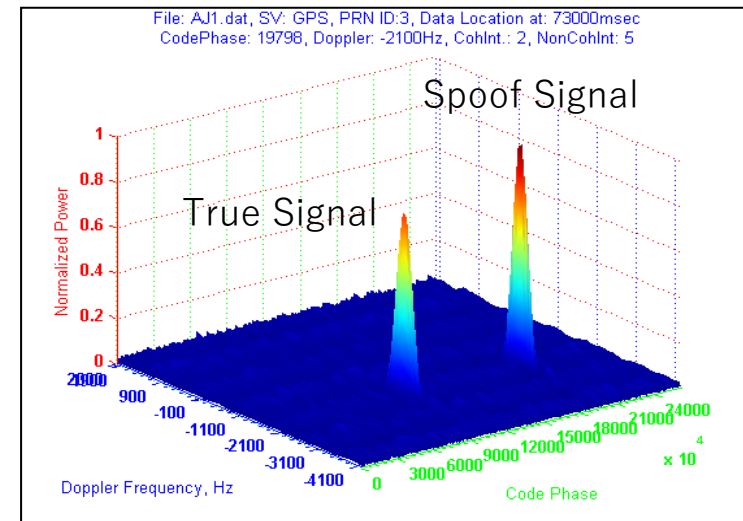
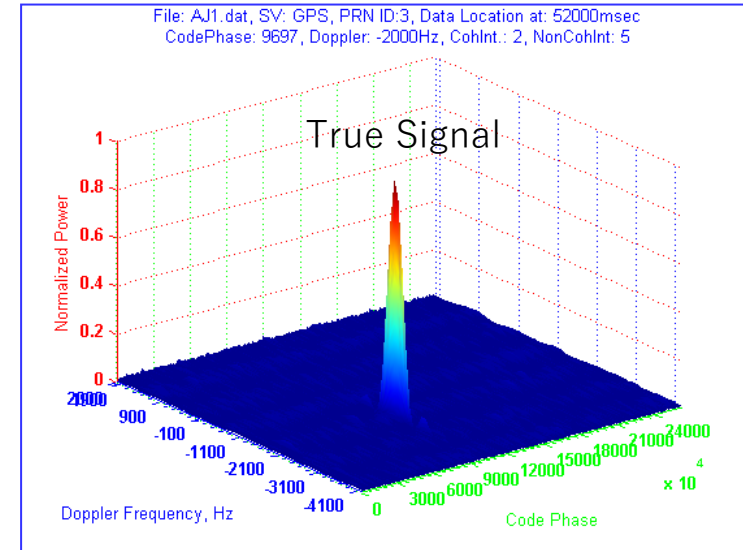


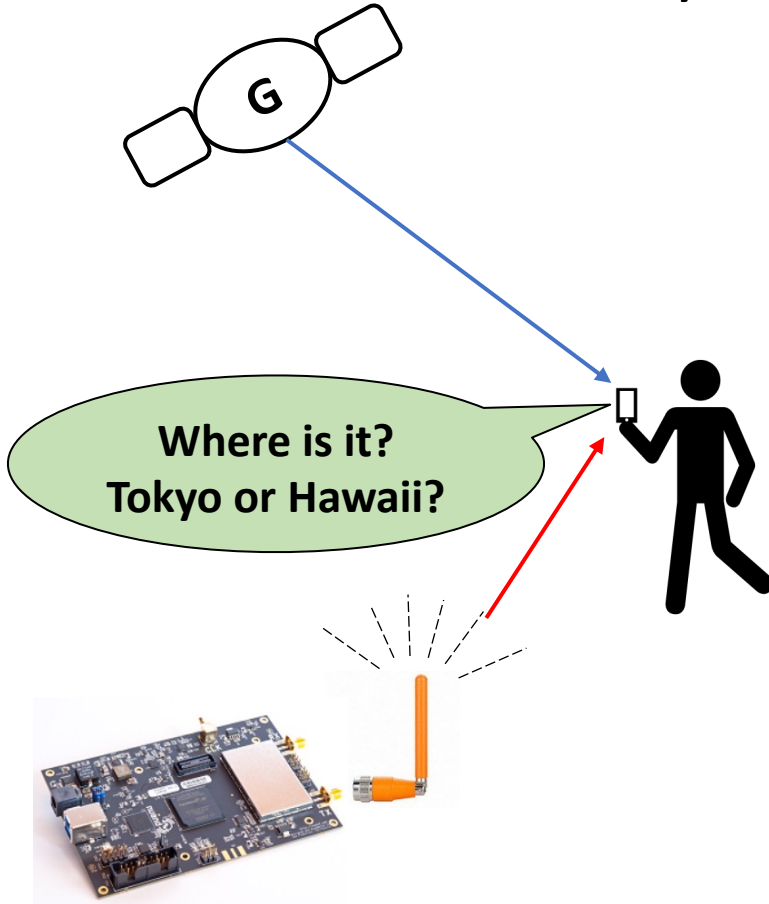
Resilient PNT From the Perspective of Spoofing Attacks

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5th May 2023

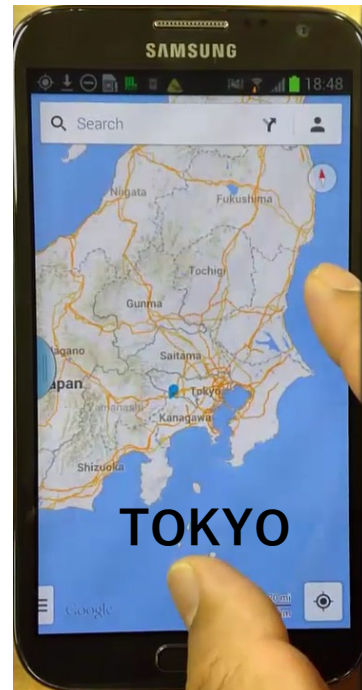


What is Location Spoofing?

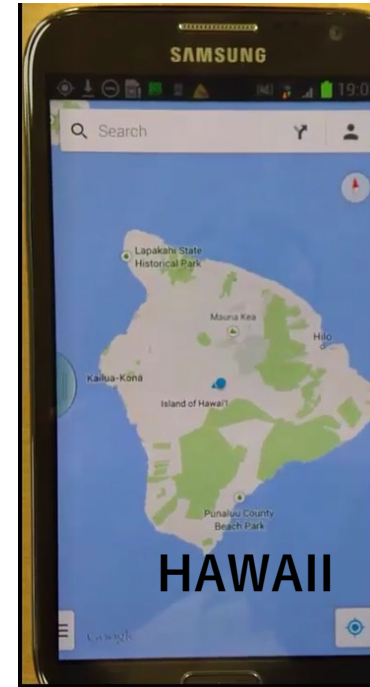
- Falsify Location Data as If it were True Location



Spoofer



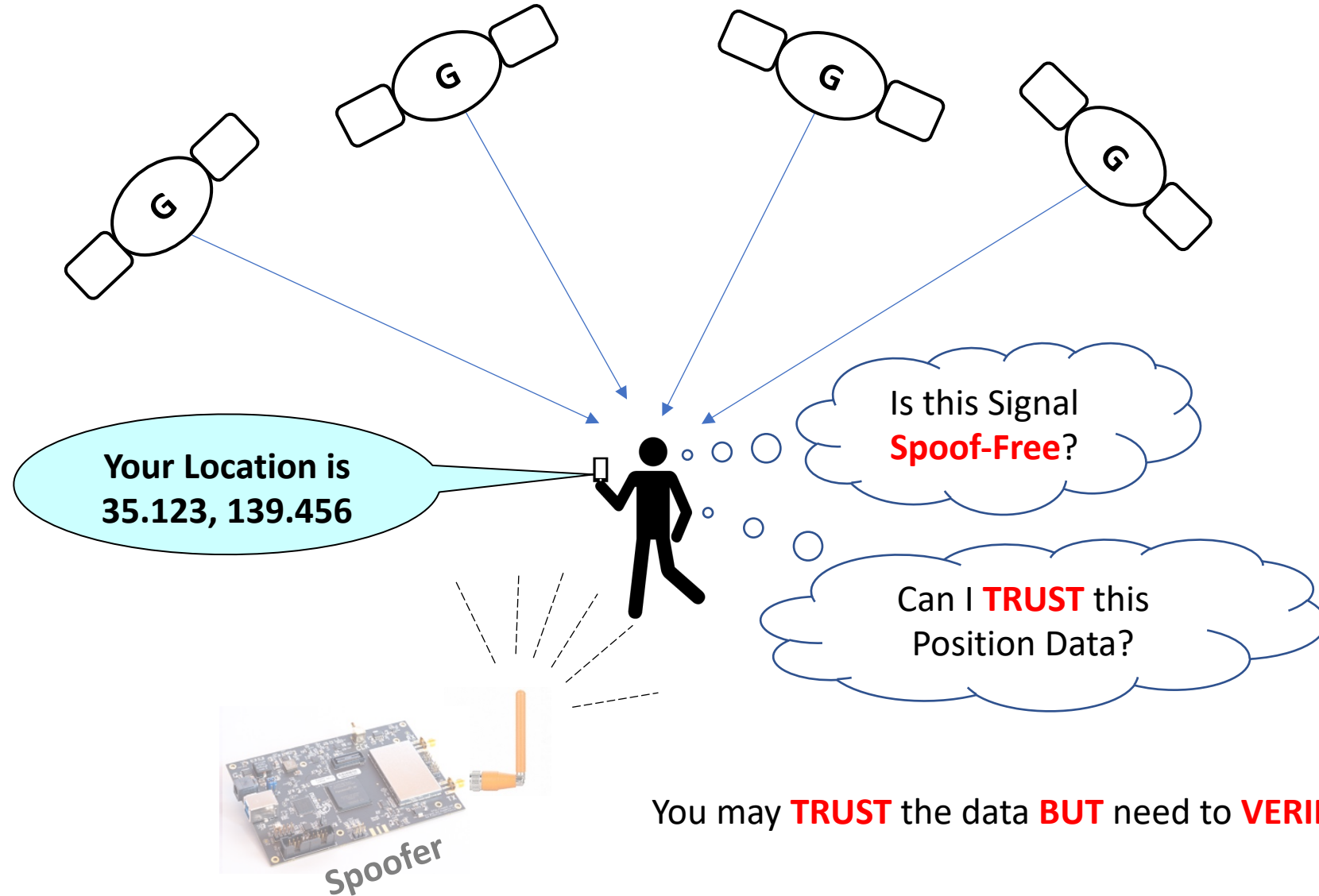
TOKYO
Or
Hawaii?



007
Tomorrow Never Dies

This movie is all
about GPS Spoofing

Current Situation with Position Data from GNSS



Resilient PNT for Security and Safety Applications

GNSS Time






Power Grid

Command & Control


GNSS Time







Finance, Stock Exchange, Internet Banking, Crypto Currency, AML/KYC

GNSS Time






5G/6G Communication Network

GNSS Position and Time

Check in

Ride Share Service

Grab UBER

GNSS Position and Time



GNSS Road Pricing



Autonomous Driving



Drone



Railway



Aviation



Marine

Quiz: Can you identify TRUE and SPOOF Data?

Ship going around the Port Area

Visible Satellites

Speed

GNSS Raw Data

SV	Sign...	G...	Pseudo Range [m]	Carrier Phase [c...	Dopple...	Lock T...	SNR	PR Std...	CF
G01	L1C/A	-	24486574.53	128677829.99	2234.0	43320	42	0.32	
E07	E1C	-	27948044.75	146342489.20	843.9	2260	29	2.56	
G08	L1C/A	-	21898681.95	115078351.51	-1427.2	64500	45	0.32	
S128	L1C/A	-	38332790.11	201440172.96	-449.1	64500	42	0.32	
G03	L1C/A	-	24491897.27	128705785.09	-316.7	64500	44	0.32	
G11	L1C/A	-	23625226.29	124151401.73	2085.9	64500	45	0.32	
S129	L1C/A	-	38244089.82	200974050.07	-441.4	28780	37	0.64	
G18	L1C/A	-	23214483.86	121992949.50	1710.5	26840	40	0.32	
E08	E1C	-	23433236.81	123142492.62	-1063.5	64500	43	0.32	

Ship going along the Ferry Route

Visible Satellites

Speed

GNSS Raw Data

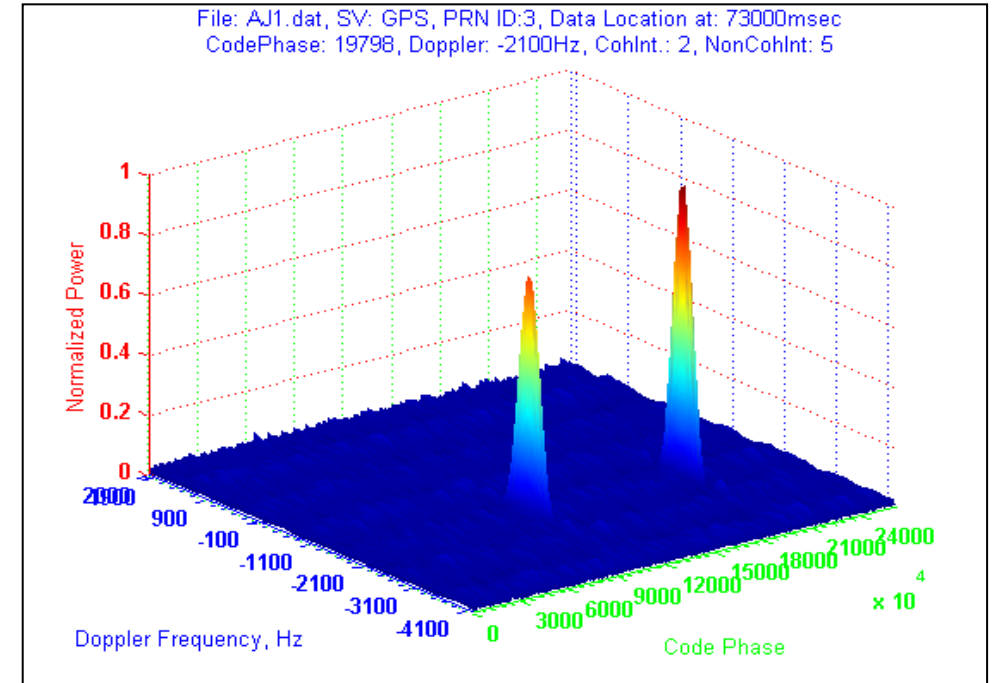
SV	Sign...	G...	Pseudo Range [m]	Carrier Phase [c...	Dopple...	Lock T...
G26	L1C/A	-	26647846.89	140035379.71	-1617.6	0
G27	L1C/A	-	21709041.25	114081632.98	-1348.5	64500
G08	L1C/A	-	21982377.36	115518046.75	1081.9	64500
G23	L1C/A	-	25233076.46	132600709.46	3649.6	3920
G16	L1C/A	-	25190739.70	132378229.64	-2205.3	0
G10	L1C/A	-	27054605.77	142172904.04	-1972.4	4140
G32	L1C/A	-	24689305.75	129743169.92	-3072.9	3920
G01	L1C/A	-	26023356.53	136753661.12	2237.1	0
G18	L1C/A	-	24589106.78	129216628.11	2135.3	0

Spoofing a GPS Watch

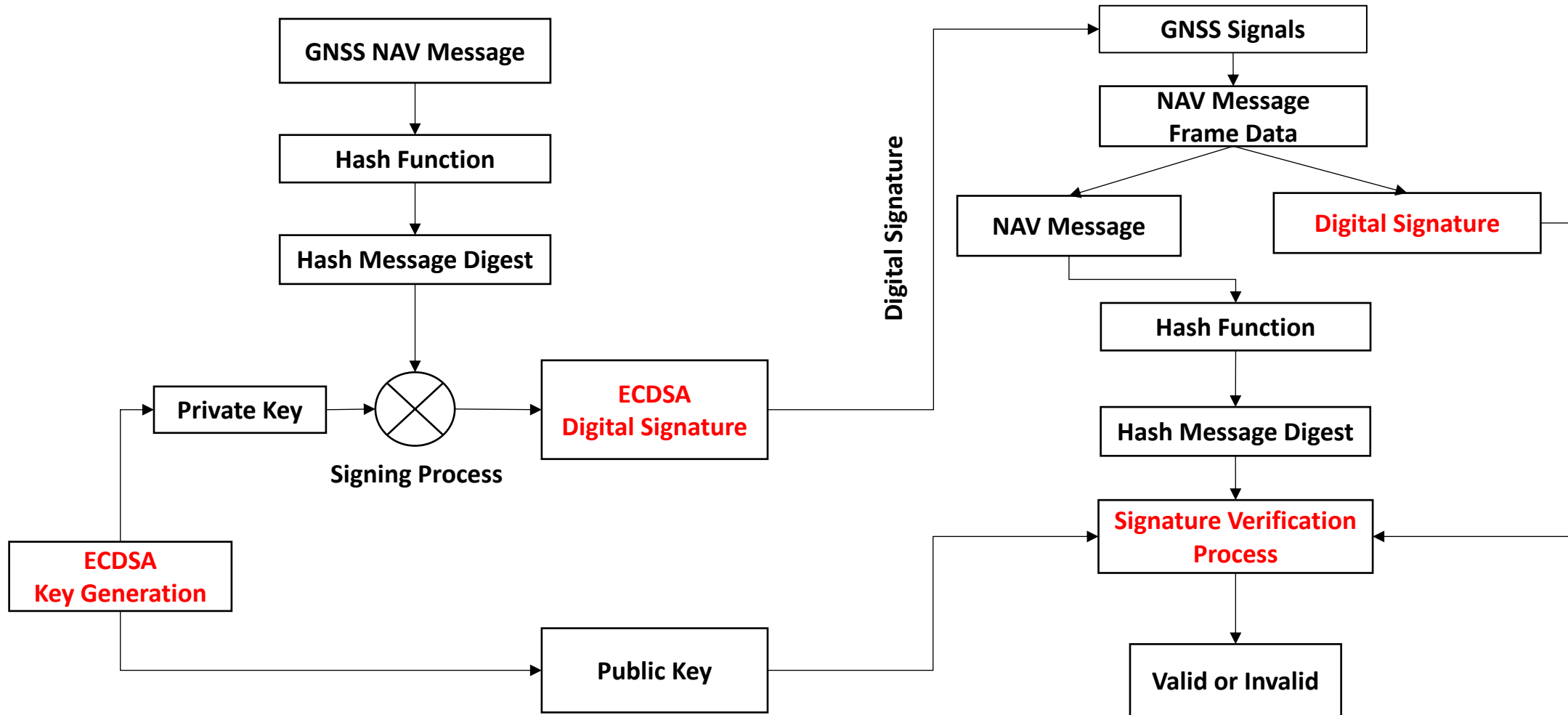


Resilient PNT: From the Perspective of Spoofing Attacks

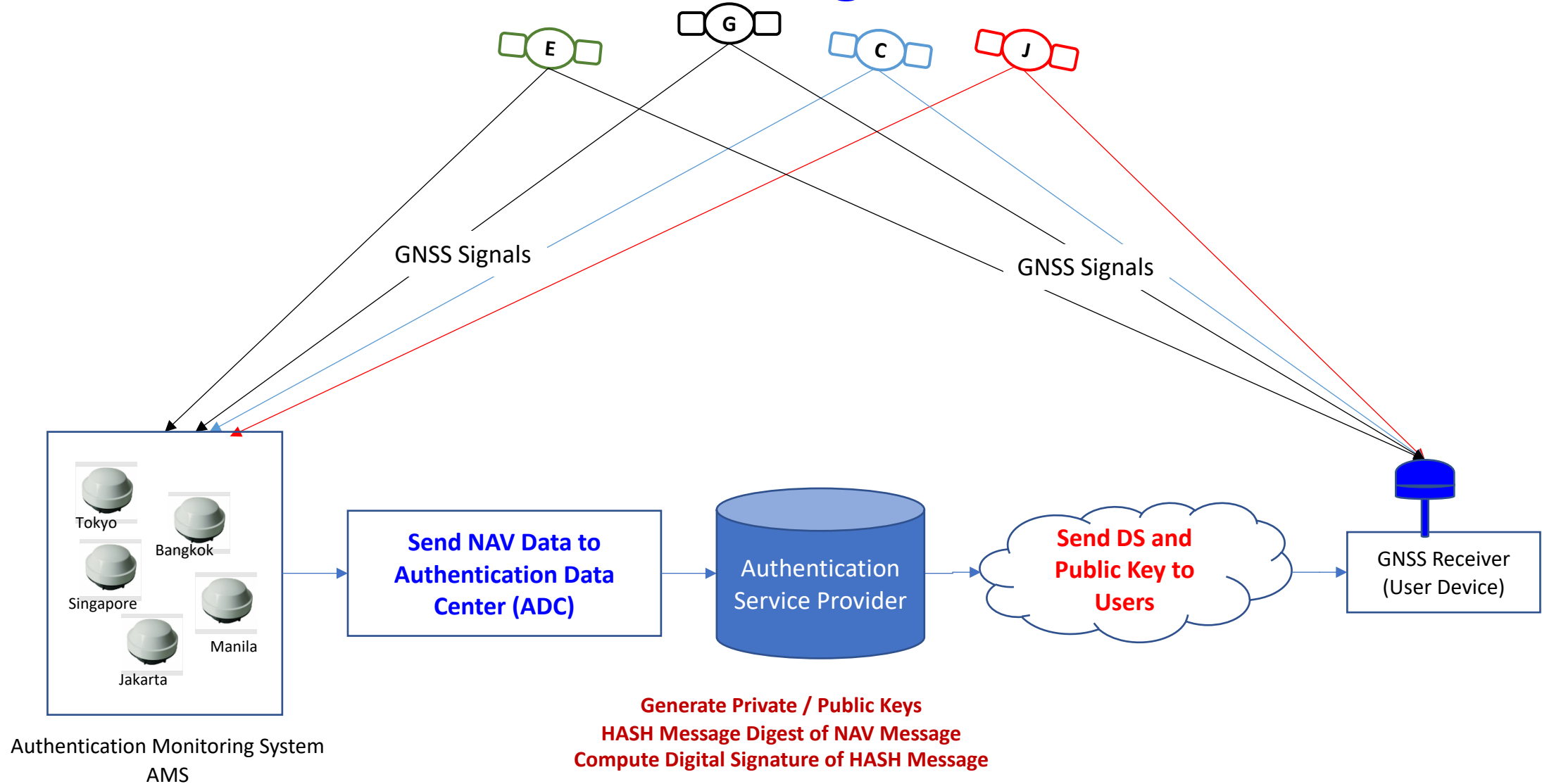
- *Detect the Spoofing Attacks*
 - *Is this possible?*
- *Mitigate the Effects of Spoofing Attacks*
 - *Enable accurate PNT information even in the presence of such attacks.*
 - *Is this possible?*



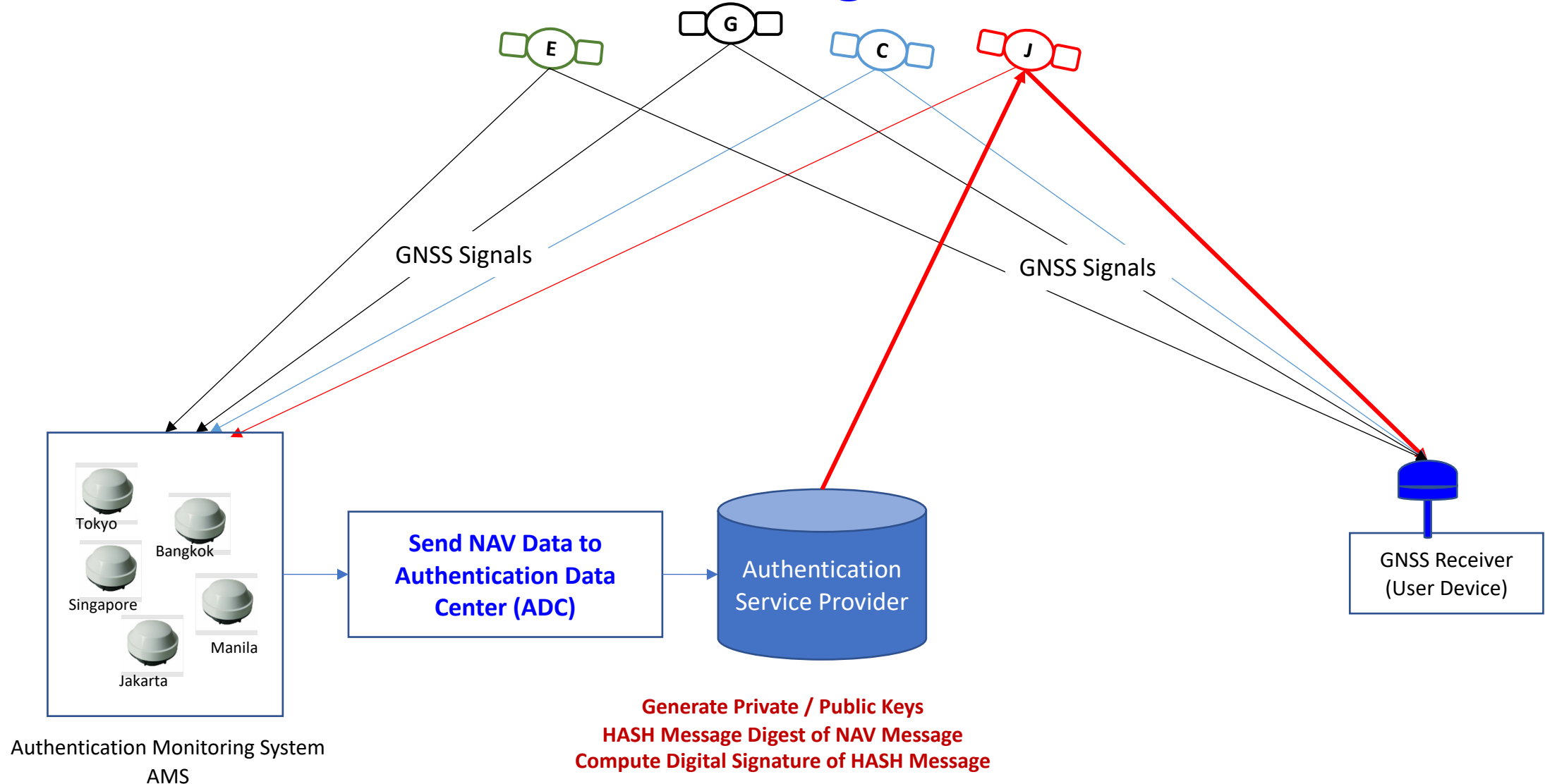
Detection of Spoofing Attacks: Broadcast a Digital Signature GNSS Signal Authentication



Internet-based GNSS Signal Authentication



Satellite-based GNSS Signal Authentication



Business Models: Toll Charging and Dynamic Road Pricing (DRP) based on GNSS

No Physical Toll Gates

- GPS-based system is used for Location, Distance and Lane occupation
- Can be implemented on any road section
 - Not limited to only highways, express ways, toll roads

Dynamically charge for road usage

- Pricing is variable and based on
 - Distance, time, location,
 - Vehicle type, lane and occupancy
 - Traffic congestion condition

Global Seamless Implementation

- The same system can be implemented globally
- Single system for smooth cross-border operation

