

# PNT Threats Are Real & Growing More Prevalent

Aug '2013

**"Truck driver has GPS jammer, accidentally jams Newark airport"**

(CNET)



Sep '11 – N. Korean Jammer Forces Down U.S. Plane



Army [RC-7B](#) ARL

## South Korea issues warning over suspected North Korean GPS disruption

March 31, 2016 (GPS World)

South Korea issued a warning Thursday after detecting satellite signal disruptions that appeared to be coming from North [...]



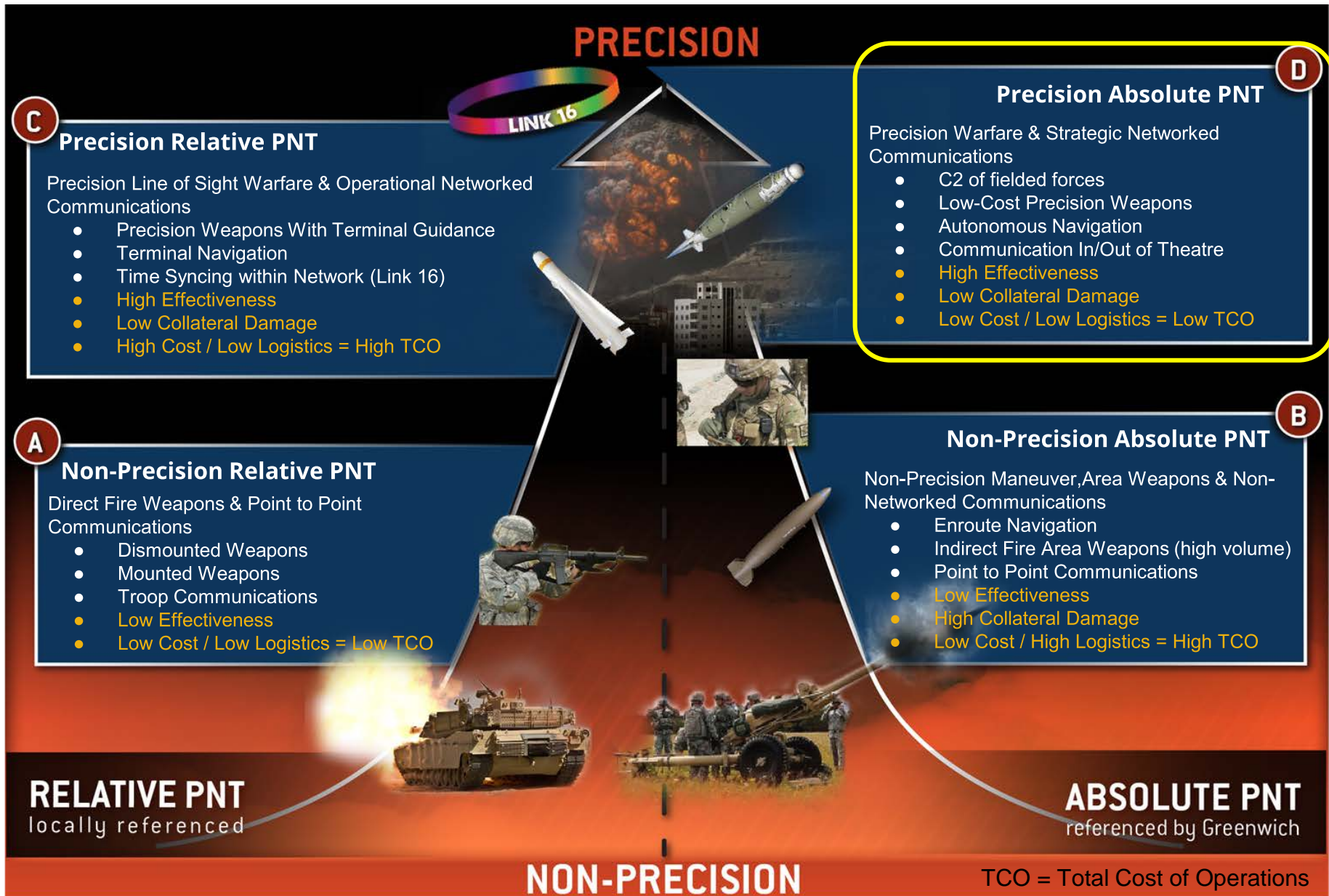
Oct '17 – "Spoofing in the Black Sea?" (GPS World)



Apr '18 – Russian military exercises disrupt GPS service in northern Norway...& disrupt cell phone service in portions of Latvia, Sweden & Norway (Resilient Nav & Timing Foundation)

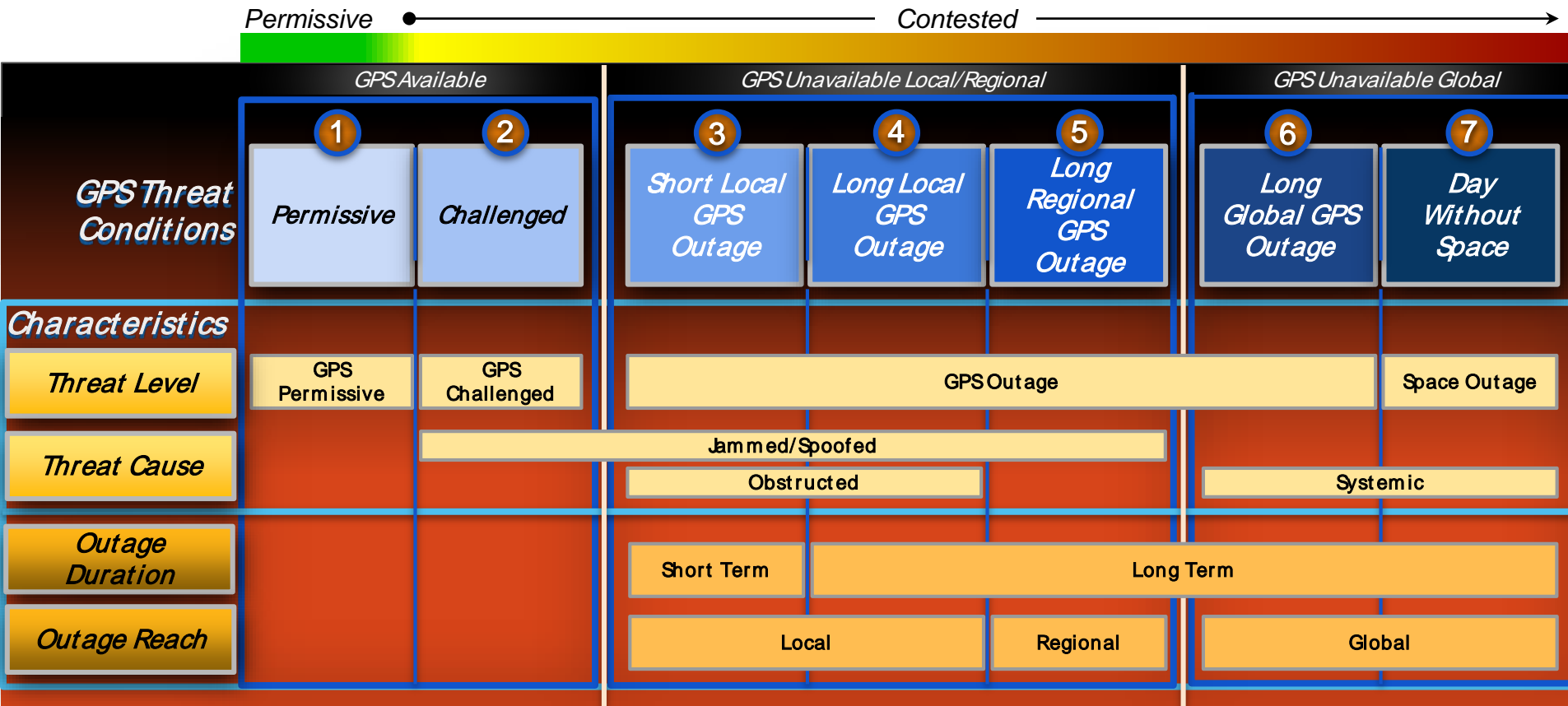
**Growing need for system solutions to pace the threat**

# PNT in the Battlespace



Many of Today's Critical Missions Depend on **Precision Absolute PNT**

# PNT Threat Environment - Absolute PNT for Precision Engagement

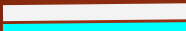



































Seven distinct threat conditions emerge as our adversaries become more sophisticated

# Assured PNT - Applicable Technologies

Position/Velocity   
Time 

Permissive ●————— Contested —————>

| GPS Threat Conditions | GPS Available   |                 | GPS Unavailable Local/Regional   |                            |                               | GPS Unavailable Global   |                        |
|-----------------------|---|-----------------|--|----------------------------|-------------------------------|--|------------------------|
|                       | 1<br>Permissive   | 2<br>Challenged | 3<br>Short Local GPS Outage  | 4<br>Long Local GPS Outage | 5<br>Long Regional GPS Outage | 6<br>Long Global GPS Outage  | 7<br>Day Without Space |
| <b>Technologies</b>   | <b>PVT Outputs</b>  |                 |  |                            |                               |  |                        |
| Mil GPS               | <br>  |                 |  |                            |                               |  |                        |
| Mil GPS&AJ/AS         | <br>  |                 | Reduces Jamming/Spoofing to Short Local Outage<br><br> <br> <br> <br> <br> |                            |                               |  |                        |
| Inertial              |   |                 | No Time, No A/S<br><br>  |                            |                               |  |                        |
| Time Ref              | <br>  |                 | Time Only<br><br>  |                            |                               | <br>                 |                        |
| Other SATNAV          | <br>  |                 | Susceptible to Jamming/Primarily Useful when Obstructed - Cond 3 & 4<br><br>   |                            |                               | <br>                 |                        |
| Other Nav             | Likely Use GPS and GPS/INS When Available<br><br> |                 | <br>   |                            |                               | Area Nav<br><br> |                        |

**No Single Technology Solves Total APNT Problem**  
**Mil GPS with AJ & AS Can Provide Significant Protection**

# Assured PNT Threat Environment Definitions

- **Assured PNT:** Position, Velocity and Time (optionally 3D attitude & acceleration) which is always available and always trustworthy to the level required for a mission (does not include platform guidance & control)
- **Permissive:** Threat environment in which military GPS UE can reliably deliver PNT without augmentation
- **Challenged:** Threat condition in which military GPS UE can only reliably deliver PNT with AJ/AS augmentation
- **Outage:** Desired signal (GPS or all of space) is unavailable for a period of time regardless of augmentation
- **Short Local GPS Outage:** GPS unavailable for a period of time during which inertial navigation can provide Assured PNT - caused by passing through a small jammer/spoofing area or obstruction
- **Long Local GPS Outage:** GPS unavailable for a period of time too long for inertial navigation to provide Assured PNT - caused by being in a small jammer/spoofing area or obstruction
- **Long Regional GPS Outage:** GPS unavailable for a period of time too long for inertial navigation to provide Assured PNT - caused by being in a large jammer/spoofing area
- **Long Global GPS Outage:** GPS unavailable for a period of time too long for inertial navigation to provide Assured PNT - caused by a global GPS systemic failure (other space assets remain intact)
- **Day Without Space:** All pertinent space assets unavailable for an extended period of time
- **PVT:** Position, Velocity and Time

# Assured PNT Applicable Technology Definitions

- **Mil GPS:** P(Y) or Mcode GPS with omni or nulling only antenna
- **Trusted GNSS:** L5, L1C, C/A Galileo, and QZSS with omni or nulling only antenna
- **Mil GPS with AJ/AS:** Military GPS with Beamforming / Beamsteering & Advance A/S technique
- **Inertial:** Use of inertial sensor to provide Position, Velocity Acceleration and Orientation
- **Time Reference:** High stability time reference, such as atomic standard
- **Other SATNAV:** Non-GPS space-based PNT signals, such as Galileo, Alt Nav, LEO payloads
- **Other Signals Nav:** Non-GPS signals, such as Galileo, Alt Nav, Pseudolites, LEO payloads, TWTR
- **Other Nav:** Non SATNAV system of system solution using sensors such as Celestial, Vision, Pseudolites, TWTR, etc.