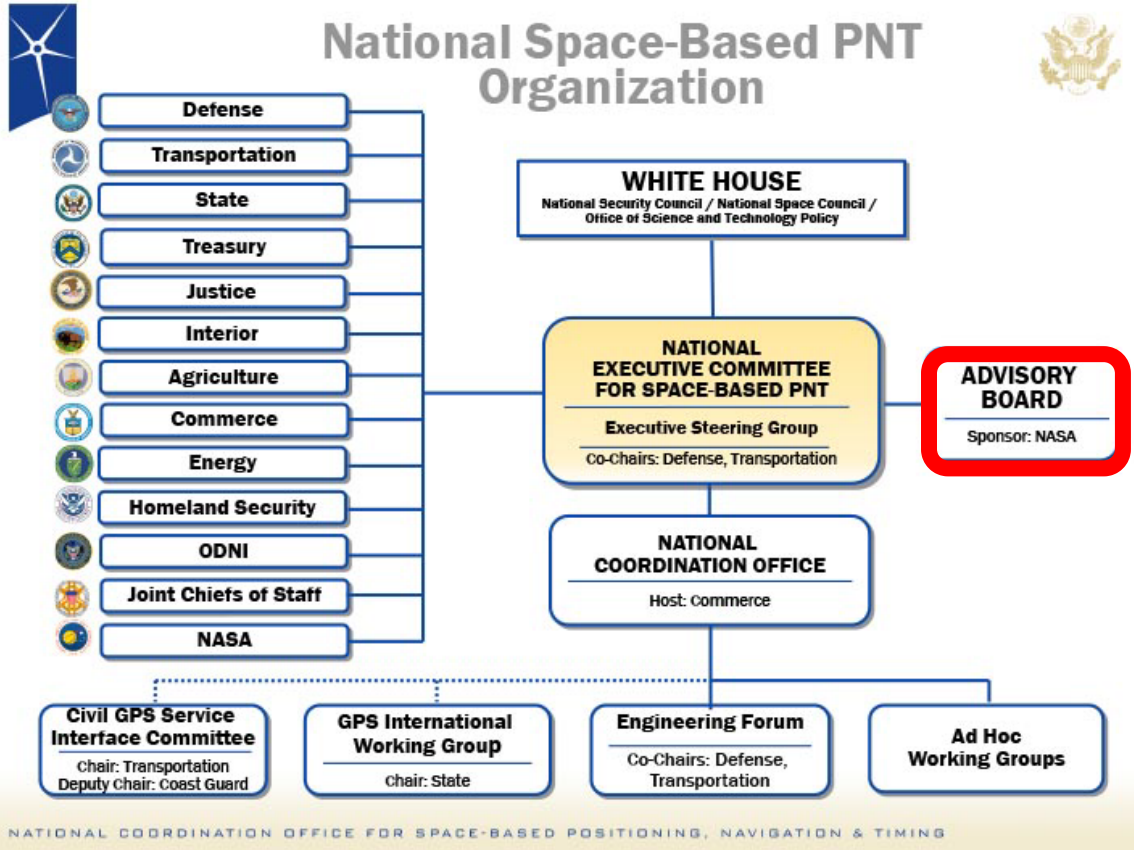




Complementary PNT capability using Broadcast Positioning System (BPS) Time and Position Using ATSC 3.0 Signals

Dr. Patrick Diamond
Member Presidents PNT Advisory Board
Speaking as a private citizen, all opinions are mine.

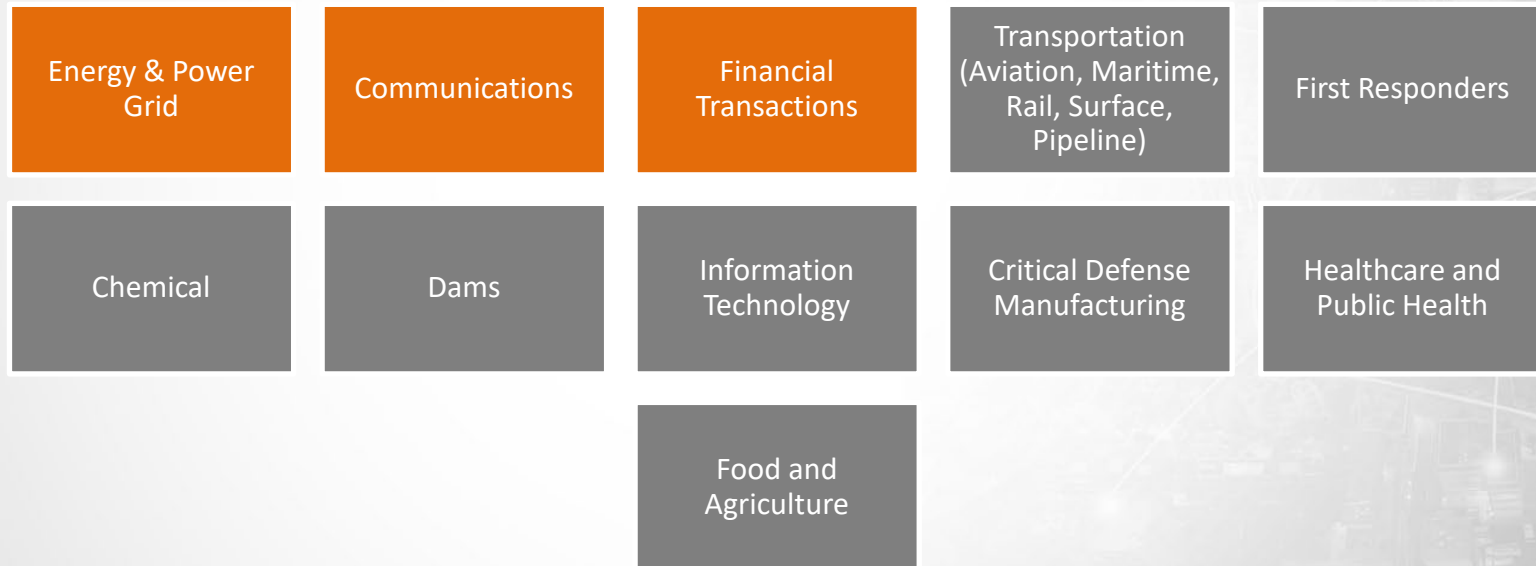
Humber College Ontario
PNT over ATSC Workshop
November 17, 2023



The National Space-Based Positioning, Navigation, and Timing (PNT) Advisory Board provides independent advice to the U.S. government on **GPS-related policy, planning, program management, and funding profiles** in relation to the current state of national and international satellite navigation services.



U.S. Critical Infrastructure Depends on Accurate PNT Service (GPS)





Dependency on GPS

The PNT signals and other data from GPS satellites allow these infrastructure capabilities to function reliably.

- 7 billion devices are in use worldwide

Without these capabilities, the US economy would come to a standstill.

- US economy could lose billions per day (source: Estimated by White House Office of Science and Technology Policy)



GPS Vulnerability

Recent outages in Denver and Dallas identify the weakness and need to provide resilient augmentation systems.

- Denver outage 36 hours before restored – disrupted aviation, cell service, ATM operation.
- Dallas outage over 40 hours - disrupted Aviation, Cell Service.

Our adversaries are aware of this weakness and have implemented augmentations within their national boundaries to mitigate this exact same weakness.

US and its allies need to do the same.



Executive Order by the President

*Per **Executive Order 13905** [3] on “Responsible Use of PNT,” the 16 Sector Risk Management Agencies (formerly Sector Specific Agencies) are directed to develop PNT profiles pursuant to the NIST 8323 master profile to identify and mitigate vulnerabilities.*



Recent actions to mitigate threat taken by US Gov.

In September 2023 the U.S. Department of Transportation John A. Volpe National Transportation Systems Center published it's Complementary PNT Action Plan.

Outlines and describes the DOT Actions to Drive CPNT Adoption.

The U.S. Department of Transportation (DOT) is the lead for civil positioning, navigation, and timing (PNT) requirements in the United States and represents the Federal civil departments and agencies in the development, acquisition, management, and operations of the Global Positioning System (GPS).

<https://www.transportation.gov/sites/dot.gov/files/2023-09/DOT%20Complementary%20PNT%20Action%20Plan.pdf>



Technical Requirements to Satisfy Critical Infrastructure Usability Needs

Name of Industry	Timing Requirements
Mobile Wireless Networks	1.1 μsec traceable to UTC
Equity Trading Systems	1 μsec within UTC NIST (SEC Section 613 rules, MifID II EU)
Power Grid	.5 - 1 μsec to UTC, IEEE 37-238, (Synchro-phasors)
Other CI Industries	200 ns satisfies all requirements



Advantages of BPS

Infrastructure
is already built

Global
standard

Passive
consumer
service

Independent

Frequency
diversity

Nationwide
coverage



ATSC 3.0-Based BPS is a Solution

- Can meet timing requirements of critical infrastructure
- Broadcast infrastructure is already built
- Based on a global standard
- Nationwide coverage
- Can be totally independent of GPS
- Passive consumer service – no uplink is required
- Resilient - high power, high tower, frequency diversity, backup generators
- US government agencies are exploring the idea



What is the Broadcast Positioning System (BPS)?



A system and method of estimating time and position at a receiver using ATSC 3.0 broadcast signals



Compliant with ATSC 3.0 standard;
uses datacasting feature

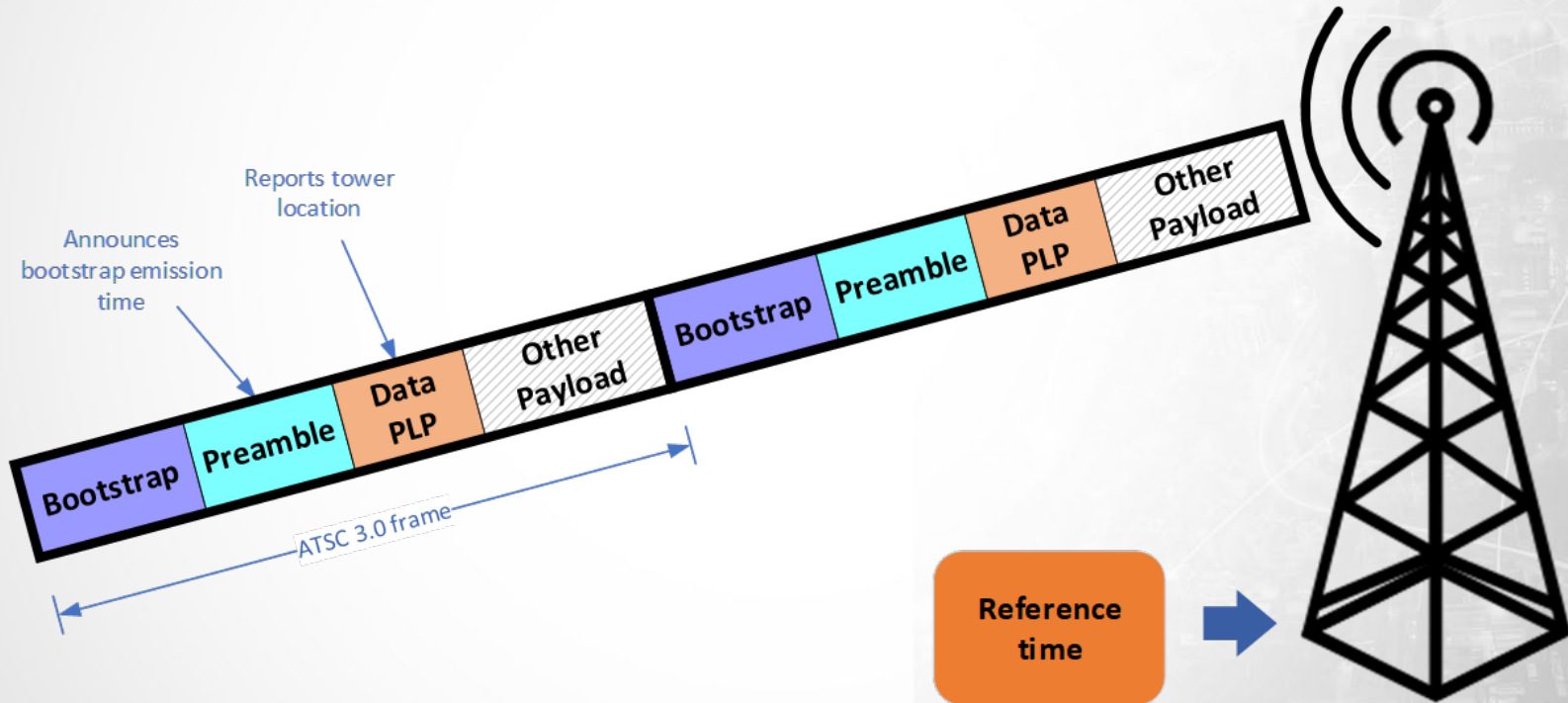


Independent and stand-alone

- GPS, Internet or cellular connectivity not required

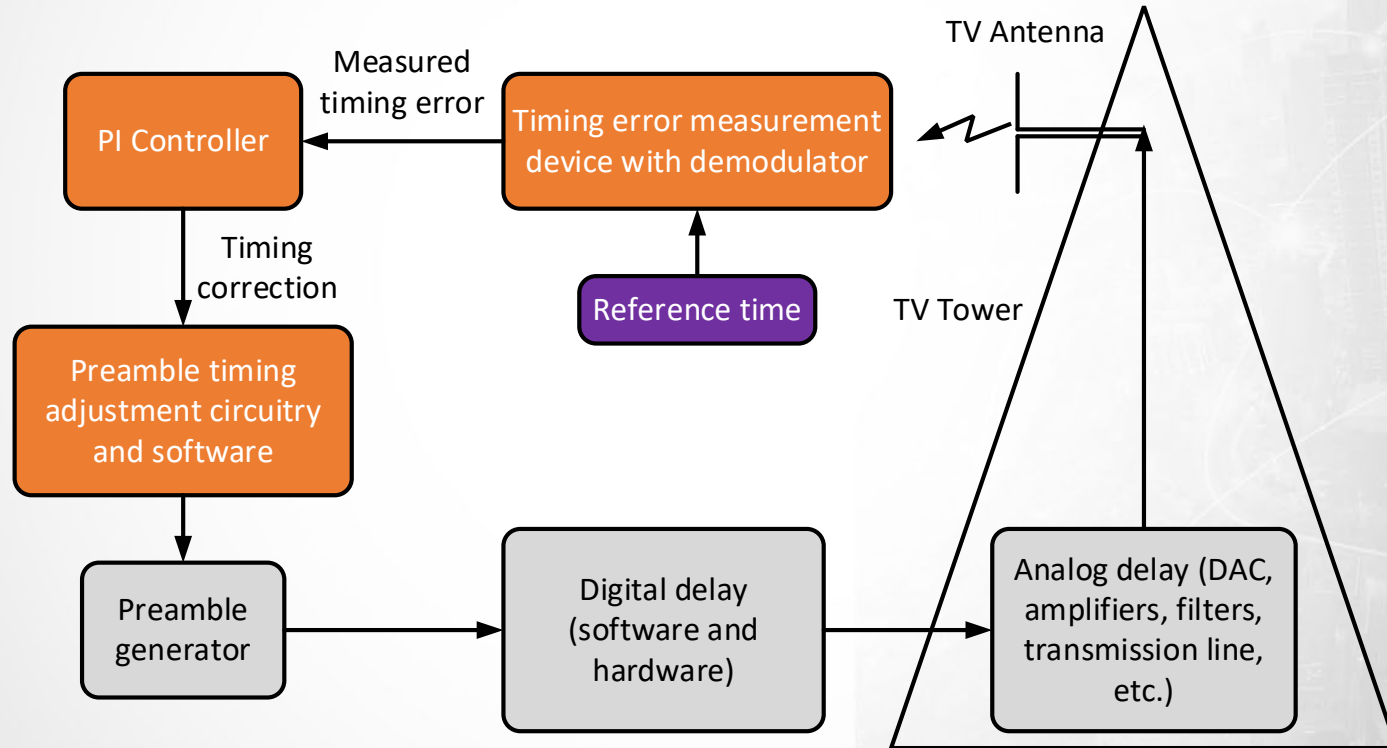


Time Delivery





Time Synchronization at the Transmitter





PNT Capabilities of BPS

One TV tower can provide accurate time at a known position

- 100 ns, 95% of the time

Four TV towers can provide both time and position estimation

- 100 m average accuracy expected

Can detect GPS spoofing

Can enable GPS-BPS hybrid location



Thank You for your Time and Attention Today!

