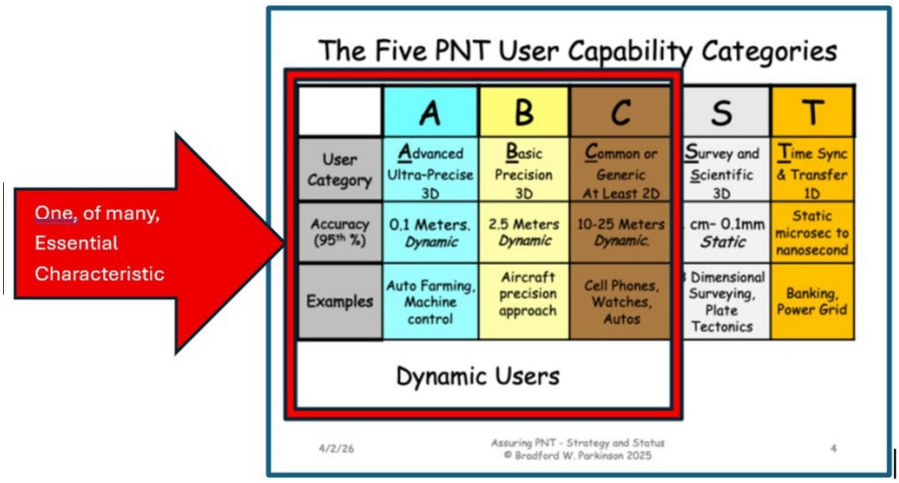
Talking Paper: **Achieving Assured PNT (Positioning, Navigation, and Timing)**

- US is massively dependent on GPS/PNT and its economic contribution (about $1B/day)
  - Thus, GPS is **a major foundation of National Power.**
  - This Validates and Reenforces a US National Goal of "***Assured*** PNT"
- For such ***assurance***, PNT applications demand differing measures of PNT – we define 5 major capability/application categories – A, B, C, S and T.



- While the accuracy characteristic is a useful tag for each concept, other requirements are also essential attributes, such as integrity, availability, and robustness to interference.
- The most significant threats to PNT are Jamming and Spoofing of weak GNSS signal.
- PNTAB ***Strategy*** is "PTA" – Protect, Toughen, Augment (GPS). **Points about "Toughening"**:
  - CRPAs have the most immediate payoff (reduce jammer effective area by factors of 100,000 or more) but they have had inadequate support for the last 20 years. In fact, prohibition by USG ("ITAR") has just been finally lifted.
  - "Deep" Inertial augmentations can also reduce effective jammer area by factors up to 10. Note: this is more thanthe federated techniques usually used.
  - Activation of the GPS L5 signal would provide "Lm – level" natural advantage – Reduce jammer effectiveness area by factor of >25 (reduction by over 96%)
  - Expanding the use of non-GPS GNSS (e.g. Galileo) would significantly improve resilience through proliferation of PNT sources but must include assurances of adequate integrity.
- **Augmentation** is currently fashionable, **but *non-GNSS* augmentations will not generally satisfy the needs of (i.e. replace GNSS) Categories A, B, and S.**
  - Experimental demonstrations are useful but inadequate to evaluate a specific augmentation. A complete ***System Definition is required***. All proposed augmentations must be scrutinized (***independently tested*** and verified) in the same way as GPS-Accuracy, Affordability, Availability (geographic and temporal), Dimensionality, Integrity, Continuity, Time to field (both system and user devices), commitment for system sustainment, and Toughness/Vulnerability.
- To achieve "Assured PNT", US needs a visionary leader with *authority and resources* to ensure future GPS capability and assure PNT **for all users**.

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