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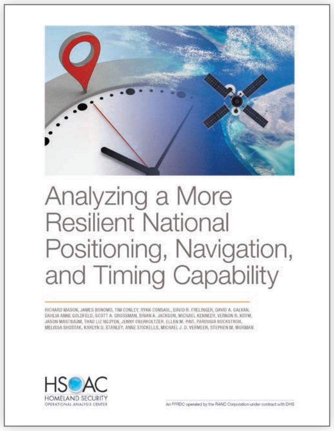
RESEARCH SUMMARY


Analyzing a More Resilient National Positioning, Navigation, and Timing Capability

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Because of the widespread use of the Global Positioning System (GPS) for positioning, navigation, and timing (PNT), concerns have been expressed that a disruption of GPS might require a national investment in backup capabilities. The authors assess the costs associated with realistic threats to domestic, nonmilitary uses of GPS, and review possible additions to the PNT ecosystem in light of those costs.

RESEARCH QUESTIONS

- What are the technology-neutral requirements to back up and complement the PNT capabilities of the GPS for homeland security and critical infrastructure?
- What are non-GPS sources for the PNT ecosystem?
- Of these sources, what PNT capabilities are already implemented?
- What are the threats to the functioning of the GPS satellite system and to other PNT parts of the national PNT ecosystem, both existing capabilities and potential backups or additions?
- How do the costs of potential additions compare to the threats they would mitigate?

KEY FINDINGS

The costs associated with GPS-focused threats were assessed

- GPS is far from the only source of capability for PNT.
- Many of these alternative and complementary PNT capabilities are already implemented broadly, and some additional technologies are being implemented for public safety or other purposes.

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- “Fallback” technologies—for example, navigation by traditional visual or manual course plotting, positioning using reference points—increase the robustness of PNT nationally.
- The threat from spoofing GPS signals should not influence a decision about any new PNT systems, as robust means to counter spoofing already exist.
- When cost estimates of GPS disruption or loss include realistic adaptation options and existing complementary technologies, the estimates are surprisingly low.

Additions to the PNT ecosystem in light of the potential benefits were considered

- No single system is a perfect backup for GPS.
- Given realistic cost estimates of GPS disruption, the bar for extensive government investment in a GPS backup (that does not serve some other purpose) is very high and therefore difficult to justify.
- The federal government is already involved in one public-private partnership that will provide a GPS backup for many users in important urban areas.
- Modest investments by the government in threat detection could also reinforce private incentives to maintain a robust PNT ecosystem.

RECOMMENDATIONS

- Government investment in a “GPS backup” appears unwarranted at this time. New PNT systems could be developed for the complementary benefits they bring while GPS is operating, but not primarily as a backup for GPS outages.
- Having diverse, time-proven, robust fallbacks to GPS available is highly desirable. Maintaining those capabilities while seeking the efficiency gains of modern PNT should be a priority.
- Dispersal and diversity of capabilities in the national PNT ecosystem is a strength, not a weakness.
- Considering both current and potential future systems, prudent system design necessitates avoiding dependencies that increase the risk associated with GPS loss.

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