

WORKING GROUP B: FUTURE PTTI NEEDS SUMMARY OF THE DISCUSSION

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The Working Group addressed the needs, concerns, and issues likely to arise over the next 25 years of those using precise time and time interval. These issues will be driven, in part, by sociological changes that are predicted to occur over the study span. These include, but are not limited to: aging of the population, the changing composition of the workforce, changing world trade patterns, increased congestion on our highways (coupled with the current desire for customized transportation solutions), environmental monitoring and control, and the resurgence of terrorism. Within the defense sector will be the realization of ForceNet, with its attendant technologies of lightweight power supplies, robotics, increased microprocessor control of communications, surveillance, and weapons systems, and the need to know positions of individuals, remote systems, and robotics to meter accuracy and the need to transmit enormous amounts of imagery information securely. The goal was to formulate recommendations that could be helpful in guiding the direction of future PTTI development.

Following a short introduction, the group of approximately 20 participants was asked to brainstorm future imperatives, business areas, technical products, focus technologies, and the resultant PTTI needs, in that order. This technique was used to develop ideas about what societal imperatives could occur in the next 25 years. Societal imperatives were selected as the start point, because they are well understood by all participants and are more accurately predicted than mere extensions or developments in technology. With those established, the group went on to determine what business areas might be expected to develop as a result of these changes. Business areas encompass the arena in which businesses could be established to service the predicted change in society. Following that, the technical products that one might expect to be able to develop and market over the next 25 years were discussed and from that, the group was able to determine what PTTI developments would have to occur in order to realize those products. Finally, the group was able to summarize the relevant focus technologies and the plans necessary to develop future PTTI capabilities.

Discussions during the 90-minute meeting touched on the reliance on satellite navigation systems, future hardware needs, space clocks, future time and frequency dissemination, real-time robust time scales, time and frequency standards for the future, and other topics likely to drive the state of the art. Table 1 displays the results of the brainstorming session, and Table 2 summarizes the focus technologies and the required PTTI capabilities.

Table 1. Results of brainstorming sessions.

Civil/Military Imperative	Business Area	Technical Product	Focus Technology	PTTI Required
Growing Population	Faster / More Secure Communications	High-speed Encrypted Communications	40 megabit/s Communications	3×10^{-11}
Security	Faster / More Secure Communications	High-speed Encrypted Communications	Time-dependent Encryption Keys	Current level of Technology
Growing Population	Faster / More Secure Information Systems	On-line Secure Data Bases	Time-dependent Encryption Keys	none
Growing Population	Improved Transportation Facilities	Improved Flight Management	10 meter positions 10 m/s velocities	1 ns absolute
Security	Surveillance	Recognition	3 centimeter imaging	3 ns absolute on orbit
Growing Population	Resource Management	Management of Agricultural Resources	1 meter imaging	1 ns absolute
Growing Population	Geriatric Services	Small Item Finder	1 mm Rel. Nav. (indoors)	1 ps relative
Growing Population	Medical Services	On-line Secure Data Bases	Time-dependent Encryption Keys	
Growing Population	Medical Services	High-speed Encrypted Communications	40 megabit/s Communications	3×10^{-11}
Growing Population	Virtual Mass Transit	Auto Car Train	3 cm Rel. Nav.	1 ns absolute Miniaturization
Security	Vulnerability Assurance	Integrated Multi-technique systems for navigation	Miniaturization	
Security	Vulnerability Assurance	Redundant Navigation, Timing, Communications Systems	Redundant PNT Systems	10 ps Time Standards
Security	Vulnerability Assurance	Distributed Standards	Calibrated Time Transfer	10 ps time transfer
Security	Vulnerability Assurance	Interoperability of Surveillance Resources	Calibrated Time Transfer	10 ps time transfer
Security	Vulnerability Assurance	Precision Weapons	Calibrated Time Transfer	1 ns absolute
Growing Population	Infrastructure in Urban Environments	Navigation and Timing in Urban Environments	Redundant PNT Systems	10 ps Time Standards
Education	Faster Communication			

In concluding the session, the Group recommended that two topics be made subjects of sessions at the PTTI meeting in 2004. These were: (1) PTTI needs for future transportation, and (2) PTTI needs for indoor positioning. It appeared from the discussion that these two areas might provide the incentive for the development of enhanced PTTI capabilities. For (1), the Group envisioned a need related to the management of heavy traffic (road and/or air) involving careful spacing and maneuvering. Demetrios Matsakis (U.S. Naval Observatory) and Donald Latterman (Science Applications International Corporation) volunteered to contribute in this area at the 2004 PTTI meeting. In the second area, the Group considered the need for high-accuracy location of objects in interior urban settings where current positioning techniques are unable to operate effectively. Mike Miller (Air Force Research Laboratory) volunteered to contribute in this area.

Table 2. Focus technologies and the required PTTI capabilities.

FOCUS TECHNOLOGY AREA	PTTI NEED
40 gbits/sec	2.5E-11
3 cm meter imaging	few ns on orbit
1 mm Rel. Nav. (indoors)	3 ps relative
1 cm positionoing real time positioning1 cm/s velocity	10 ps
Miniaturization	1 cubic cm tot volume < 50 mW 10 ⁻¹¹ @ 1 sec
Redundant PNT Systems	state-of the art interoperabilkity
Time-Spatial dependent Encryption Keys	Current state of the art

The Group further recommended that future PTTI meetings should provide for an additional, separate meeting to address expected military needs for PTTI, and its final recommendation was that the brainstorming process be employed at future meetings to develop new topics of concern and to attempt to develop future PTTI needs.

35th Annual Precise Time and Time Interval (PTTI) Meeting