



T-Mobile Hybrid
Location meeting
with OET

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August 27, 2008

Hybrid issues

- No commercial hybrid (A-GPS + ?) solutions exist today for GSM
 - Lots of puffery from various vendors
 - Hybrid technologies show some promise to improve location yields depending on the specific technologies chosen, but technologies are not developed yet and performance is not proven
 - Not currently supported in standards - likely to be substantial effort required to standardize any proposed hybrid solution prior to availability for E911

- Potential hybrid approaches have not yet been shown to improve accuracy
 - Overly optimistic lab projections from vendors
 - No empirical test results
 - More likely to improve yield (in some environments) than accuracy
 - Accuracy would (in theory) tend toward the mid-point of the two constituent technologies
 - Significant risk in meeting 30 sec latency requirement with hybrid solution
 - > High accuracy A-GPS measurements demands most of latency budget

- It is premature to raise the performance standard in anticipation of a technological breakthrough

- Hybrid solutions would require change out of most or all handsets, requiring substantial transition time

- We continue to monitor and investigate potential technology improvements

Technology Review Process

- T-Mobile has an on-going dedicated effort to review and investigate potential new location technologies
 - Investigation/Analysis Phase
 - Lab Phase
 - Field-Trial Phase
 - Deployment Phase

- ETAG (E911 Technology Advisory Group) Concept
 - Highly recommended to investigate and evaluate potential technology improvements for use in wireless E911 networks
 - Help sort out viable location technologies from the vaporware concepts
 - Use to verify vendor performance claims in the real world – prior to adopting any new performance rules
 - FCC could help by acknowledging the approach and establishing credibility of this process

For a Location Solution to be Technically Feasible and Viable, it must be:

- Technically Capable
 - Meet technical requirements (accuracy, yield, latency) across all environments/deployments
 - > String of pearls
 - > Service area boundaries
 - > Single/limited number/density of cell sites
 - > Line of sight obstructions to towers/satellites
 - > Indoor (to the extent required)
- Logistically Feasible
 - Capable of being deployed, maintained reliably
 - New technologies in handsets require many years to implement
- Economically Feasible
 - Must not increase consumer costs significantly
 - Cost effective implementation in the network
 - Does not add significant costs to handsets
- Commercially Available
 - Capable of integrating into a high-reliability wireless network without impacting voice/data services
 - Fair/reasonable licensing of underlying technology
 - Cannot rely on a single-source provider
 - Solution must be standardized

A-GPS/TDOA Hybrid Potential

- Unlikely to deploy a hybrid solution that involves TDOA
 - TDOA is not a good complement to A-GPS; need is for a technology that provides significant improvements in environments where A-GPS is weak, particularly but not limited to indoors
 - Does not improve indoor performance significantly
 - Expensive and logistically challenging to deploy and maintain
 - Concentration of IPR limits vendor choice and innovation
 - > Insufficient market pressure to meet delivery schedules & improve service quality
 - > Very thin/unhealthy eco-system for TDOA
 - » Has not been widely accepted (limited use in the U.S., no use outside U.S.)
 - » Unlikely to be widely adopted in the future

TDOA Principal Vendor Performance Claims are not Credible

- TruePosition has made inaccurate/misleading performance claims of “under 50 meter accuracy about 75% of the time” (APCO Conference 5 Aug 08)
 - TP data is biased
 - > Favors higher site density deployments versus representative mix of service areas
 - > Vast majority of undeployed counties very rural, one cell site or incidental coverage
 - > Including these in the analysis will dramatically reduce the compliance percentages
 - TP data is national – not county level
 - At national level TP’s claim not supported by T-Mobile’s national test data
 - Data are outdoor only
 - > Performance will generally get worse if indoor test results are included
 - > Indoor performance cannot be improved by adding A-GPS

Other Hybrid Opportunities

- **WiFi Location Technologies**
 - Concept is still being developed
 - Not yet attempted for E911 by any handset vendors or carriers
 - > Substantial development and standardization work required prior to any use for E911
 - Would require an 802.11 interface in each phone
 - > Change out of nearly all current handsets
 - » Many years to turn over entire subscriber base
 - > Limited field tests to date, lots of work to be done
 - Requires constant, intensive maintenance of a database of WiFi access point locations

- **iPhone**
 - Some WiFi location publicity from the iPhone platform
 - > To date, very different applications than E911

- **Proposed approaches using other transmission sources for triangulation (e.g. TV)**
 - Concepts still being developed
 - Many significant impacts: handset form-factor, power consumption, cost, significant development required, deployment/rollout into subscriber base

Compliance Approach

Premature to increase accuracy requirements until new technologies are identified, tested, and proven viable

- Network-Based Technology
 - As long as a carrier employs a Phase II network-based solution which covers every handset – should be held to network-based accuracy standard

- Blended Technologies
 - When both handset-based and network-based location technologies deployed simultaneously, consider utilizing a blending process to weight the results from each technology for compliance measurements

- Performance Monitoring
 - Use uncertainty estimate trending to verify proper on-going performance across all deployments

Indoor Location

- Two major issues need to be resolved before indoor location becomes viable and useful for wireless callers
 - Need a technology that can reliably (with high yield) calculate a position for a wireless device operating indoors
 - > Both A-GPS and TDOA have significantly worse yield indoors – due to signal attenuation
 - Need a technology that can accurately place a caller inside the building they are actually in
 - > Existing technologies are not accurate enough indoors

Indoor Location (Cont)

- Location technologies are a long way from providing highly accurate indoor location estimates ('which door to kick-in')
- If the required percentage of indoor test calls is quite limited, as per the current NRIC VII FG-1A standard of 5%, it is possible to meet existing accuracy requirements when averaged over large geographic areas (e.g., a state)
 - If this geographic area is reduced in size or if the percentage of required indoor test calls is increased, it is not possible with current technologies to meet existing accuracy standards, let alone increased accuracy requirements
- T-Mobile is unaware of any near-term technology improvements which will resolve this limitation
 - No solution granular enough to determine in which house caller is located

Indoor Testing

- Beyond the technical issues of high-yield, high-accuracy indoor location – there are many significant logistical/practical issues associated with empirically measuring indoor performance
 - Establishing accurate ground-truth
 - Getting repeatable access to indoor facilities
 - > Compounded by both privacy and security concerns
 - Precludes the use of time/cost saving semi-automatic test call generation methods
 - > Counter to OET Bulletin No. 71's admonition to keep testing methods "efficient, reliable, simple, cost-effective"

- Increasing the percentage of required indoor test calls simply exacerbates the problem, and adds no additional benefit to the public
- OET Bulletin No. 71 suggested development of standards and test methodologies which could obviate the need for extensive Commission guidelines, permit a type-acceptance approach
- Perhaps type-acceptance approach is the only practical way to ensure the best accuracy which is technologically feasible and economically reasonable is delivered in all environments
- **Could take the form of testing indoor performance in several representative indoor environments, rather than routine empirical indoor testing nationwide**

Current Accuracy Issues

- Verizon recently filed county level accuracy proposal specific to its location technology (A-GPS) and network/handset deployment
- AT&T just filed proposal specific to its location technology and network deployment
 - T-Mobile cannot yet comment on the viability of their proposal
 - Potentially significant differences exist between AT&T and T-Mobile relative to feasibility and implementation time required for county-level accuracy
 - > Quantity of string-of-pearl type deployments
 - > Quantity of county deployments with low cell site density
 - > Percentage of population covered by compliant counties
 - > Timing of A-GPS equipped handset rollout (which itself is influenced by equipment availability) and the resulting ratio of A-GPS to non-A-GPS handsets in the subscriber base

Summary

- No commercial hybrid solutions exist today for GSM
- Hybrid solutions do not necessarily improve accuracy outdoors or indoors
- Current location technologies are unable to produce reliable (high accuracy and high yield) location estimates indoors
- T-Mobile is unaware of any near-term technology improvements which will resolve this limitation
- It is premature to raise the performance standard in anticipation of a technological breakthrough
- E911 Technology Advisory Group (ETAG) recommended to investigate and evaluate potential technology improvements for use in wireless E911 networks



Thank You!