Real-Time Internet-Based GPS·C Tests at the University of New Brunswick

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Introduction:

Canada-wide Differential GPS (CDGPS) is a wide-area GPS correction delivery service that is currently under development and is scheduled to be operational by spring of 2002. CDGPS will deliver GPS·C wide area corrections via the MSAT-1 L-band geostationary communications satellite broadcasting to all of Canada and territorial waters. Future plans include the potential of accessing the corrections via the Internet.

GPS·C corrections are generated through a network of real-time GPS tracking stations across Canada connected by high speed communication links to computing facilities in Ottawa. This infrastructure is developed, maintained and operated by Geodetic Survey Division (GSD), Natural Resources Canada.

A joint project is being conducted between the University of New Brunswick (UNB), Department of Geodesy and Geomatics Engineering and GSD to perform real-time static tests to assess the achievable positional accuracy using Internet based correction delivery in Fredericton and compare performance to standalone GPS results.

Methodology:

GPS·C RTCA corrections are transmitted through a virtual private network (VPN) over the Internet.

Corrections localized by a virtual reference station at UNB which outputs RTCM-104 corrections.

Two GPS receivers (NavCom NCT-2000Ds) operated in single frequency mode sharing the signals from a single antenna
- one of the receivers applies the GPS·C corrections.
- the other receiver is operated with no corrections (standalone GPS).

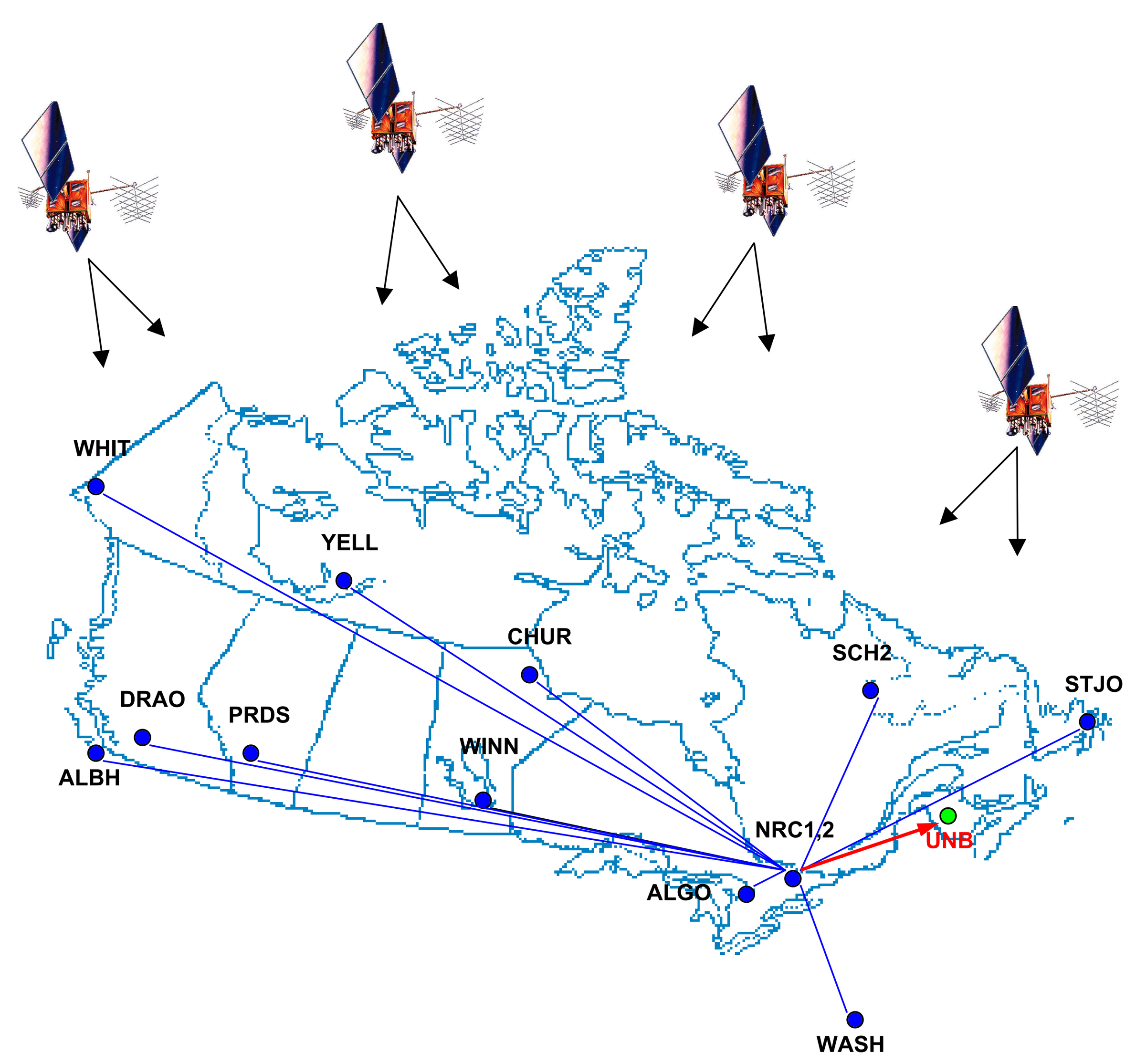
GPS antenna currently positioned on roof of Gillin Hall at UNB.

24 hrs of 1 Hz data collected, elevation mask 10°.

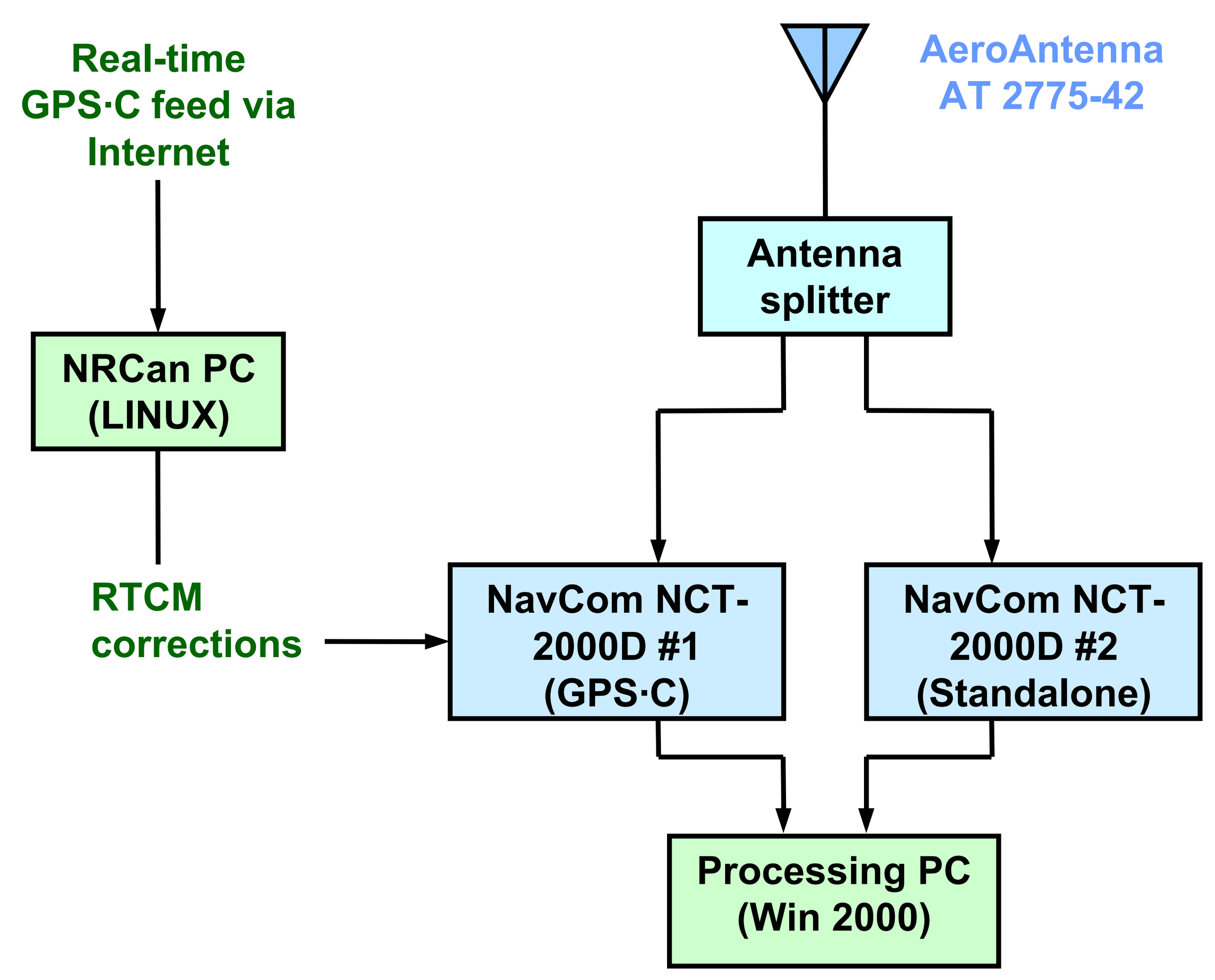
Receiver's position solution output in NMEA format by NavCom's StarUtil software.

The resulting co-ordinates are in NAD83 (CSRS). These were subsequently transformed to ITRF97 (consistent with WGS-84 at ~10 cm level) for comparison with the standalone GPS results.

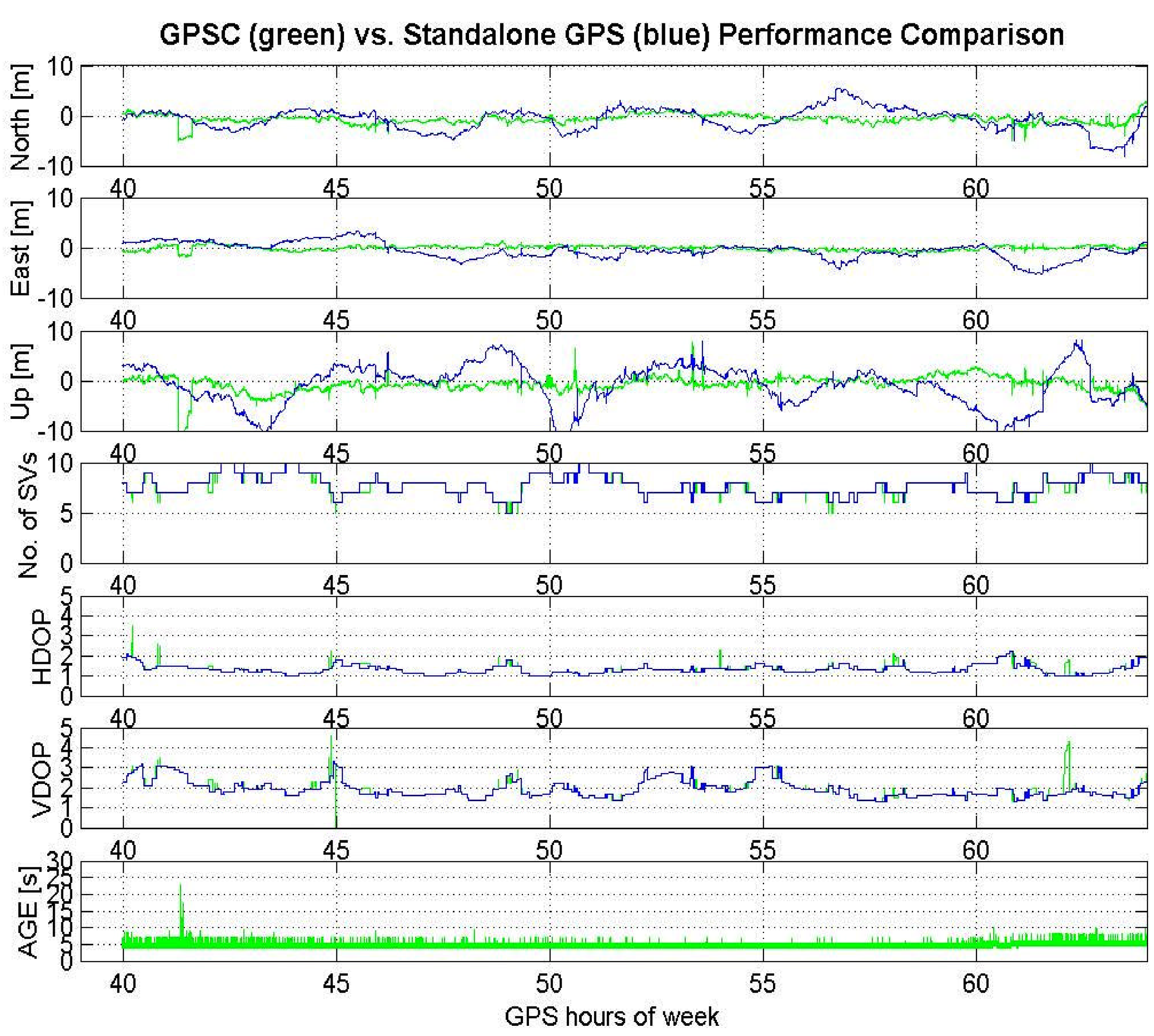
Canadian Active Control System Network

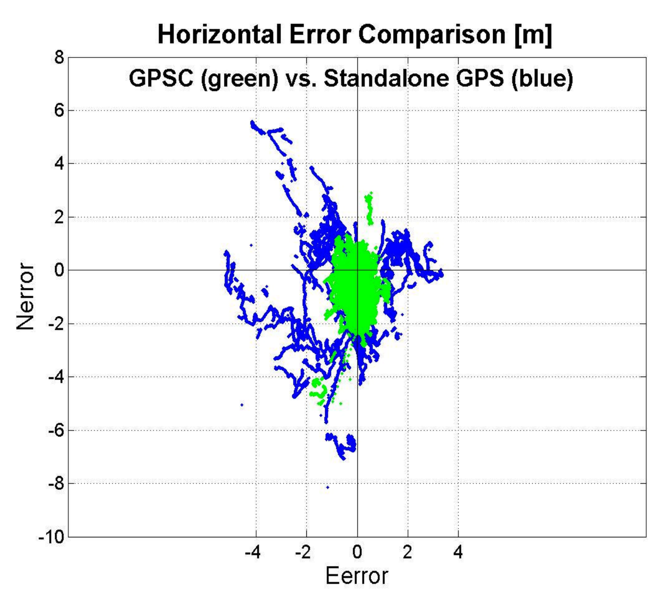


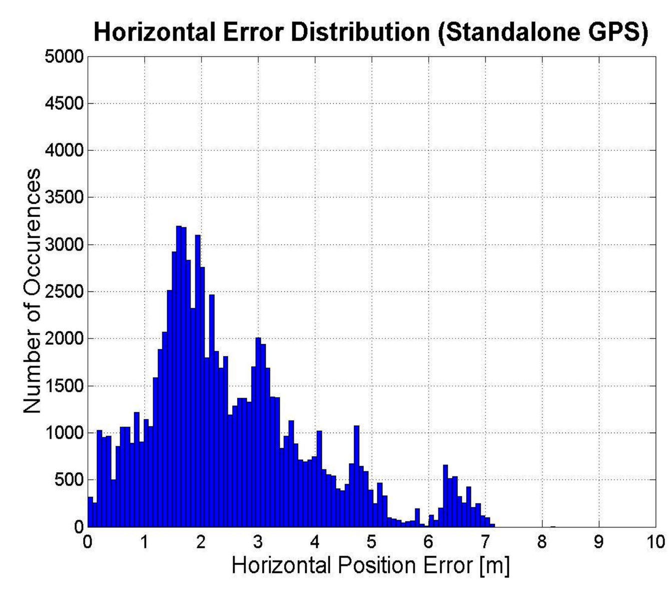
System Architecture

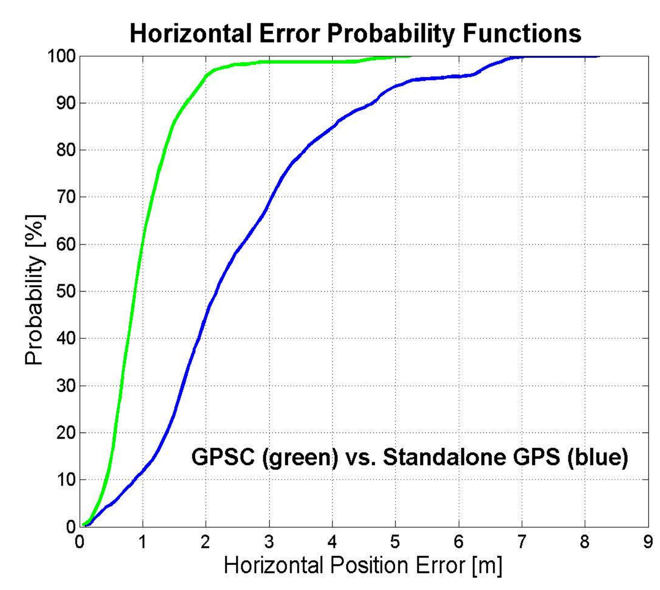


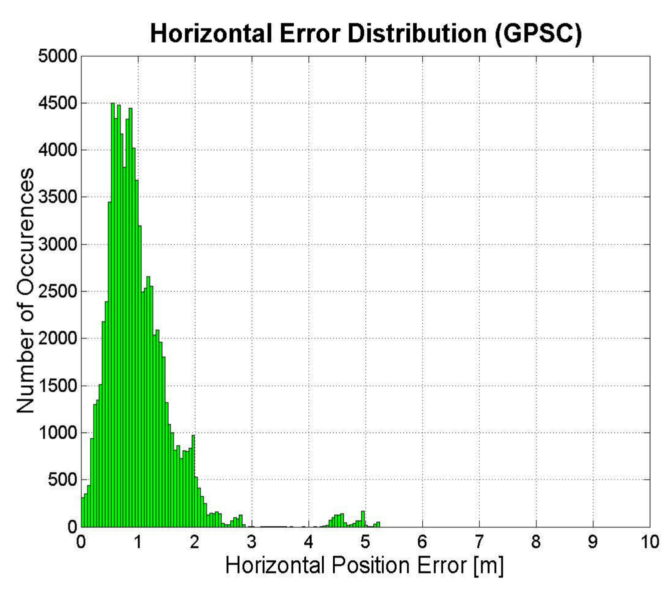
Positioning Results











Standalone GPS Statistical Analysis

	N error	E error	U error
Mean [m]	-0.70	-0.58	-0.97
std. dev. [m]	2.22	1.65	4.04
r.m.s. [m]	2.32	1.75	4.16
3d r.m.s. [m]	5.07		

GPS·C Statistical Analysis

	N error	E error	U error
Mean [m]	-0.66	-0.07	-0.66
std. dev. [m]	0.88	0.47	1.57
r.m.s. [m]	1.10	0.48	1.70
3d r.m.s. [m]	2.08		

Discussion:

Initial GPS·C results show 3d r.m.s. positioning accuracies at the 2 m level. During periods of strong geometrical strength 3d r.m.s. error improves to better than 1 metre.

Noticeable offset shown in GPS·C north and up mean values.

Standard deviations improved by 65% due to wide-area GPS corrections.

Results are affected by strong multipath environment.

Conclusions and Further Research:

GPS·C shows promising results.

Internet correction distribution is viable for testing and development.

Bias in latitude and height likely caused by residual ionospheric error and multipath.

Ionospheric correction accuracy is expected to improve when the revised ionospheric grid model is implemented.

GPS·C performance should be investigated in multipath-free environment and in kinematic tests.