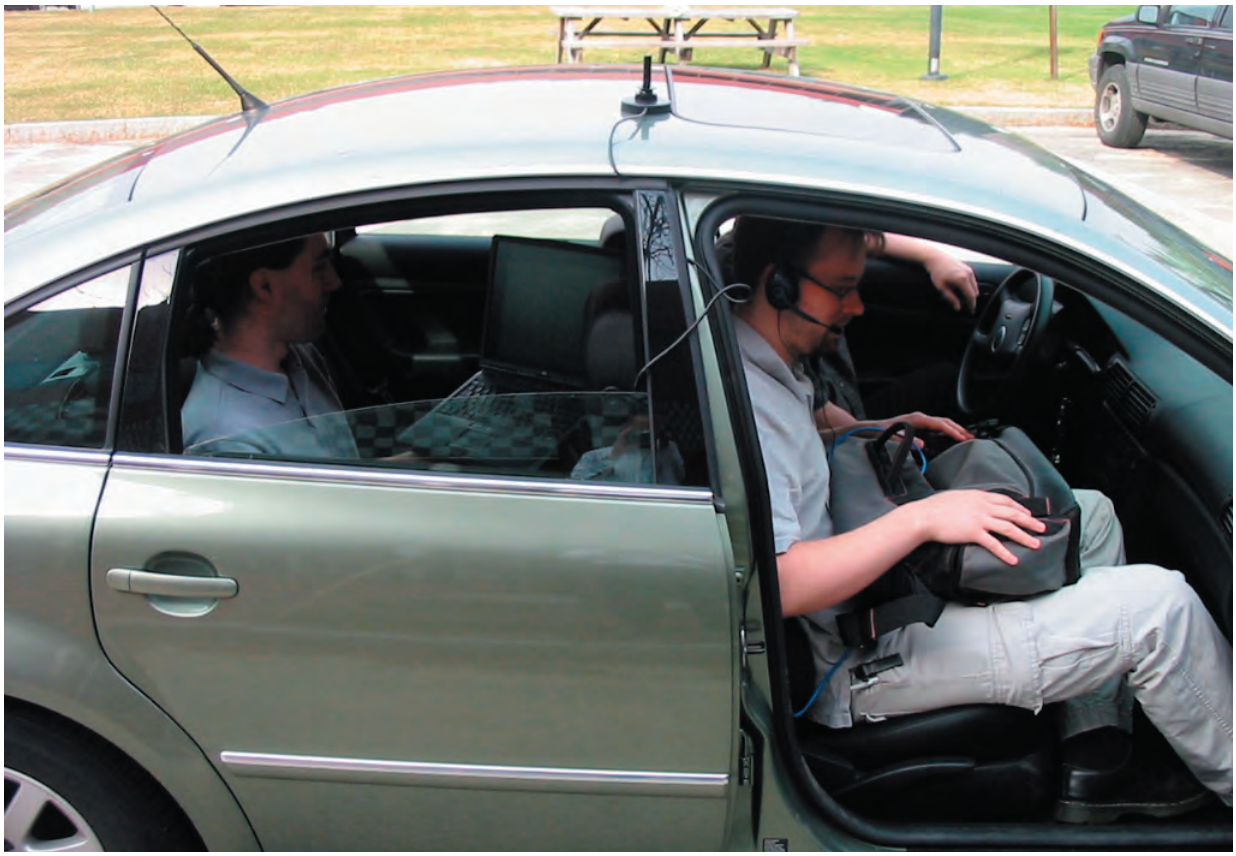
# ENGINEERING ADVENTURES- WARDRIVING WITH BRIC

BRIC (Broadcast Reliable Internet Codec) has been under development by us at Comrex for some time. It holds the promise of a new and flexible way to deliver high-quality live remote broadcast audio over a variety of IP based networks like DSL, Cable modems, high-speed cellular, and 802.11x (Wi-Fi). It's the latter that is especially exciting, given the widespread deployment of "Hotspots" in an increasing number of restaurants, bookstores, airports and other easily accessible locations.

To the Comrex engineering staff, the theory that BRICs would prove useful over Wi-Fi was sound, but too often the "real world" leaves theory lacking. So it was on March 30, 2005, an unseasonably warm and sunny New England day, that the engineering team set forth boldly to test BRIC on as many publicly available hotspots as possible. This is the story of that venture and its results.



## ENGINEERS GONE WILD



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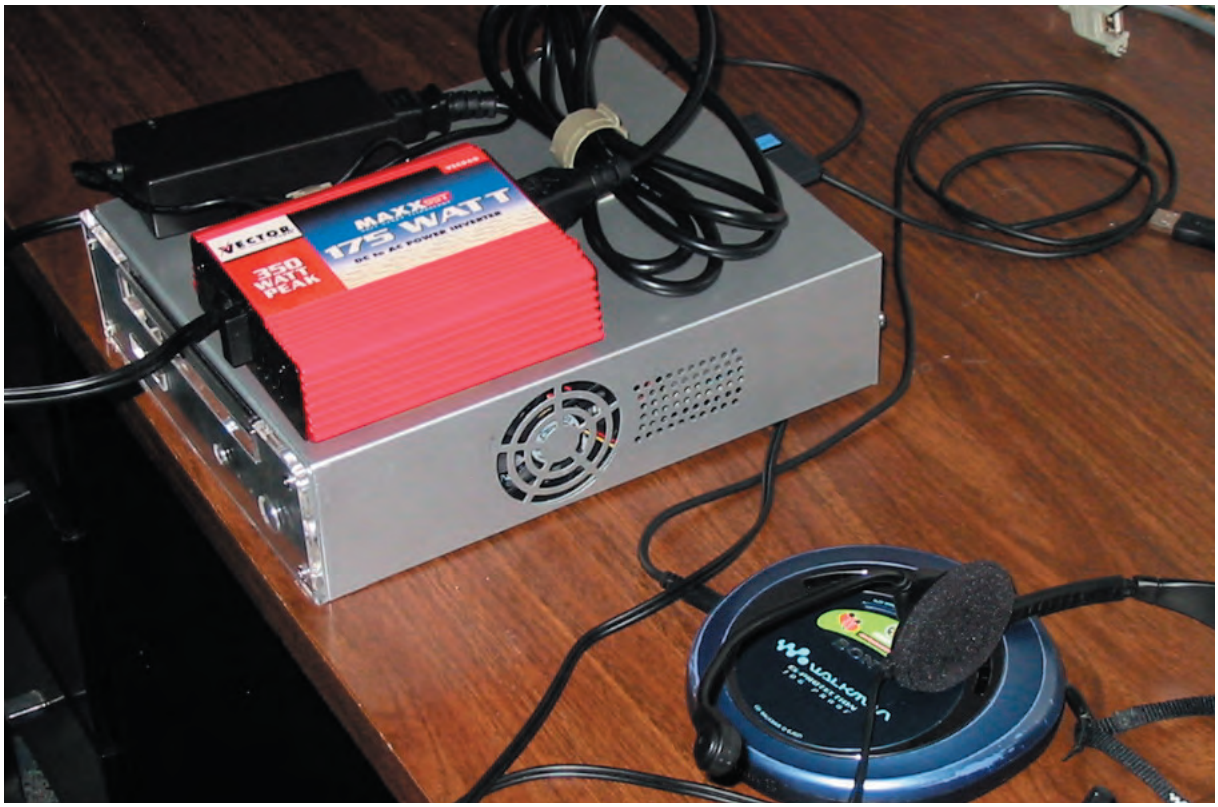
The final hardware for the ACCESS codec (the first codec to truly be a BRIC) was still very much underway and we used the prototype system pictured. The package obviously resembles your typical incendiary device and we did not want to alarm to public (or the authorities) with our testing so we felt it wise to encase the system in a laptop bag, which could be left discretely at our feet while the system was remote controlled by a harmless-looking laptop.




## The World's First BRIC Ready for Adventure

Our first stop was Panera Bread Company in Chelmsford, MA, a popular coffee shop which has in fact become the world's largest free Internet provider, with 537 stores offering unsecured Wi-Fi access. Because we had limited battery power, we were pleased to have found a cherished table near an AC outlet.

Once we had ordered our coffee and pastries, we prepared to connect to a public Wi-Fi with BRIC for the first time in history. We had visions of Alexander Graham Bell at that famous



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moment his telephone first came alive, having spilled his drink and beckoned Mr. Watson for help over the invention. We did intend, however, to be more careful than that with our coffees. But our excitement was soon muted when we found that our wireless access card couldn't connect to the Panera access point. Inquiries about the health of the Wi-Fi network among the baristas and bakers met with the expected quizzical looks and shrugs.

We decided as a last ditch effort that a new Wi-Fi card was in order. Luckily, the chosen Panera was adjacent to a WalMart, retailer of all things useful and otherwise. Our other engineers had an aversion to entering the mega-plex, with one guy flatly stating he had never set foot in one, and hoped never to have to. (I wondered how it was possible for an adult to have avoided WalMart his entire life.) So it fell to me to find the computer section of the giant store, and obtain the required hardware, leaving our engineer's WalMart virginity intact.

The replacement card did the trick and we were soon happily connected to the Panera Bread Network. We connected to another prototype BRIC located at the Comrex lab which was wired in an "analog loopback" configuration, and sent audio across the link in full duplex. Our chosen audio source was a book-on-CD playing from a CD-walkman. So it was that day that the first sounds transmitted over this breakthrough technology was from "Harry Potter and the Goblet of Fire".

The two key factors in using the public Internet for real-time audio are stability and latency. The nature of BRIC is that audio is broken into "packets" and sent off into the ether in hopes they will arrive at their destination quickly and in reasonable order. The only way to compensate for packets that are received late is to add a buffer at the input to the decoder, so that all packets will be received and ordered before decoding. The size of this buffer dictates the overall time delay of a particular link. So it's important to find the "sweet spot" on these networks, balancing acceptable packet loss with reasonable delay.



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At Panera we found that a solid connection was possible with a one-way audio delay of about 150mS. This put the delay in the same order of magnitude as a POTS codec, which seems workable for broadcasters. Optimism ensued as we headed toward our next destination.

Just up the road a few miles was the business district of Nashua, NH. Located on the state line and benefiting from the lack of a sales tax, this area is a retail Mecca. It also blossoms with wireless access points, as we found as we cruised the main throughway. Our laptop lit up with dozens of Wi-Fi networks, some secure, but many wide open. Our destination was Border Books, whose café includes a T-Mobile provided Hotspot. T-Mobile sports a subscription model, and we were taken aback a bit at paying $6-$10 (based on package chosen) for our one-time test. But regular users do get a better deal. The T-mobile connection was solid at a similar 150mS delay setting.

We made a quick stop at a nearby Starbucks, which also supplies Wi-Fi via T-mobile. Since this network had already been tested (and we'd had more than sufficient caffeine intake), we made a quick attempt to connect via the car. But shortly after we got our system booted and signal acquired, the caffeine took its toll when one of our engineers moved the laptop bag slightly the wrong way and dislodged the battery connector, killing power to the system. Rather than reboot and reconnect we went in search of a different network to try. Next stop: McDonald's.

Powered by a company called Wayport (which also provides access in many airports and hotels), the McDonald's Wi-Fi network is perhaps the most ubiquitous. But our engineers rebelled against actually going in (note to self: vegetarians make lousy alpha-testers) and we were once again relegated to the parking lot. Things went smoothly this time, however, and we were soon running our first mobile test. Delay and stability were quite reasonable on this link, and we could achieve rock-solid performance with only slightly over 100mS latency. We tooled around the parking lot a bit and lost our signal only when a large delivery



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truck passed between us and the restaurant. (We found traffic able to block Wi-Fi quite effectively.) We thought the $4 "daypass" charge to use the network was still high, but a Wayport subscription could bring this cost down.

We lost the sounds of Harry Pottter as we re-entered the highway, but we continued on towards the UPS store, which by coincidence shared a strip-mall with a highly recommended Mexican restaurant. After a vegetarian-friendly lunch, we tested the UPS store access point. Flush with our McDonald's success we opted to try it from the car, which worked quite well at the 250mS delay setting. This was the highest latency we found, and may have had more to do with the fact that we were parked 100 feet from the store front than anything else. The UPS store access was also "pay per use" but had the advantage of allowing charges to a range of other Wi-Fi subscription services. So if you already have an account elsewhere you can simply input that info to gain access.

A second network appeared on our laptop as available during this test. The ID shown on our laptop was simply "JT" but it was fairly strong throughout the area. We "sniffed" the area and pinpointed the signal to come from a local car dealer's parking lot. We surmised they offered free wireless to customers waiting for repairs. Since car dealers are popular sites for remote broadcasts we felt it our duty to run the test. We caught a few odd glances from the occasional salesman in the lot, but managed to secure a reliable connection with about 200mS delay.

We continued on a bit, sniffing commercial and residential areas alike and found quite a number of "wide open" accessible Wi-Fi networks. With wireless routers costing less than $50, the number of systems on-line wasn't the surprise as much as the lack of security. It's not rocket science to set these routers so they can't be easily "piggybacked". I suggested strongly that we resist the temptation to piggyback on any banks or law offices we found. But our laptop battery soon ran down anyway and we had to pack in our wireless adventure.

It should be noted that piggybacking on an unsecured private wireless network is probably deemed illegal in most jurisdictions, although the illegality of doing so without intent to hack anything really hasn't been tested in court. But this really shouldn't be necessary anyway, since legal public Wi-Fi is now so widespread. And with the advent of BRIC, all these now become points of origin for remote broadcasts, news, and sports with high-fidelity, full-duplex sound and reasonably low delay.



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