



# TIME AND MONEY II

WORKSHOP ON TIME SYNC REQUIREMENTS IN FINANCIAL MARKETS

## How Secure Time Affects and Challenges the U.S. Financial Trading Markets

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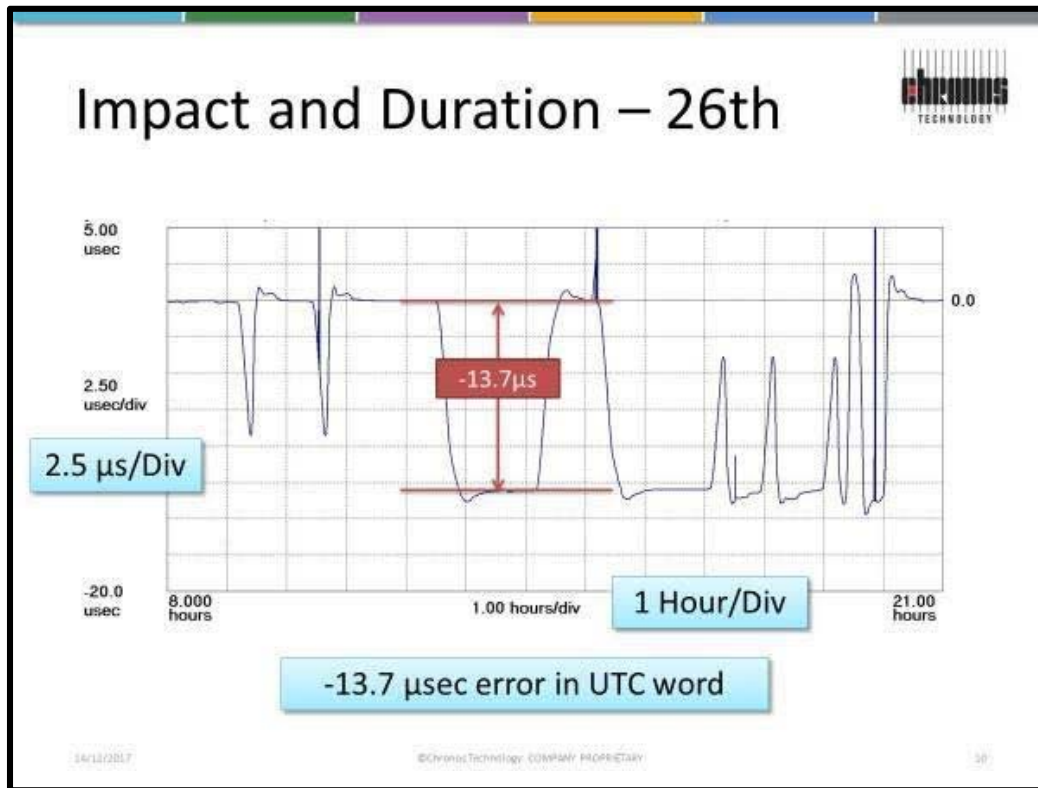
# HOW SECURE TIME AFFECTS AND CHALLENGES THE U.S. FINANCIAL TRADING MARKETS

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# GPS SYSTEM FAILURE



*Half the satellites agree on a 13 microsecond error, Jan 26, 2016.*

*One receiver trying to find the correct time.*

*How can a receiver decide, with two sets of consistent but very different answers?*

From the 2016 Workshop on Sync and Timing Systems, Presented by Charles Curry, Chronos Managing Director

Reference: [http://www.atis.org/wsts/2016/papers/5-02\\_Chronos\\_Curry\\_SVN23\\_What\\_Happened.pdf](http://www.atis.org/wsts/2016/papers/5-02_Chronos_Curry_SVN23_What_Happened.pdf)

# GPS JAMMING AT NEWARK AIRPORT

*When jamming interfered with GPS signals at Newark Airport, so-called 'personal-privacy devices' were found to be responsible...*

*.... these are low cost, low power, mobile, and very hard to pin down*



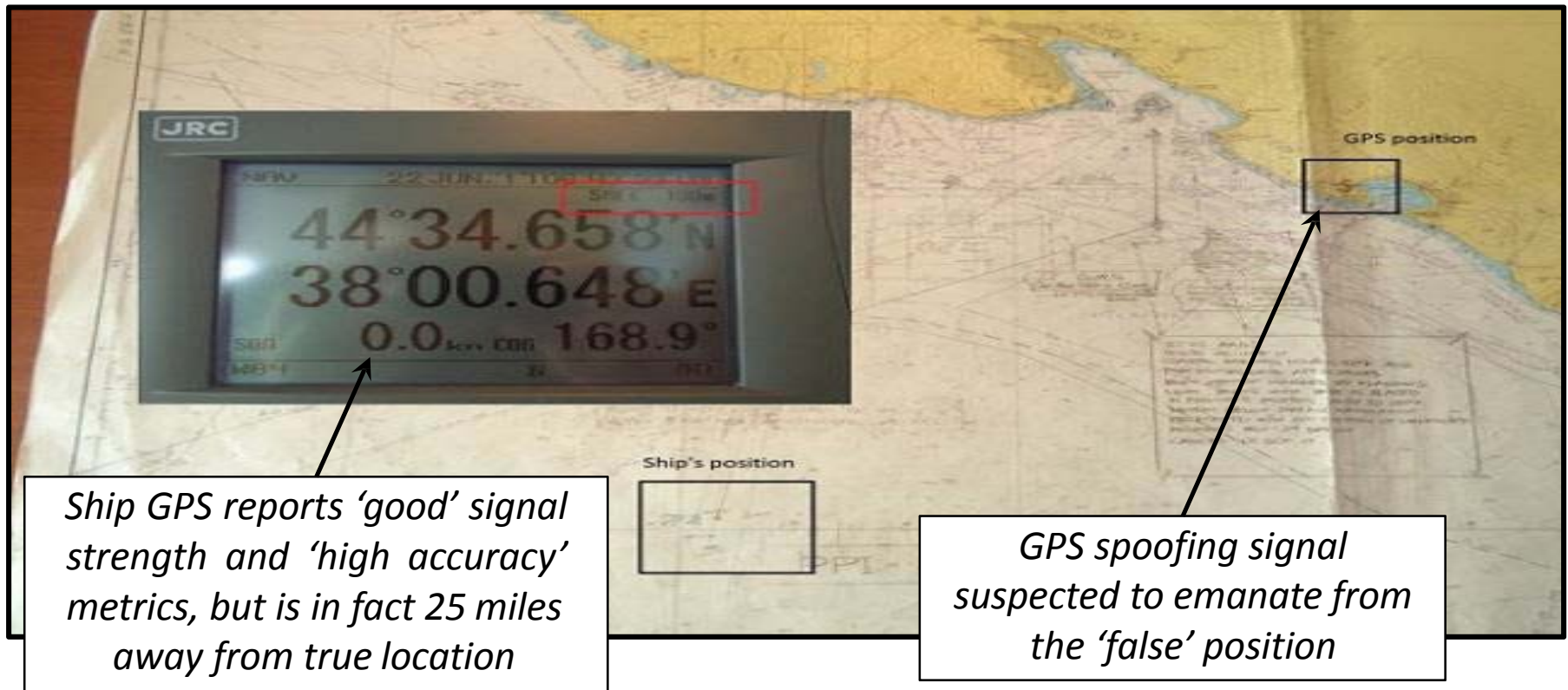
The screenshot shows a product listing for a "Mini GPS jammer for Car". The product is a small black device with a gold-colored antenna. The listing includes the following details:

- Price:** US\$57.90
- SKU:** JM132806
- Rating:** ★★★★★ ( 10 product reviews )
- Shipping:** Calculated at checkout
- Quantity:** 1 (dropdown menu) **Add to cart** button

Additional features include a "Free Shipping" badge, a "Like" button with the text "Sign Up to see what your friends like.", and a "SHARE" button with social media icons. A banner at the bottom of the product listing states "Free shipping via DHL US & European Countries".

Reference: <http://gpsworld.com/personal-privacy-jammers-12837/>

# GPS SPOOFING ON BLACK SEA

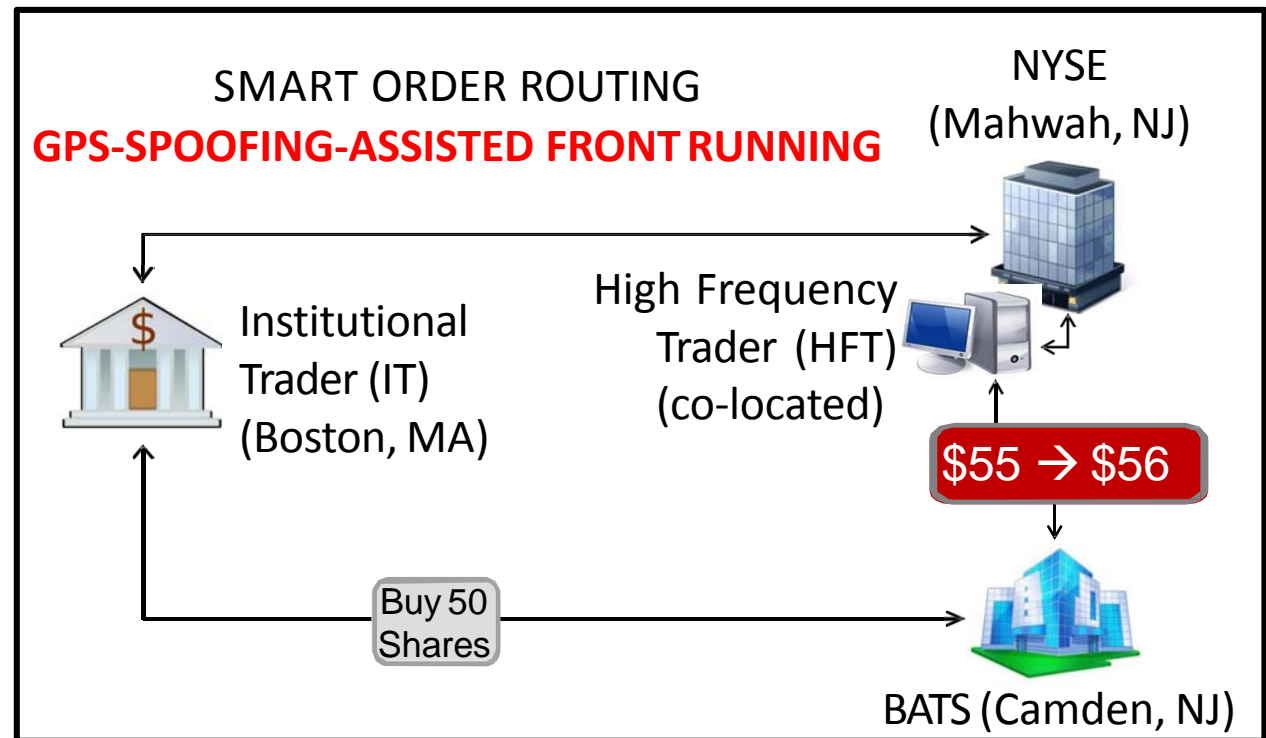


Reference: <http://www.insidegnss.com/node/5555>

# GPS SPOOFING IMPACT ON FINANCE

*Trade executed at best price at NYSE.*

*HFT detects “whale” at NYSE and quickly changes ask price at BATS; HFT’s alteration arrives before the IT’s order...*



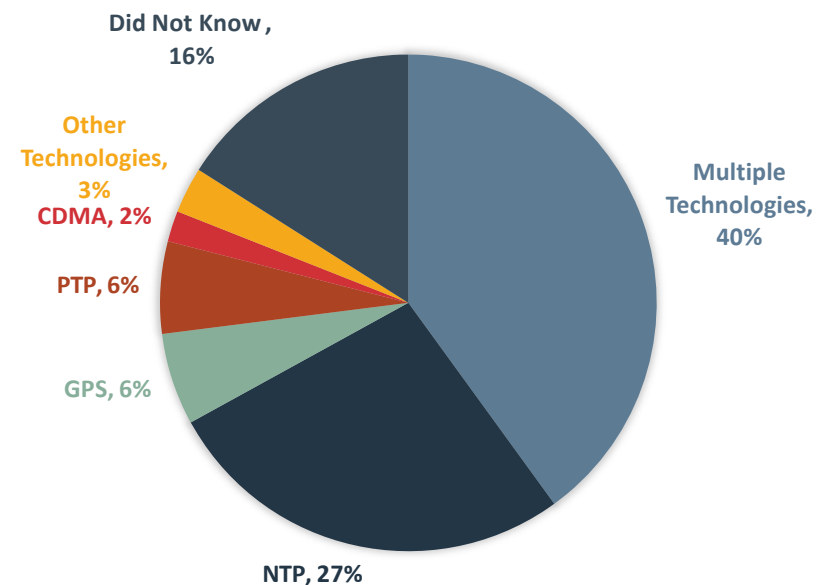
From ATIS Webinar on GPS Vulnerabilities, 2013, Todd Humphreys, UT, Austin

Reference: <https://www.youtube.com/watch?v=U8xyVeZSyOU&feature=youtu.be>

# WHAT'S NEXT

- The barriers to execute GPS-based timing manipulation or denial attacks are minimal
- Secure time (from diverse, redundant, and resilient sources) should be viewed as a cost of doing business and as part as a MiFID II compliance strategy. If your networks are worth securing, so are your clocks.
- Financial firm's timing performance needs and compliance obligations are increasing. Secure time is possible to implement today, but implementation must be done deliberately.

SOURCES OF BUSINESS CLOCK SYNCHRONIZATION (FROM SEC SYNC SURVEY)



**GPS timing issues will propagate into most time transfer technologies and infrastructures deployed in finance today**