

Cryptographic Provenance for Digital Publishing



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Challenge

Our overall objective is to transform trust in digital media by creating new publishing workflows that incorporate cryptographically signatures indicating the provenance of digital media and effectively communicate this information to readers. To this end, we will design, develop and test a novel technical system to support information consumers in authenticating the provenance of digital media on the web and develop interfaces that effectively convey the stronger transparency and accountability properties of content published with these properties.

Our project is motivated by research questions including:

- How can cryptography help ensure trustworthiness of digital media?
- Can user interfaces make information about the authenticity and integrity of digital media usable for news consumers?
- How does the successful communication of information authenticity contribute to the perceived trustworthiness of specific pieces of digital media?
- If users understand the greater accountability and transparency provided by our system, does this influence their broader consumption and/or confidence in publishers of digital information?

Solution

Our cryptographic prototype builds on top of Google's Trillian log infrastructure and the WordPress content management system (the most widely-used CMS found in the above research). The figure below shows a flowchart of the technical design of the prototype:

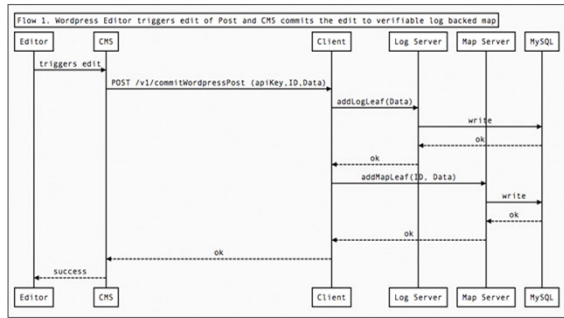


Fig. 1: Flowchart of the cryptographic provenance tool prototype's integration with the WordPress CMS

Scientific Impact

- We surveyed platform-facing (e.g. Schema, Facebook and Twitter) metadata markup practices used by US news organizations, revealing wide discrepancies. The most robust metadata was associated with proprietary content management systems (CMSs) available only to legacy organizations, highlighting that digital publishing may replicate historical inequalities for media serving US Black, ethnic minority, and diaspora communities.
- We investigated digital news consumers' needs and behaviors relevant to news transparency and authentication. We found digital news users have specific expectations regarding news transparency; they indicate a strong desire for a news authentication tool that independently secures and verifies content and that can seamlessly integrate with the places they already get digital news.
- Ongoing work will focus on journalists' attitudes towards more fully transparent auto-publication changes, as well as usability and design experiments focusing on effectively conveying complex changes to text (above) and their impact on readers' trust in published news content.



Fig. 2: Existing approaches to conveying text changes

Broader Impacts

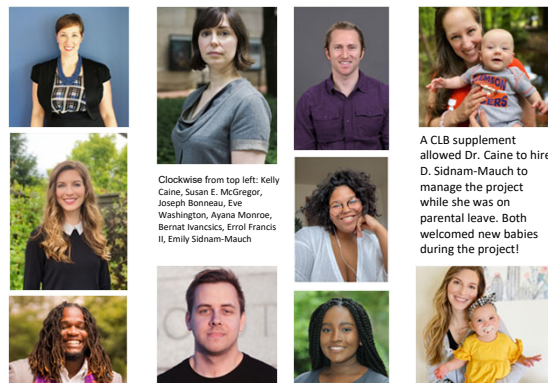
The findings from our research on news production practices contributes to understandings of how digital news production practices vary and affect access to perspectives from diverse media sources. Our user research adds to the base of knowledge on user needs relevant to security and trust indicators for digital news. As we continue to develop our prototype, we anticipate that the techniques we develop will demonstrate the practicality of news provenance as an important new application for cryptographic transparency techniques. In addition:

- We contributed research knowledge to communities of interest by presenting our research proposal and initial results at Columbia's Data Science Institute Cybersecurity Poster Session and Data Science Day, the UNC Chapel Hill CSS Annual Research Symposium, and the ICWSM MEDIATE Workshop.
- The project has provided training in cryptography, human-centered computing, and digital media to the 3 graduate researchers and 4 REU students.
- Research from this project has been used to add and update content in PI Caine's Usable Privacy and Security courses, PI Bonneau's graduate cryptography course and textbook, and PI McGregor's undergraduate-level data science course offered to NYC public high-school students at the Bard High School Early College Program's Manhattan campus in Fall 2021.



REU students Eve Washington (left) and Ayana Monroe (right) present their posters to the public at Columbia's Data Science Day Poster Session (4/6/2022)

Current research team



Clockwise from top left: Kelly Caine, Susan E. McGregor, Joseph Bonneau, Eve Washington, Ayana Monroe, Bernat Ivancsics, Errol Francis II, Emily Sidnam-Mauch

A CLB supplement allowed Dr. Caine to hire D. Sidnam-Mauch to manage the project while she was on parental leave. Both welcomed new babies during the project!

Publications

- Bernat Ivancsics, Eve Washington, Errol Francis II, Ayana Monroe, Emily Sidnam-Mauch, Joseph Bonneau, Kelly Caine & Susan E. McGregor, "Comparing digital news infrastructures: An analysis of the markup selections across the online platforms of U.S.-based news," Digital Journalism: The Platformization of News, (10), 2022.
- Ivancsics, Bernat; Washington, Eve; Yang, Helen; Sidnam-Mauch, Emily; Monroe, Ayana; Francis II, Errol; Bonneau, Joseph; Caine, Kelly & McGregor, Susan E. (2022, May 26-30). *Comparing digital news infrastructures: An analysis of the markup selections across the online platforms of U.S.-based news organizations*. [Paper presentation], ICA, 2022: Paris, France.
- Monroe, A., Francis II, E., Sidnam-Mauch, E., Ivancsics, B., Washington, E., McGregor, S. E., Bonneau, J., & Caine, K. (2022, April 6). *A transparency-driven analysis of news trust tools*. [Poster presentation]. Columbia University Data Science Institute Data Science Day 2022, New York City, NY, USA.
- Washington, E., Ivancsics, B., Sidnam-Mauch, E., Monroe, A., Caine, K., & McGregor, S. E. (2022, April 6). *Comparison of tools for digitally tracking changes in text*. [Poster presentation]. Columbia University Data Science Institute Data Science Day 2022, New York City, NY, USA.
- Ivancsics, B., Washington, E., Yang, H., Sidnam-Mauch, E., Monroe, A., Francis II, E., Bonneau, J., Caine, K., & McGregor, S. E. (2022, April 6). *Assessing the markup layer in U.S.-based digital news publishing*. [Poster presentation]. Columbia University Data Science Institute Data Science Day 2022, New York City, NY, USA.
- Caine, K., McGregor, S., Bonneau, J., Francis II, E., Ivancsics, B., Kern, B., Zitek, A., Elwood-Dieu, K., & Monroe, A. (2021, February 19). *The news authentication project: Cryptographic provenance for digital publishing*. [Virtual poster presentation]. Columbia University 2021 Data Science Institute Cybersecurity Center Poster Session.
- Caine, K., McGregor, S., Bonneau, J., Francis II, E., Ivancsics, B., Kern, B., Zitek, A., Elwood-Dieu, K., Monroe, A., Yang, H., & Washington, E. (2021, April 21). *The news authentication project: Cryptographic provenance for digital publishing*. [Video poster presentation]. Columbia University Data Science Day, April 21, 2021.
- Monroe, A., Francis II, E., Sidnam-Mauch, E., Ivancsics, B., McGregor, S., Bonneau, J., & Caine, K. (2021, October 13). *Perceived need and desired features for a news authentication tool*. [Poster Presentation]. University of North Carolina at Chapel Hill Chancellor's Science Scholars Annual Research Symposium, Chapel Hill, NC, USA.

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