

RESULTS FROM THE EWRI SUMMIT ON THE FUTURE OF EPANET

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ABSTRACT

The Environmental and Water Resources Institute (EWRI) in association with the National Center for Infrastructure Modeling and Management (NCIMM), EPA, and the broad user and open-source software development communities convened an EPANET Visioning Summit in Reston Virginia on April 3-4, 2018. The mission of the summit was to develop a shared vision for the future development of EPANET. There were 35 invited participants including representatives from EWRI, EPA, NCIMM, commercial software companies, engineering consultants, water utilities, academia, and professional organizations. The Summit included keynote plenary presentations, an evening session on successful open-source programs, and a series of focused breakout sessions. Results of this Summit are summarized in this paper.

Keywords: EPANET, modeling, simulation, applications, software

1 Background

EPANET is a widely used public domain tool for the analysis of water distribution systems. It has been the primary platform for the support of research in this area, a free multi-featured software package for modeling water distribution systems around the world, and as the technical basis for several highly successful commercial software packages. EPANET has helped to support critical investments in infrastructure improvements and operation at drinking water utilities worldwide.

EPANET was originally developed in 1993 by Dr. Lewis Rossman of the EPA Office of Research Development. Since then, EPA has continued to modify and distribute the software along with source code, documentation and a programmer's toolkit. Over the years, university researchers and private industry have developed modified versions of EPANET to meet their own needs, and, in 2015, an open source community emerged to further develop EPANET. In 2016, the National Center for Infrastructure Modeling and Management (NCIMM) was awarded a USEPA grant with a charge to facilitate tech transfer of EPA's open source water infrastructure models including EPANET through novel research, community support and outreach, and model and code development. The Environmental and Water Resources Institute (EWRI) and its committees and councils have a long history of involvement in the water distribution system modeling field.

2 EPANET Summit

EWRI convened an EPANET Visioning Summit in Reston Virginia on April 3-4, 2018. The mission of the summit was to develop a shared vision for the future development of EPANET. The workshop was organized in association with the new National Center for Infrastructure Modeling and Management (NCIMM), EPA and the broad user and open-source software development community. There were 35 invited participants including representatives from EWRI, EPA, NCIMM, commercial software companies, engineering consultants, water utilities, academia, and professional organizations. NCIMM is a relatively new organization and is in the process of developing partnerships and advisory boards that involve the broader EPANET community; part of the goal of the meeting was to better understand NCIMM's role in the future development of EPANET. The Summit included keynote plenary presentations, an evening session on successful open-source programs, and a series of focused breakout sessions.

The opening plenary session was designed to provide a basic understanding of EPANET and the associated community. It included presentations on: the history of EPANET, how NCIMM can help support EPANET, what EPA is planning for EPANET, how the open EPANET community works, EPANET challenges and opportunities, an end user perspective on EPANET, and the role of commercial vendors in EPANET development.

Breakout sessions focused on addressing the following questions:

- 1) What is the appropriate structure and style for future EPANET development?
- 2) What additional functionality is needed in EPANET and other water distribution system modeling software?
- 3) How can the various members of the EPANET community work together to best move EPANET forward in the future?

The results of the three breakout groups are described below.

2.1 Future Structure for EPANET

The group proposed a phased program for future EPANET modifications:

- Starting with the currently distributed version EPANET 2.012 with recent modifications made by the open-source group Open Water Analytics (OWA).
- EPANET 2.2: Near term modifications to the engine to address some identified deficiencies including a more rigorous hydraulic convergence criteria, a more efficient node reordering method, avoiding negative pressure results, avoiding numerical issues with low or zero flows, improved modeling of tank dynamics and eliminating water quality mass balance errors.
- Development of EPANET 3 using an object-oriented structure. Dr. Lewis Rossman, the original developer of EPANET has prepared a white paper on this subject [1] and has developed a “strawman” version of EPANET 3 as a starting point for this phase.
- The possibility of a complete long-term restructuring of EPANET in the future (EPANET 4).

Options for the development of alternative GIS-enabled graphical user interfaces (GUIs) were discussed. Options included the EPANET-UI software recently developed for EPA or alternative independently-developed GUIs. The engine and GUI associated with each of these phases is illustrated in Figure 1.

	CURRENT	SHORT-TERM	LONGER-TERM	FUTURE?
ENGINE	EPANET 2.012	EPANET 2.2	EPANET 3.0	EPANET 4.0
GUI	DELPHI 7	Delphi 10 (or Lazarus?)	?	?

Figure 1. Proposed Future Phased Development of EPANET

2.2 Needed Functionality

This group enumerated additional functionality that is needed in EPANET and other water distribution system models. A total of 44 specific areas of functionality were identified in four areas. These areas and examples of the identified functionality are listed below:

- User experience:
 - start and stop the simulation to dynamically change its parameters
 - a better interface for spatial data embedding (GIS)
- Development needs
 - integrate tools as extensions (e.g., RTX, MSX)
 - library of QA models for testing datasets
- Hydraulics
 - improved hydraulic solution speed
 - better diagnostics when run fails
- Water quality
 - integrate EPANET with EPANET-MSX
 - incorporate dispersion into water quality analysis

For each of the identified functionality topics, it was noted whether this functionality is available in whole or part within commercial water distribution system analysis software packages.

2.3 Future Community Efforts in the Development of EPANET

There was general agreement in this group surrounding the continued development of EPANET as an open-source project, with strong community contributions and based upon a permissive license. While the general agreement is a good step forward, more specific details need to be addressed within the broader framework. Continued discussion among the represented groups will further shape the overall development to ensure that the diverse EPANET community can work together effectively to further the advancement of EPANET.

3 Moving Forward

The EPANET Visioning Task Committee has been established under the EWRI Water Distribution Systems Analysis Committee (WDSA). The purpose of this is to coordinate the broader EPANET community and to chart a direction for the future short term and long term development of the

EPANET and to recommend a role for EWRI in future EPANET–related activities. The committee will follow up on the results of the Summit, produce a written report summarizing the conclusions, and prepare a series of “white papers” on various related topics. Overall, the results of the summit will result in more coordination and communication among EPANET stakeholders, and a shared vision for the future of this important water infrastructure software.

4 References

- [1] L. Rossman, “A Proposed Design for EPANET 3”. An unpublished white paper prepared for the EWRI EPANET Visioning Task Committee. April 25, 2018.