Data Transfer via Alternative Conduits: Using Fluid Networks

Abstract

Digital convergence has reshaped a gamut of industry demographics in the 21C, comprised of cloud computing, healthcare, pharmaceutical, consumer supplies, government, defense, manufacturing, entertainment, and even on-line education, among many others. At the center of the web-convergence lies the problem of network bandwidth limitation. Traditionally, research has focused on two major resolution strategies in parallel: data compression to minimize the network traffic (*i.e.* algorithmic; software) and alternative conduit for data transfer such as wireless (*i.e.* infrastructural; hardware).

Building a network infrastructure is extremely costly. In addition, maintenance and upgrade costs may be prohibitive, given the U.S. consumer demographics. To this end, the emphasis is placed on seeking *existing* infrastructure which connects business and residential entities.

The objective of this research, therefore, is to seek the possibility and feasibility of (digital) data transfers via the extensive *water* and/or *sewer* network(s), while minimizing structural modifications to the existing infrastructure. To date, *sonar* has been proven to be effective. If successful, the value of this intellectual property may be immeasurable.

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Key Words: Digital Convergence, Web Convergence, Information Network Management, Network Bandwidth, Data Transfer Conduit, Fluid Network, Intellectual Property, Business Model, Technology Strategy.

I. Introduction

Digital convergence has reshaped a gamut of industry demographics in the 21C, comprised of cloud computing, healthcare, pharmaceutical, consumer supplies, government, defense, manufacturing, entertainment, and even on-line education, among many others. The *web convergence* for business and home, as well as for personal interests, has been one of the topical areas of Management Information Systems (MIS) and Management of Technology (MoT), in which the demand sharply exceeds the supply. Consequently, this imbalance provides an opportunity as well as challenge for the area research.

At the center of the web-convergence problem lie the network bandwidth limitations. Traditionally, research has focused on two major resolution strategies in parallel:

- *Data compression* to minimize the network traffic (*i.e.* algorithmic; software); and
- *Alternative conduit* for data transfer such as wireless (*i.e.* infrastructural; hardware).

Building a network infrastructure is extremely costly. In addition, maintenance and upgrade costs may be prohibitive, given the U.S. consumer demographics from one coast to the other. Further, managerial challenges such as constant (bandwidth) upgrades to the network and technical challenges comprising incompatibility, portability, and/or power failure increase the problem dimensions in real time. More specifically, its problem complexity is expected to belong to a high-order polynomial class, well beyond geometric. To this end, the emphasis is placed on seeking other *existing* (network) infrastructure which connects business and residential entities.

The objective of this research, therefore, is to seek the possibility of (digital) data transfers via the extensive and proprietary *water* and/or *sewer* network(s), while minimizing structural modifications to the existing infrastructure. If successful, proposed framework of this research may be extended to encompass the open waters such as intercontinental *oceans* to allow alternative global network infrastructure. In essence, the value of the intellectual property may be immeasurable.

Fluid has been proven to carry electricity, which motivated this research in information network management. Indeed, electrical power lines have been employed to transmit data in limited applications [Willow, 2012]. Ahola [2003] stresses in his research, "There has not been carried out much research work that is focused on the high frequency characteristics of industrial low voltage distribution networks. The industrial low voltage distribution network may be utilized as a communication channel to data transfer required by the on-line condition monitoring of electric motors. The advantage of using power-line data transfer is that it does not require the installing of new cables." Moreover, research has been focused primarily on (wireless) transmission of *static data* (*i.e.* sensors) such as device utilization [QuadLogic, 2010]. Confined to local data transfers, the Power Line Communication (PLC) technology is most extensively employed in industry [Wikipedia, 2010]. Conceptually, low-bandwidth digital data, next to electrical power, is transmitted over high voltage transmission lines, distributed over medium voltage, and used inside buildings at lower voltages. A summary of possible digital networks is provided by Wikipedia [2010] in Table 1.

Table 1. Conduits for Digital Networks

v·d·e **Internet access** [hide]

Network type	Wired					Wireless		
	Optical	Coaxial cable	Twisted pair	Phone line	Power line	Unlicensed terrestrial bands	Licensed terrestrial bands	Satellite
LAN	Ethernet	G.hn	Ethernet	HomePNA · G.hn	G.hn · HomePlug Powerline Alliance	Wi-Fi · Bluetooth · DECT · Wireless USB		
WAN	PON · Ethernet	DOCSIS	Ethernet	Dial-up · ISDN · DSL	BPL	Muni Wi-Fi	GPRS · iBurst · WiBro/WiMAX · UMTS-TDD, HSPA · EVDO · LTE · MMDS	Satellite

The Universal Serial Bus (USB) technology, patented by a consortium of a number of for-profit organizations [USB, 2010], is one of the globally adopted proprietary data connectors at present. USB connectors supply power and data in parallel via a single conduit with acceptable reliability. However, it is a bus, as opposed to a network, which transmits data within an Information Technology (IT) device. Whereas the network is a conduit that allows *inter-system* data communications, the bus operates for *intra-system* purposes inclusively.

Unlike *light* as the conduit for data transmission that provides near-indefinite bandwidth, research on fluid networks have been almost nonexistent to date. Fluid is infamous for disseminating particles which infiltrates it. In effect, integration of data packets to complete their delivery, as well as supporting the entire data communication infrastructure, is moot at best for the time being.

As an alternative, converting the data into *analog sonar signals* prior to their transmission in fluid is suggested in this paper. Sonar signals have been proven to successfully engage with fluid for data transmission. Moreover, their inherent characteristic such as propagation allows them to be reliably delivered – in fluid – over long distance. Difficulty may arise in open waters, however, due to the lack of control mechanism discovered/developed for sonar signals [Yao *et al.*, 2010]. On the other hand, fluid passing through enclosures such as water and sewer networks may provide a technically feasible platform for sonar signal communication.

II. Conceptualization of Data-to-Sonar Conversion

This section introduces the proposed conceptualization model of the Data-to-Sonar (*D-S*) as well as *S-D* conversions. Illustrated in Figure 1 is the conceptual D-S process for the pre-delivery phase of data communication. Its reversal is the S-D process for post-receipt phase. Note the constraint of applying *enclosed* fluid network architectures in this paper.

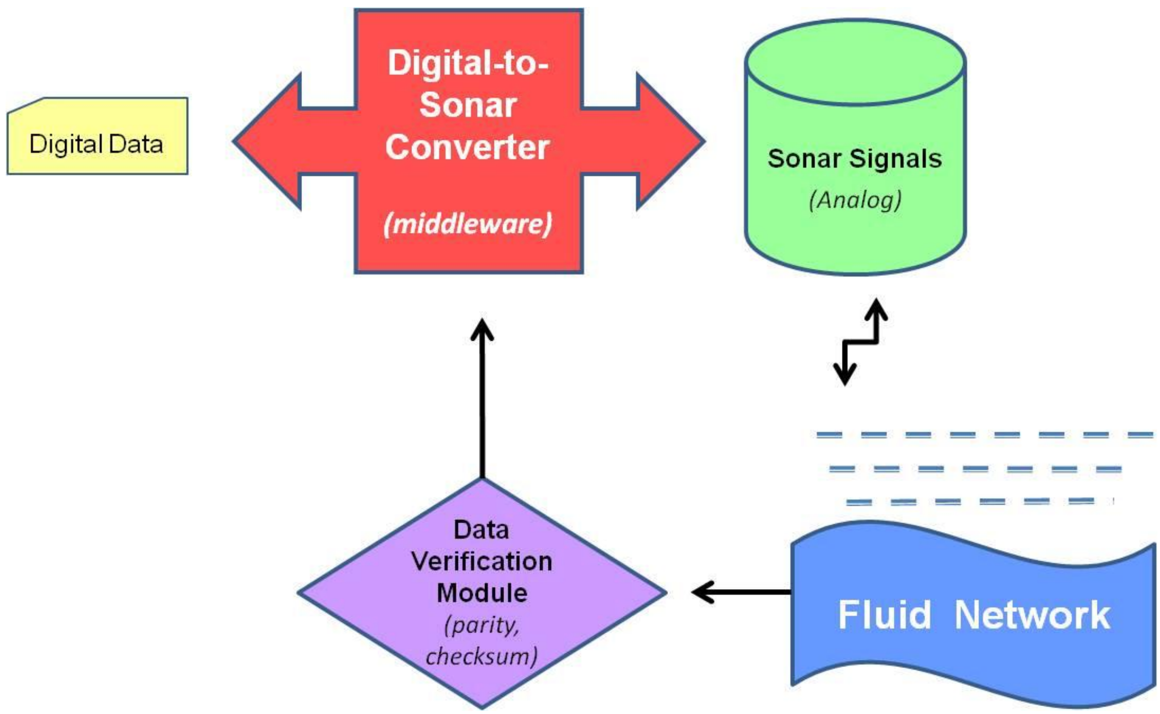

Figure 1. Data-to-Sonar Conversion

Each data packet must be converted into corresponding (analog) audio signals prior to its delivery through the fluid network. Undoubtedly, central to this process is the development of the *Digital-to-Sonar* (D-S) and *Sonar-to-Digital* (S-D) converter. It is an intelligent middleware dedicated to accurately parsing the two distinct types of data. Layout for systems and functional design for the MOduarization-DEModularization (MODEM) may lend itself to the design of the D-S converter. Modularization is the process in which digital data is converted into analog, and vice versa for demodularization.

In practice, state attributes of fluid are expected to greatly influence the transmission rate of (sonar) data. For example, viscosity of fluid in a sewer network may cause interference to data delivery, increasing the noise rate. In effect, both α and β errors may increase. Type I or α error is specified as the rate of inconsistent data receipt, in which the data is not received in full or in its entirety. Its end effect is a corrupted data. Another inconsistency, type II or β error, in contrast, results in unauthenticated data, which deviates from the original. Unauthenticated data may not recurrently be corrupt.

Collaboration from Research-and-Development (R&D) entities is an absolute prerequisite for the design, development, β tests, validation, implementation, and quality assurance for the proposed D-S converter. Indeed, the value chain of this proposed architecture must associate itself with many for-profit consortia globally.

Intellectual properties accrued from technology innovation projects comprised of data communications via fluid networks discussed in this paper, coupled with *original* technologies such as the Third-Generation Display (3GD) and *e*-Paper, designed and developed by Willow [2010], are considered vital to complete the next-generation value chain of the U.S. economy. In addition, reliability of a developed prototype system may be secured by the *Integrated Systems Design Methodology* © [Willow, 2007].

III. Summary and Conclusions

In the midst of digital and web convergence for the global economy, demand for data network bandwidth is expected to increase geometrically if not exponentially, in the 21 century. Traditionally, research has focused on two major resolution strategies in parallel: data compression to minimize the network traffic (*i.e.* algorithmic; software) and alternative conduit for data transfer such as wireless (*i.e.* infrastructural; hardware).

The objective of this research was to seek the possibility of (digital) data transfers via the extensive *water* and/or *sewer* network(s), while minimizing structural modifications to the existing infrastructure.

Technically, however, digital data was not able to propagate through fluid. As a feasible alternative, conversion of digital data into analog sonar signals was suggested. A conceptual systems architecture was built, in which a seminal centerpiece entitled the

Digital-to-Sonar (D-S) converter was introduced. The D-S parsing process resembles that of the MODEM for a number of Information Technology (IT) platforms.

The value of this original intellectual property may be immeasurable, if successful. The effect, in essence, is a construction of a global economic value chain with a ubiquitous digital network which is environmentally safe and sustainable.

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As always, this paper is dedicated to his little precocious son, Ocean Willow, who may use his own *swimming pool* for data communications some day. . .

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