

Chapter 11

A Semiotic Framework for Research into Self-Configuring Computer Networks

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Abstract

Self-configuring computer networks are designed to offer services to users in response to their specific requirements on particular occasions. In order for such networks to obtain information about their users' requirements and then to respond appropriately, processes of communication need to take place, not only between the user and the network, but also within the network itself for the purpose both of configuring the network appropriately and of providing the required services. These processes can be analysed in terms of a multilevel semiotic framework in such a way as to clarify our understanding of their properties in relation to structure, meaning, and contextually situated use. Such a framework offers an attractive basis for research into self-configuring networks.

11.1 Introduction

11.1.1 Background

Computer networks have become a very familiar part of the contemporary world. At one end of the scale, local networks play a vital role in supporting the activities of countless organisations, and they have also spread into less formal contexts, such as domestic settings. On a broader front, the

global Internet has enabled people all over the world to enjoy network access on a grand scale.

The authors of the present chapter are involved in research into networked systems. In particular, we are interested in environments known as *self-configuring* or *ad hoc* networks. In these environments a number of electronic devices are co-located and connected to a common networking medium, which may be either wired or wireless. Within such a created network the devices communicate to determine the services that each can offer; and then the collaboration offers a set of combined services to the user or users. Examples include: (i) a domestic environment, where each device in the home is connected to every other device, allowing for interactions currently not possible; (ii) an operating theatre environment, where devices to support a surgical operation are brought together to assist the hospital workers; and (iii) a spacecraft environment, where devices that have been manufactured to heavily defined constraints employ a self-configuring network in order to provide services to the users and to the craft itself.

In considering such environments the difference between the devices and the network should be recognised. All the intelligence resides in the former, while the latter is simply a medium for interconnection.

When a device is brought into the network, whether through a physical connection (being plugged in) or coming into the range of a wireless connection, it must communicate its entrance to the other devices. In addition, devices require the ability to enquire about the services that other devices offer and to respond to such enquiries themselves.

Devices therefore provide services to other devices; and the combinations of these services (superservices) provide benefits to the user or users of the network. Many systems exist to provide such interconnection. These include UpnP, HAVI and JINI, while more academic research-oriented examples are Aura (CMU), Oxygen, Endeavour and Portolano. However, accounts of these have not so far contained any explicit discussion of the semiotic implications of such systems.

UPnP (<http://www.upnp.org>) is based on XML and Internet technologies and describes devices in terms of a set of services with invocable operations. HAVI (<http://www.havi.org>) is designed for interconnection of home audio and video equipment based on Firewire (IEEE 1394) as a physical layer. It defines services as a set of objects, again with operations. JINI (<http://www.jini.org>) is a Java-based service-discovery mechanism. Services are specified as Java interfaces and the interaction between clients and services is done through remote method invocation (RMI).

In Aura [12] the system exists to support user mobility; for example as a user moves between environments it allows the user to continue on a task. The