

Display Interfaces

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Display Interfaces

Fundamentals and Standards

Robert L. Myers

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Foreword

By their nature, display interfaces and the standards that govern their use are ephemeral. They are the more so because extremely rapid developments in the field have been driven by increasing pixel content of displays and by requirements for increased colour depth and update rates.

So, why write a book on this subject? There are several reasons, but foremost among them is the fact that the nature and the performance limitations of display interfaces are often ill understood by many professionals involved in display and display system development. That is why this latest addition to the Wiley-SID series in Display Technology pays particular attention to the principles that underlie display interfaces and their architecture.

In the first four chapters, the author includes information on basic concepts, the human visual system, the fundamentals of colour and different display technologies to enable an inexperienced reader to acquire sufficient background information to address the remaining nine chapters of the book. In these chapters, all aspects of display interfaces are addressed, starting with performance requirements and the basics of analogue and digital interfaces. Then follow discussions of standards for format and timing, analogue video (for TV and computers) and digital interfaces. Other interfaces than those used to convey image data to the display are also discussed; these are the interfaces, which, among other functions, enable a computer to identify and then correctly to address a newly connected display. The book concludes with a discussion of the impact of digital and HDTV and of the changes that will be necessary if future interface designs are to be able to deal with ever increasing display pixel content. Throughout the book, a great deal of practical information with examples of commonly used hardware is provided. This is backed up by a section containing references to source material available in print or from the web and a glossary in which all the commonly used terms are defined.

Interface architectures and the standards that govern them will certainly change. Even so, this volume will remain a valuable handbook for engineers and scientists who are working in the field and a lucid and easy to read introduction to the subject for those who are not.

Anthony C Lowe
Braishfield, UK 2002

Preface

Human beings are visual creatures. We rely on imagery and our sight for communication, entertainment, and practically every interaction with our environment and with other individuals. So it is not surprising that the single most important output device for electronic information and entertainment products is some form of display. For many years, this was almost always a cathode-ray tube (CRT) display, and the basics of those were more or less the same regardless of the particular application in question.

Today, the situation has changed. Many different display technologies have either opened new applications for electronic displays, or are challenging the CRT for supremacy in its traditional markets. With these new types of display, and with the new applications and usage models that they enable, a bewildering array of issues face the display designer and system integrator. Besides the obvious question of which display to use, how does one ensure that the displayed image will appear as expected – either in terms of being a recognizable facsimile of reality, or at the least appearing similar to some other display? What interface should be used, and how? What does the display really have to do – or not do – in order to provide a satisfactory image? While the display systems based on each of the various technologies must all perform the same basic functions, how the desired performance is actually achieved can vary greatly depending on the technology, application, or usage model in question.

This book is an attempt to address many of these issues, and is intended for anyone who needs to deal with electronic displays – both CRTs and the newer technologies – as a systems integrator, content provider, graphics hardware designer, or even as a serious amateur user or hobbyist. I will examine the basic operation of the more popular display technologies, but the inner workings of display will not be the main thrust of the discussion. Instead, I will approach the problem of using electronic displays primarily from a “functional description” perspective. Rather than being concerned with the details of the operation of each technology, this will look more at how each type of display behaves, and how to make the best use of them in various systems and environments.

From another perspective, this book is simply my attempt at producing both the tutorial and reference that I wished I had had when I started working with electronic displays. This

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does not mean that I will only cover the basics of display systems and interfaces, or limit the discussion to only the simplest aspects of the subject, but rather that I will at least try to present the material in a manner accessible to the person who does *not* spend all of their time working in this field, while at the same time trying to include as much of the commonly-needed reference material for display systems work as possible.

This begins with an overview of some of the basic concepts in display systems, the workings of human vision, and color science. Entire books can be (and have been!) written on these subjects, but at least the fundamentals in each area must be presented before an understanding of how best to make use of electronic displays can be developed. Ultimately, any display system must first and foremost be viewed as a human interface, and we should neither fail to address the needs and expectations of the viewer, nor provide capabilities in the display which greatly exceed those.

Next will be a review of the major display types and technologies, including a look at some of the typical applications of each and some of the more interesting new technologies now on the horizon. The non-CRT technologies now gaining market share, and especially some exciting new developments just now being introduced, permit electronic displays to be employed in applications never before thought possible. With each of these, come new challenges for the display designer and system integrator, not the least of which is meeting user expectations that remain primarily shaped by the CRT.

Having covered both those factors which define required display performance, and those technologies which will be used to deliver that performance, it will be time to get to the main subject of this work – the interface between the display device itself, and the systems which provide image information for presentation via that device. There is a surprisingly wide range of past and present interfaces which have been defined and used, with varying degrees of success and acceptance. These include some that have been defined as industry standards, and some that achieved nearly complete dominance in a given application even though they were never really intended as anything but a quick solution for a particular product.

Selected standards within the display industry are discussed, both in terms of their history and in the basic requirements and applications of each standard. The display industry has benefited greatly from these, particularly those standards that have established common interface, timing, and control definitions. As the numbers of different display types and technologies continue to grow, it is these standards which permit the easy use of practically any display within a single system design. Particular attention is given to the similarities and differences between standards in two of the largest display markets today – television and the computer industry - and what may be expected as these continue on the course of convergence. The question of “analog” vs. “digital” interfaces is one of the key questions in this area, and is dealt with at some length.

The field of display interfaces covers not only the means through which image information is conveyed to the display itself. In modern systems, there is also very often the need for supplemental interfaces, and specialized standards for the identification, configuration, and control of the display device by the host system. These are very often included in the same physical interface standards as the “video” connection itself,

Many of the difficulties and shortcomings common in practical applications and display system implementations are also reviewed, along with possible solutions for each where possible. Again, a large share of these, in the modern display market, arise from the need to integrate a wide range of display types and technologies within a single system, while obtaining optimum performance from each. Many of the concepts presented in earlier chapters

come together at this point as we confront this problem of optimizing the complete display system.

Finally, although there is certainly a lot of risk in doing so, it is appropriate that we look at where the future of display and display interfaces might go, and try to make some predictions in that regard so that we can – hopefully – be better prepared to meet the future when it becomes the present (as it seems to continue to want to do).

My goal is that this book will prove a valuable reference, as well as an educational text, for a wide range of people who deal with electronic display technology and systems. In attempting to meet that goal, the knowledge and insight of a number of friends and colleagues in this industry has been invaluable. In truth, a book of this type can never be the original work of one author; it must be a compilation of knowledge and information produced and presented over years of development within the field in question, from a very large number of individuals and organizations. First, my thanks go to all the colleagues with whom I have worked on various standards committees and other such groups, past and present. My experiences from this work, and the knowledge that I gained by working with these people, were invaluable in the creation of this book. I would especially like to thank the following people who have served, and in many cases continue to serve, on the Video Electronics Standards Association's Display Committee, and who so often provided insights into the standards discussed here: Jack Hosek, of NEC-Mitsubishi; Ian Miller, of Samsung; Alain d'Hautecourt, of Viewsonic; Don Chambers, of Total Technologies; Gary Manchester, of Molex; Hans van der Ven, of Panasonic; Richard Cappels, formerly of Apple Computer; Shaun Kerigan, formerly of IBM, Andy Morrish, of National Semiconductor; Mary DuVal, of Texas Instruments; Jory Olson, of InFocus; Hugo Steemers and Joseph Lee, of Silicon Image; Joe Goodart, of Dell; and John Frederick of Compaq Computer (now HP). I would also like to thank Bill Lempesis and Joan Holewinski of the VESA staff for their support.

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Writing such books is not my full-time occupation (as will no doubt be evident when reading this one), and so my appreciation is also due to those who provided the additional support and understanding required in trying to fit the time needed for this task into and around other commitments. This group must include at least my management and colleagues within HP's Electronic Systems Technology Center, and especially Judy Glazer, Ken Knaus, and David Braun, and most certainly my family – my wife Jane and my daughter Meredith, who saw far too many evenings and weekends of my time given to work over a keyboard instead of being spent with them.

Last but not least, I would like to thank several people directly involved with the production of this book. I am very grateful for the help of Anthony Lowe, past president of the SID, who originally suggested this book and provided many helpful comments and reviews of the text as it developed. Peter Mitchell and Simone Taylor of John Wiley & Sons had, at different times through the course of this writing, editorial responsibilities for this line of books, and finally my deepest appreciation to Kathryn Sharples of John Wiley & Sons, who provided all manner of day-to-day support for this novice author, and whom I am sure doubted more than once that this would ever be finished!