# Forth Standards — An Update

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*Perhaps the most important current development in Forth is the effort to develop an ANSI (American National Standards Institute) standard under the auspices of the X3 committee of the Computer and Business Equipment Manufacturers Association (CBEMA). It has been underway since October, 1986. This paper, describing the progress to date, is the first of a series. Future articles will describe future developments.*

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*Information on CBEMA publications and procedures may be obtained from:*

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*— MGK, Editor*

While people may question the need for a Forth Standard, there are, in fact, two "official standards" in use, Forth-79 and Forth-83, and several public domain and commercial dialects that in some ways act as de-facto standards, e.g. Fig-Forth, Laxen and Perry's F83, Polyforth, Mac or MultiForth, and Novix or cmForth. These are all Forth but, for example, users of Creative Solutions' MacForth might have trouble recognizing Computer Cowboys' cmForth as being related, and it would certainly be difficult to transport a complex program from one dialect to the other. An ANSI sponsored Forth standard is intended to encourage Forth systems that allow the greatest possible transportability of code, at least if the code is written to conform to that standard. (A particular Forth might provide, for example, words that are hardware specific, but it should still be possible to write code that is transportable to other standard systems.)

The current effort at standardization is due in part to the increased acceptance of Forth by professional programmers, and in part to the need for a nationally recognized standard if Forth is to be used by many firms and agencies. Other reasons include being able to support common Forth libraries, having books and publications relevant to more than one implementation, and reducing training expenses.

It has been suggested that Forth-83 should be submitted directly to ANSI. There are several reasons why this was not done, including a feeling that Forth-83 lacked sufficient acceptance among vendors, or sufficient "authority," problems and controversy about that standard, and the feeling that a new standard would gain wider acceptance, both within and outside the community of Forth users.

## *A Brief History*

Efforts to standardize Forth date back to a 1977 conference at Kitt Peak observatory that resulted in a glossary called AST.01, and a subsequent series of meetings in Europe culminated in a meeting in Utrecht, The Netherlands, in February 1978 that led to Forth-77, directed mainly to users of minicomputers. The Forth Standards Team (FST) evolved from an ad hoc group within the International Astronomical Union. A meeting in October 1978 at Catalina Island led to a 1978 standard, but it was not widely disseminated. In October 1979 another meeting at Catalina Island led to Forth-79, released in 1980. That was the first standard to endure for more than a year and the first to gain any widespread acceptance.

In 1981 the first Rochester Forth Conference took standards as it's theme, and either because of that conference or because of the widespread perception of a need for revision of Forth-79, the FST met again and a new draft standard was released in 1982. The final version, published in 1983, is the currently accepted standard, Forth-83. The main goal of this standard was to make the language more consistent and to remove implementation dependencies from the document. Unfortunately, there was considerable controversy about Forth-83, with several major vendors refusing to support it (e.g. FORTH, Inc., Creative Solutions, Miller Microcomputer Systems, and Mountain View Press). Most of the objections were to changes in usage and word actions. These included redefinitions of **PICK** and **ROLL**, what is returned as the **TRUE** flag, confusion and ambiguity on **DO** loops and **LEAVE** behavior, specification of floored division, and more. Later, with the increased availability of 32-bit processors, there has been a consensus that Forth-83's specification of a 16-bit word size is inadequate.

In 1981, Bill Ragsdale (then chairman of the FST) had looked into the possibility of developing an ANSI Forth standard, but concluded that the Forth community was not ready. The idea continued to be discussed, however, and in October, 1986, Elizabeth Rather and Martin Tracy gathered a few interested people at the headquarters of FORTH, Inc. to discuss the possibility. Those attending were: Greg Bailey (Athena Programming, Santa Barbara, CA), W. B. Dress (Oak Ridge National Laboratory, Oak Ridge, TN), Ray Duncan (Laboratory Microsystems, Inc., Los Angeles, CA), Burt Feliss (IBM Corp., San Jose, CA), Charles H. Moore (Computer Cowboys, Woodside, CA, "inventor" of Forth), Elizabeth D. Rather (Forth Inc., Manhattan Beach, CA, FST), Dean Sanderson (Forth Inc., Manhattan Beach, CA, FST), Gerald A. Shifrin (MCI Telecommunications, McLean, VA), and Martin Tracy (Forth Inc., Manhattan Beach, CA). It was agreed to proceed with a proposal to obtain CBEMA sponsorship for an ANSI Forth Standard.

But controversy developed because, shortly after the proposal was submitted to CBEMA, a parallel ANSI effort was begun under IEEE sponsorship. Several felt that IEEE was more appropriate due to its widespread use in embedded systems. There was also concern that many would be barred by cost from the CBEMA process. Further, the FST decided to start the proposal phase for updating the Forth-83 standard within the existing FST framework. This opened the possibility of having the current development of three Forth standards. After a number of discussions agreement was reached to open the CBEMA sponsored X3 committee to IEEE participation, allowing IEEE members to attend X3 meetings without having to pay the higher fees. And the FST agreed that their proposals would be dedicated to experimental extensions which, if useful, would be submitted to X3. All the activity now fell into a single effort.

## *Issues and Problems*

There are many issues in the development of a new standard. Most are related to impacts on vendors' existing products and applications. So while many would like to "improve" Forth, the ANSI team decided to use Forth-83 as the starting basis and to minimize changes. Another concern is that a new standard should be applicable to the various types of implementations, such

as Forths in silicon, ROM-based Forths, stand-alone Forths, and those running under an operating system. Further, among Forth users there have been debates in a many areas, including specified word size, the use of blocks as opposed to files of source code, allowance of standard state-smart words (permitted by Forth-79 but prohibited by Forth-83), the need for floating-point operators, termination of **DO** loops, and so on. A new standard must attempt to bring all these divergent viewpoints together.

Vendors of Forth systems and code are likely to feel strongest the impact of a new standard. While they will find it desirable to be able to label a product as "ANSI Standard Forth," enormous work will be needed to update software and documentation and to convince customers to do the same. One of the greatest problems with Forth-83 was its lack of vendor commitment. And the labor needed to produce the standard is a problem. Aside from the time and expense needed to participate in the process, there are the problems of communication, coordination, planning, and so on. The ANSI Forth Technical Committee (TC) is using General Electric's GEnie online communications system to help with this.

Finally, it takes a fair number of working volunteers to develop the new standard. ANSI requires that the TC have reasonable representation from the user community and the involvement of more users is essential.

## *The Standardization Process*

An important part of the standardization effort is that all proceedings are open to public scrutiny. The technical committee is made up of all those willing to pay a $200 membership fee (which allows for one alternate) and attend the meetings. Observers are also welcome, but must pay $150.

The primary X3 requirements for a draft ANS programming- language standard are that

1) due process must be achieved and documented,
2) the draft Standard must be technically sound, and
3) the draft Standard must represent a consensus. The following procedures are meant to meet those requirements.

Once the Forth standardization proposal was accepted by CBEMA, a Technical Committee (TC) was formed to start writing the standard. To maintain voting membership in the TC, participants must attend at least 3 out of 4 meetings. The TC will hold about four meetings per year in various places in the U.S. Publication of a draft standard, referred to as "dpANS," is expected to take at least one year. This draft will be made available for public comment. It is expected to be at least three years before an approved ANSI standard will be published.

The following is summarized from X3/SD-2, Accredited Standards Committee (Operating under the procedures of the American National Standards Institute), X3 - Information Processing Systems, Organization and Procedures, Secretariat: Computer & Business Equipment Manufacturers Association, October, 1985. The detailed process includes additional procedures for resolving negative ballots and adverse comments during each step of the process.

There are 18 milestones associated with the approval of an ANSI standard. The first five involve planning and X3 (CBEMA) approval of the project and have been completed. Following that are six development phases:

1) the TC develops a work plan for completing the dpANS.
2) the TC develops a draft standard and issues a call for comments.
3) the TC issues a letter ballot on dpANS. Copies of the draft and associated documents are circulated through X3. Other X3 TC's and X3's Standards Planning and Requirements Committee review the document for conflicts.

4) The TC reviews all comments from the draft distribution and, for each comment, modifies the dpANS or responds with its rationale for not making the change.
5) The dpANS and additional documentation are sent to the X3 Secretariat.
6) If all objections are resolved and there are no negative votes from the TC, then the package is sent to X3 for distribution for advance review. Otherwise, the package is sent to X3 members and observers who may append any additional comments to the package submitted for public review. A majority of the TC must approve this package.

Once the development phase is complete, a seven step approval phase is initiated:

1) The X3 Secretariat initiates a four month public review. A release announcing availability of the draft is sent to the trade press.
2) Any comments received during this period are sent to the TC for review. The dpANS and any public comments and TC responses are sent to the X3 membership with a six-week ballot.
3) Any negative votes from X3 or adverse public comments are sent back to the TC to prepare responses.
4) If the X3 negative votes or adverse comments are not resolved, then those comments and the TC responses are sent back to X3 for another 30 day ballot.
5) If everything has been resolved (no negative ballots or unresolved comments), then the is sent to the ANSI Board of Standards Review (BSR). Otherwise, it is sent back for reconsideration by X3 or the TC as necessary.
6) The ANSI BSR then processes the dpANS. They are primarily concerned with the requirements for "due process" and the need for consensus.
7) The TC then provides a clean copy of the document to the ANSI staff which ensures that it conforms to the ANSI Style Manual.

This completes the approval process. The project then enters the maintenance phase. During this period, the TC processes inquiries and comments on the standard. If necessary, the TC is also responsible for working with ISO, the International Standards Organization, towards an International Standard. Maintenance continues on a five year cycle, reaffirming or revising the standard.

## *The ANS Forth Technical Committee*

The ANSI Forth Technical Committee, designated X3J14, is sponsored by the X3 Secretariat of CBEMA. The following were the original membership of the TC: Elizabeth Rather, Acting Chair (principal), Greg Bailey (principal), Gary Betts (principal), Ronald Braithwaite (principal), Bob Bunch (observer), Richard Burton (observer), Chris Colburn (alternate), Don Colburn (principal), Ted Dickens (principal), John Dorband (alternate), Ray Duncan (principal), Douglas Fishman (observer), Lawrence Forsley (principal), Charles Keane (principal), Guy Kelly (principal, representing IEEE Computer Society), Tom Kurihara (liaison to X3/SPARC), Charles Moore, (principal), Mike Nemeth (principal), David Petty (principal), William Ragsdale (principal, representing The Forth Interest Group), James Rash (principal), Gerald Shifrin (principal), Robert Smith (principal), Martin Tracy (Alternate), Fred Virtue (liaison to X3/SPARC). Since the first meeting several others have joined the TC; they are Wil Baden, Dennis Ruffer, Andy Kobziar, John Gotwals, John Stevenson, George Shaw, and Dean Sanderson.

The X3 Secretariat appoints the permanent officers of X3J14. As of March, 1988, the following were X3J14 officers: Elizabeth Rather, Acting Chair, Ray Duncan, Vice-Chair, Martin Tracy, Acting Secretary, and Ron Braithwaite, Document Editor. The position of International

Representative is vacant. The X3 Secretariat will eventually name a permanent Chair who will then designate the Secretary.

There are four subcommittees in the TC: Documentation - Ted Dickens, Chair; Logistics - Gary Betts, Chair; Research - Guy Kelly, Chair; Technical - Greg Bailey, Chair. These positions are appointed by the TC chair.

### *Progress as of March 1, 1988*

Much of the initial activity of the ANSI Forth TC has been to set up procedures to conduct business. The following is the progress to date.

Except for the sections on uncontrolled reference words and on experimental proposals, the FORTH-83 standard document was adopted as the "BASIS" document. The BASIS document is the working document for all activity of the TC. That is, all changes, deletions, additions, and so on are proposed as updates to this document. The BASIS document eventually evolves into the draft proposed American National Standard (dpANS) document as the TC ratifies technical proposals that update the BASIS. The TC Documentation Subcommittee has rewritten the Forth-83 document to conform to an ANSI format.

The Research Committee mailed 274 surveys on current practices to vendors of Forth systems, to determine current usage in the language. Only 24 responses were received. Of those, only 14 indicated 200 or more users (required for consideration of common usage by a previous vote). The results of the survey were interesting: responders with systems differing from the Forth-83 standard fell into the areas of word addressing, 32-bits word size, the lack of floored division, and the lack of disk commands. Most of the responders offered extensions for strings, multitasking, graphics, floating-point math, and more. Suggestions from the responders varied widely, but a number thought the standard should be layered (allowing optional standard extensions) and that it needed to deal with 32 bit numbers, floating-point math, the operating system interface, strings, graphics, and ROMability.

The Technical Subcommittee (TSC) reported on areas of consensus and controversy with respect to the Forth-83 standard. The TSC was unanimous on keeping the following from Forth-83: `DUP` , `DROP` , `OVER` , `SWAP` , `>R` , `R>`, `AND` , `OR` , `XOR` , `+` , `-` , `0=` , `0<` , `=` , `U<` , `@` , `!` , and the ASCII collating sequence.

From a survey sent to members of the TSC, Greg Bailey assembled a list of 14 controversial areas. A member of the TSC was assigned to be a "magnet" for each area. That is, proposals relating to an area are directed to the magnet for analysis and review. The magnets are: Vocabularies and `:` , John Stevenson; Mass Storage (blocks and text files), Andy Kobizar; LOOPS, EXIT and Termination, Ray Duncan; Division, Bob Smith; Documentation, Gary Betts; Testing, Chuck Moore; Assemblers, Greg Bailey; System extension wordsets, Mike Nemeth; ROMability, Martin Tracy; Host and File Structures, Don Colburn; Interpreter, Dennis Ruffer; `'` , `>BODY`, `[']` , etc., Charles Keane; Numerical output, John Gotwals; Control, i.e. `ABORT` , `QUIT`, etc., Wil Baden.

There was a general consensus on standardizing some changes to Forth-83 (much of the following is from Ray Duncan's write-up of the third TC meeting):

- A cell size proposal from Elizabeth Rather, to remove all references to 16-bit words and providing for standard Forth systems with different word sizes. The terms "single precision and "double-precision" replace previous references to "16-bit" and "32-bit."
- Require any standard program to include a list of resource requirements, system implementation options, and environmental dependencies. System implementation options are defined as features, properties, parameters, boundary conditions, behaviors, or side effects in which respect standard systems are permitted to defer (this includes word size).

- Relax the definition and/or requirement of equivalent execution in order to allow for standard systems implemented on different physical or virtual machines.
- Remove the requirement for floored division from the standard, while still making it available for existing Forth-83 Standard programs or other programs which require its rounding behavior.
- Add **NIP** and **TUCK** to the controlled reference word set, in recognition of their widespread usage.
- Add **EVAL** , a word that allows the interpretation of arbitrary strings, to the BASIS. This word only originated with Martin Tracy about a year ago but has been rapidly accepted in the Forth community. When **EVAL** is available, words that redirect the input stream can be readily ported from one system to another, and new interpreters can be easily built in an implementation-independent manner.

The current BASIS document and technical proposal forms (with instructions) are available for the cost of reproduction and postage from the Secretary, ANSI ASC X3/X3J14 Forth Standards Committee, 111 N. Sepulveda Blvd., Suite 300, Manhattan Beach, CA 90266

## *Plans as of March 1, 1988*

While progress has been made, much work remains. Over 200 technical proposals have been received and must be evaluated in detail. Further, appendices must be added to BASIS that will

1) identify problem areas in program portability and
2) provide a rationale for each difference between ANS FORTH and Forth-83.

Also, a technical proposal for a minimum extension set of floating-point operators must be evaluated. Martin Tracy will confer with vendors currently supplying floating-point implementations to be sure the proposal does not contain major conflicts with existing practice.

The next meeting of X3J14 will be in Rochester, New York (Larry Forsley, host) on May 11–14, 1988. New members and observers are welcome, Technical Proposals from all interested parties are invited. Requests to be placed on the mailing list for the next meeting should be addressed to Chair, X3J14 Forth Standards Committee at the address above.

Future meetings are scheduled to occur on a quarterly basis, with the next two meetings planned for Beaverton, Oregon (Gary Betts, host) and Washington, DC (Jim Rash, host).

## *Summary*

An ANSI sponsored Forth standard is currently under development. The processes specified by ANSI and CBEMA are designed to ensure that "due process" is followed and that consensus is reached. Those involved are trying hard to involve the entire Forth community. Good progress has been made in a number of crucial areas, including organization, vendor support, and user involvement. Technical progress has been achieved in such areas as word size, floating-point, machine dependency, and portability. Much work remains to be done to resolve all technical issues.

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