

Comp.specification.z and Z FORUM

Frequently Asked Questions

Jonathan P. Bowen

The University of Reading, Department of Computer Science
Whiteknights, PO Box 225, Reading, Berks RG6 6AY, UK

Email: J.P.Bowen@reading.ac.uk

URL: <http://www.cs.reading.ac.uk/people/jpb/>

Abstract. This appendix provides some details on how to access information on Z, particularly electronically. It has been generated from a message that is updated and sent out monthly on the Internet. This information is issued each month on the `comp.specification.z` newsgroup and is available on-line on the following World Wide Web (WWW) hypertext page where it is split into convenient sections and updated each month:

<http://www.cis.ohio-state.edu/hypertext/faq/usenet/z-faq/faq.html>

1 What is it?

Z (pronounced “zed”) is a formal specification notation based on set theory and first order predicate logic. It has been developed at the Programming Research Group at the Oxford University Computing Laboratory (OUCL) and elsewhere since the late 1970s. It is used by industry as part of the software (and hardware) development process in Europe, USA and elsewhere. Currently it is undergoing international ISO standardization.

The `comp.specification.z` electronic USENET newsgroup was established in June 1991 and is intended to handle messages concerned with Z. It has an estimated readership of tens of thousands of people worldwide. `Comp.specification.z` provides a convenient forum for messages concerned with recent developments and the use of Z. Pointers to and reviews of recent books and articles are particularly encouraged. These may be included in the Z bibliography (see below) if they appear in `comp.specification.z`. If you do not have direct news access, you can search for `comp.specification.z` articles on the World Wide Web using Deja News:

<http://search.dejanews.com/dnquery.xp?QRY=comp.specification.z>

2 What if I do not have access to USENET news?

There is an associated Z FORUM electronic mailing list that was initiated in January 1986 by Ruaridh Macdonald, RSRE, UK. Articles are automatically cross-posted between `comp.specification.z` and the mailing list for those whose do not have access to USENET news. This may apply especially to industrial Z users who are particularly encouraged to subscribe and post their experiences to the list. Please contact

zforum-request@comlab.ox.ac.uk with your name, address and email address to join the mailing list (or if you change your email address or wish to be removed from the list). Readers are strongly urged to read the `comp.specification.z` newsgroup rather than the Z FORUM mailing list if possible. Messages for submission to the Z FORUM mailing list and the `comp.specification.z` newsgroup may be emailed to `zforum@comlab.ox.ac.uk`. This method of posting is particularly recommended for important messages like announcements of meetings since not all messages posted on `comp.specification.z` reach the OUCL.

A mailing list for the Z User Meeting educational issues session has been set by Neville Dean, Anglia Polytechnic University, UK. Anyone interested may join by emailing `zgeis-request@comlab.ox.ac.uk` with your contact details.

3 What if I do not have access to email?

If you wish to join the postal Z mailing list, please send your address to Amanda Kingscote, Praxis Critical Systems Ltd, 20 Manvers Street, Bath BA1 1PX, UK (tel +44-1225-466991, fax +44-1225-469006, email `ark@praxis-cs.co.uk`). This will ensure you receive details of Z meetings, etc., particularly for people without access to electronic mail.

4 How can I join in?

If you are currently using Z, you are welcome to introduce yourself to the newsgroup and Z FORUM list by describing your work with Z or raising any questions you might have about Z which are not answered here. You may also advertize publications concerning Z which you or your colleagues produce. These may then be added to the master Z bibliography maintained at the OUCL (see below).

5 Where are Z-related files archived?

On-line information relevant to the Z notation may be found as part of the World Wide Web (WWW) Virtual Library under the following URL:

<http://www.comlab.ox.ac.uk/archive/z.html>

This includes hyperlinks to many Z-related resources available on-line around the world. See also the following page on formal methods in general:

<http://www.comlab.ox.ac.uk/archive/formal-methods.html>

An older Z archive is also available via anonymous FTP under:

<ftp://ftp.comlab.ox.ac.uk/pub/Zforum/>

6 What tools are available?

Various tools for formatting, type-checking and aiding proofs in Z are available under:

<http://www.comlab.ox.ac.uk/archive/z.html#tools>

This includes links to a number of L^AT_EX style files which support the Z notation. Information on Object-Z L^AT_EX macros ('oz.sty') may be found under:

<http://svrc.it.uq.edu.au/Object-Z/pages/latex.html>

The FuZZ package, a syntax and type-checker with a L^AT_EX style option and fonts, is available from the Spivey Partnership, 10 Warneford Road, Oxford OX4 1LU, UK. It is compatible with the 2nd edition of Spivey's Z Reference Manual. Access the following URL for brief information including ordering:

<http://www.comlab.ox.ac.uk/oucl/software/fuzz.html>

Contact Mike Spivey (email Mike.Spivey@comlab.oxford.ac.uk) for further information.

CADiZ is a suite of integrated tools for preparing and type-checking Z specifications as professional quality typeset documents. The Z dialect it recognizes is evolving in line with the standard. The typesetting can be performed by either *troff* or L^AT_EX for UNIX or Word for Windows. The mouse can be used to interact with a view of the typeset specification to inspect properties deduced by the type-checker, to see the expansion of schema calculus expressions, and to reason about conjectures such as proof obligations. The PC version is integrated with MS Word using OLE2, providing WYSIWYG editing of Z paragraphs directly in Word documents. (The *troff* and L^AT_EX versions use ordinary text editors on ASCII mark-up.) Further development of the tools is ongoing. CADiZ is a BCS Award winning product available for Sun, SGI and PC machines from York Software Engineering Ltd, Glanford House, Bellwin Drive, Flixborough, Scunthorpe, North Lincolnshire, DN15 8SN, UK (email yse@cse-euro.demon.co.uk, tel +44-1724-862169, fax +44-1724-846256). URL:

<http://www.cse-euro.demon.co.uk/yse/products/cadiz/>

ProofPower is a suite of tools supporting specification and proof in Higher Order Logic (HOL) and in Z. As an option, ProofPower also supports verification of SPARK-Ada programs against Z specifications using the Compliance Notation designed by DERA. Short courses on ProofPower-Z are available as demand arises. Information about ProofPower can be obtained from the following location:

<http://www.trireme.demon.co.uk/>

Please address enquiries to ProofPower-support@win.icl.co.uk or to Roger Jones, International Computers Ltd., Lovelace Road, Bracknell, RG12 8SN, UK (tel +44-1344-472000).

Zola is a commercial integrated support tool for Z on Sun workstations, for automated assistance at all stages of the specification construction, proving and maintenance process. It is intended for system developers and includes a WYSIWYG editor, type-checker and tactical theorem prover suitable for the creation and maintenance of large specifications. For further information, contact Chris Paine, Imperial Software Technology Ltd, Berkshire House, 252 Kings Road, Reading RG1 4HP, UK (tel +44-118-958-7055, fax +44-118-958-9005, email fms@ist.co.uk), or see:

<http://www.ist.co.uk/products/zola.html>

ZTC is a Z type-checker available free of charge for educational and non-profit uses. It is intended to be compliant with the 2nd edition of Spivey's Z Reference Manual. It accepts L^AT_EX with 'zed' or 'oz' styles, and ZSL – an ASCII version of Z. ZANS is a Z animator. It is a research prototype that is still very crude. Both ZTC and ZANS run on Linux, SunOS, Solaris, HP-UX and DOS. They are available via FTP under:

<ftp://ise.cs.depaul.edu/pub/ZTC/>

<ftp://ise.cs.depaul.edu/pub/ZANS/>

Contact Xiaoping Jia jia@cs.depaul.edu for further information.

Formaliser is a syntax-directed WYSIWYG Z editor and interactive type checker, running under Microsoft Windows, available from Logica. Contact Susan Stepney, Logica UK Limited, Cambridge Division, Betjeman House, 104 Hills Road, Cambridge CB2 1LQ, UK (email stepneys@logica.com, tel +44-1223-366343, fax +44-1223-251001) or see on-line under:

<http://public.logica.com/~formaliser/>

The B-Toolkit is a set of integrated tools which fully supports the B-Method for formal software development and is available from B-Core (UK) Limited, Magdalen Centre, The Oxford Science Park, Oxford OX4 4GA, UK. For further details, contact Ib Sørensen (tel +44-1865-784520, fax +44-1865-784518, email B@b-core.com) or see on-line under:

<http://www.b-core.com/>

Nitpick is a freely available tool for fully automatically analyzing software specifications in (roughly) a subset of Z. See under:

<http://www.cs.cmu.edu/~nitpick/>

Z/EVES is an analysis tool for Z specifications, that can be used to check for syntax, type-correctness and 'domain errors' (are functions applied on their domain?), expand schemas, calculate preconditions and check for totality, and state and prove conjectures, with the aid of a heuristic theorem prover. It supports the 'zed'/'fuzz' style L^AT_EX markup. and runs on SunOS, OS/2, Linux, Windows 3.1, Windows'95 and, with the appropriate compatibility package from Sun, Solaris. It is available electronically at no cost. Email eves@ora.on.ca or see:

<http://www.ora.on.ca/distribution.html>

Z fonts for MS Windows and Macintosh are available on-line. For hyperlinks to these and other Z tool resources see the WWW Z page:

<http://www.comlab.ox.ac.uk/archive/z.html#tools>

7 How can I learn about Z?

There are a number of courses on Z run by industry and academia. Oxford University offers industrial short courses in the use Z. As well as introductory courses, recent newly developed material includes advanced Z-based courses on proof and refinement, partly based around the B-Tool. Courses are held in Oxford, or elsewhere (e.g., on a

company's premises) if there is enough demand. For further information, contact Jim Woodcock (email Jim.Woodcock@comlab.ox.ac.uk, tel +44-1865-283514, fax +44-1865-273839).

Logica offer a five day course on Z at company sites. Contact Susan Stepney (tel +44-1223-366343, fax +44-1223-322315, email stepneys@logica.com) at Logica UK Limited, Betjeman House, 104 Hills Road, Cambridge CB2 1LQ, UK, or see on-line under

<http://public.logica.com/~formaliser/services/zcourse.htm>

Praxis Critical Systems Ltd runs a range of Z (and other formal methods) courses. For details contact Anthony Hall on +44-1225-466991 or jah@praxis-cs.co.uk.

Formal Systems (Europe) Ltd run a range of Z, CSP and other formal methods courses, primarily in the US and with such lecturers as Jim Woodcock and Bill Roscoe (both lecturers at the OUCL). For dates and prices contact Kate Pearson (tel +44-1865-728460, fax +44-1865-201114) at Formal Systems (Europe) Limited, 3 Alfred Street, Oxford OX1 4EH, UK.

8 What has been published about Z?

A searchable on-line Z bibliography is available in B_IB_TE_X format under:

<http://www.comlab.ox.ac.uk/archive/z/bib.html>

The following books largely concerning Z have been or are due to be published (in approximate chronological order):

- I. Hayes (ed.), Specification Case Studies, Prentice Hall International Series in Computer Science, 1987. (2nd ed., 1993)
- J. M. Spivey, Understanding Z: A specification language and its formal semantics, Cambridge University Press, 1988.
- D. Ince, An Introduction to Discrete Mathematics, Formal System Specification and Z, Oxford University Press, 1988. (2nd ed., 1993)
- J. C. P. Woodcock & M. Loomes, Software Engineering Mathematics: Formal Methods Demystified, Pitman, 1998. (Also Addison-Wesley, 1989)
- J. M. Spivey, The Z Notation: A reference manual, Prentice Hall International Series in Computer Science, 1989. (2nd ed., 1992) URL:

<http://spivey.oriel.ox.ac.uk/~mike/zrm/>

[Widely used as a de facto standard for Z. Often known as ZRM2.]

- A. Diller, Z: An introduction to formal methods, Wiley, 1990.
- J. E. Nicholls (ed.), Z user workshop, Oxford 1989, Springer-Verlag, Workshops in Computing, 1990.
- B. Potter, J. Sinclair & D. Till, An Introduction to Formal Specification and Z, Prentice Hall International Series in Computer Science, 1991. (2nd ed., 1996)
- D. Lightfoot, Formal Specification using Z, MacMillan, 1991.
- A. Norcliffe & G. Slater, Mathematics for Software Construction, Ellis Horwood, 1991.
- J. E. Nicholls (ed.), Z User Workshop, Oxford 1990, Springer-Verlag, Workshops in Computing, 1991.

- I. Craig, *The Formal Specification of Advanced AI Architectures*, Ellis Horwood, 1991.
- M. Imperato, *An Introduction to Z*, Chartwell-Bratt, 1991.
- J. B. Wordsworth, *Software Development with Z*, Addison-Wesley, 1992.
- S. Stepney, R. Barden & D. Cooper (eds.), *Object Orientation in Z*, Springer-Verlag, *Workshops in Computing*, August 1992. URL:
<http://public.logica.com/~stepneys/bib/ss/ooz/>
- J. E. Nicholls (ed.), *Z User Workshop*, York 1991, Springer-Verlag, *Workshops in Computing*, 1992.
- D. Edmond, *Information Modeling: Specification and implementation*, Prentice Hall, 1992.
- J. P. Bowen & J. E. Nicholls (eds.), *Z User Workshop*, London 1992, Springer-Verlag, *Workshops in Computing*, 1993. URL:
<http://www.comlab.ox.ac.uk/archive/z/zum92.html>
- S. Stepney, *High Integrity Compilation: A case study*, Prentice Hall, 1993. URL:
<http://public.logica.com/~stepneys/bib/ss/hic/>
- M. McMorran & S. Powell, *Z Guide for Beginners*, Blackwell Scientific, 1993.
- K. C. Lano & H. Haughton (eds.), *Object-oriented Specification Case Studies*, Prentice Hall International Object-Oriented Series, 1993.
- B. Ratcliff, *Introducing Specification using Z: A practical case study approach*, McGraw-Hill, 1994.
- A. Diller, *Z: An introduction to formal methods*, 2nd ed., Wiley, 1994.
- J. P. Bowen & J. A. Hall (eds.), *Z User Workshop*, Cambridge 1994, Springer-Verlag, *Workshops in Computing*, 1994. URL:
<http://www.comlab.ox.ac.uk/archive/z/zum94.html>
- R. Barden, S. Stepney & D. Cooper, *Z in Practice*, Prentice Hall BCS Practitioner Series, 1994. URL:
<http://public.logica.com/~stepneys/bib/ss/zip/>
- D. Rann, J. Turner & J. Whitworth, *Z: A beginner's guide*. Chapman & Hall, 1994.
- D. Heath, D. Allum & L. Dunckley, *Introductory Logic and Formal Methods*. A. Waller, Henley-on-Thames, 1994.
- L. Bottaci and J. Jones, *Formal Specification using Z: A modelling approach*. International Thomson Publishing, 1995.
- D. Sheppard, *An Introduction to Formal Specification with Z and VDM*. McGraw Hill International Series in Software Engineering, 1995.
- J. P. Bowen & M. G. Hinchey (eds.), *ZUM'95: The Z Formal Specification Notation*, Springer-Verlag, *Lecture Notes in Computer Science*, volume 967, 1995. URL:
<http://www.comlab.ox.ac.uk/archive/z/zum95.html>
- J. P. Bowen, *Formal Specification and Documentation using Z: A Case Study Approach*, International Thomson Compress Press, 1996. URL:
<http://www.comlab.ox.ac.uk/oucl/users/jonathan.bowen/zbook.html>
- J. C. P. Woodcock & J. Davies, *Using Z: Specification, proof and refinement*, Prentice Hall International Series in Computer Science, 1996. URL:

<http://www.comlab.ox.ac.uk/usingz.html>

- A. Harry, *Formal Methods Fact File: VDM and Z*, Wiley, 1996.
- J. Jacky, *The Way of Z: Practical Programming with Formal Methods*, Cambridge University Press, 1997. URL:
<http://www.radonc.washington.edu/prostaff/jon/z-book/>
- J. P. Bowen, M. G. Hinchey & D. Till (eds.), *ZUM'97: The Z Formal Specification Notation*, Springer-Verlag, Lecture Notes in Computer Science, volume 1212, 1997. URL:
<http://www.cs.reading.ac.uk/zum97/>
- J. P. Bowen, A. Fett & M. G. Hinchey (eds.), *ZUM'98: The Z Formal Specification Notation*, Springer-Verlag, Lecture Notes in Computer Science, volume 1493, 1998. URL:

<http://www.fmse.cs.reading.ac.uk/zum98/>

See also an on-line list of Z books from Blackwells Bookshop under:

http://www.blackwell.co.uk/cgi-bin/bb_catset?09_IBY

Formal Methods: A Survey by S. Austin & G. I. Parkin, March 1993 includes information on the use and teaching of Z in industry and academia. Contact DITC Office, Formal Methods Survey, National Laboratory, Teddington, Middlesex TW11 0LW, UK (tel +44-181-943-7002, fax +44-181-977-7091) for a copy.

OUCL Technical Monographs and Reports, including many on Z, is available from the librarian (email library@comlab.ox.ac.uk, tel +44-1865-273837, fax +44-1865-273839).

For information on formal methods publications in general, see:

<http://www.comlab.ox.ac.uk/archive/formal-methods/pubs.html>

9 What is object-oriented Z?

Several object-oriented extensions to or versions of Z have been proposed. The book *Object orientation in Z*, listed above, is a collection of papers describing various OOZ approaches – Hall, ZERO, MooZ, Object-Z, OOZE, Schuman&Pitt, Z⁺⁺, ZEST and Fresco (an OO VDM method) – in the main written by the methods' inventors, and all specifying the same two examples. A more recent book entitled *Object-oriented specification case studies* surveys the principal methods and languages for formal object-oriented specification, including Z-based approaches.

10 How can I run Z?

Z is a (non-executable in general) specification language, so there is no such thing as a Z compiler/linker/etc. as you would expect for a programming language. Some people have looked at animating subsets of Z for rapid prototyping purposes, using logic and functional programming for example, but this is not really the major point of Z, which is to increase human understandability of the specified system and allow the possibility of formal reasoning and development. However, Prolog seems to be the main favoured language for Z prototyping and some references may be found in the Z bibliography (see above).

11 Where can I meet other Z people?

The 11th International Conference of Z Users (ZUM'98) is being held in Berlin, Germany, 24–26 September 1998. A Call for Participation has been issued. For further information, please contact the Conference Chair: Mike Hinchey, Department of Computer Science, College of Information Science and Technology, University of Nebraska at Omaha, 6001 Dodge Street, Omaha, NE 68182–0500, USA (tel +1-402-554-4996, fax: +1-402-554-2975 email: michael.hinchey@ul.ie). See on-line information under:

<http://www.fmse.cs.reading.ac.uk/zum98/>

Information on Z User Meetings is issued on `comp.specification.z` and other related newsgroups, various specialist electronic mailing lists, and the Z postal mailing list. Previous proceedings for Z User Meetings have been published in the Springer-Verlag LNCS and Workshops in Computing series since the 4th meeting in 1989. For further on-line information on previous Z User Meetings, see the following URL:

<http://www.comlab.ox.ac.uk/archive/z/zum.html>

For a list of meetings with a formal methods content, see:

<http://www.comlab.ox.ac.uk/archive/formal-methods/meetings.html>

12 What is the Z User Group?

The Z User Group was set up in 1992 to oversee Z-related activities, and the Z User Meetings in particular. As a subscriber to either `comp.specification.z`, ZFORUM or the postal mailing list, you may consider yourself a member of the Z User Group. There are currently no charges for membership, although this is subject to review if necessary. Contact zforum-request@comlab.ox.ac.uk for further information. For on-line information, see the following URL:

<http://www.comlab.ox.ac.uk/archive/z/zug.html>

13 How can I obtain the draft Z standard?

The proposed Z standard under ISO/IEC JTC1/SC22 is available on-line. See under

<http://www.comlab.ox.ac.uk/oucl/groups/zstandards/>

for information and locations. An early version is also available in printed form from the OUCL librarian (email library@comlab.ox.ac.uk, tel +44-1865-273837, fax +44-1865-273839) by requesting Technical Monograph number PRG-107. For links to recent on-line information, see:

<http://www.comlab.ox.ac.uk/archive/z.html#standards>

14 Where else is Z discussed?

The BCS-FACS (British Computer Society Formal Aspects of Computer Science special interest group) and FME (Formal Methods Europe) are two organizations interested in formal methods in general. Contact BCS FACS, Dept of Computer Studies, Loughborough University of Technology, Loughborough, Leicester LE11 3TU, UK (tel +44-1509-222676, fax +44-1509-211586, email FACS@lut.ac.uk) for further information.

A *FACS Europe* newsletter is issued to members of FACS and FME. Please send suitable Z-related material to the Z column editor, David Till, Dept of Computer Science, City University, Northampton Square, London, EC1V 0HB, UK (tel +44-171-477-8552, email till@cs.city.ac.uk) for possible publication. Material from articles appearing on the `comp.specification.z` newsgroup may be included if considered of sufficient interest (with permission from the originator if possible). It would be helpful for posters of articles on `comp.specification.z` to indicate if they do not want further distribution for any reason.

15 How does VDM compare with Z?

See I. J. Hayes, C. B. Jones & J. E. Nicholls, Understanding the differences between VDM and Z, FACS Europe, series I, 1(1):7–30, Autumn 1993 available as an on-line Technical Report from Manchester in compressed POSTSCRIPT format under:

<ftp://ftp.cs.man.ac.uk/pub/TR/UMCS-93-8-1.ps.Z>

See also I. J. Hayes, VDM and Z: A comparative case study, Formal Aspects of Computing, 4(1):76–99, 1992. VDM is discussed on the (unmoderated) VDM FORUM mailing list. Send a message containing the command ‘`join vdm-forum name`’ where name is your real name to mailbase@mailbase.ac.uk. To contact the list administrator, email John Fitzgerald on vdm-forum-request@mailbase.ac.uk.

16 How does the B-Method compare with Z?

B is a tool-based formal method for software development, conceived by the originator of Z, Jean-Raymond Abrial, whereas Z is designed mainly for specification. See

<http://www.b-core.com/ZVdB.html>

for a comparison. See also

<http://www.comlab.ox.ac.uk/archive/formal-methods/b.html>

for further information on B.

17 What if I have spotted a mistake or an omission?

Please send corrections or new relevant information about meetings, books, tools, etc., to J.P.Bowen@reading.ac.uk. New questions and model answers are also gratefully received!

