density counterpart, yet not as fast as another single-density system, the Acorn DFS 0.98.

Again, I received more than one version during the course of the review (1.50, 1.51 and 1.52). There are a few minor changes in the very latest version – for example, DFS settings are now retained over a Break, and apparently more protected software can be run, though I was unable to check this. Speed was identical to the earlier versions, except in benchmark 11, where the latest release was considerably slower! I was also pleased to see that they managed to get their own name right – version 1.51 greets you with 'Watford Electronics DDFS'!
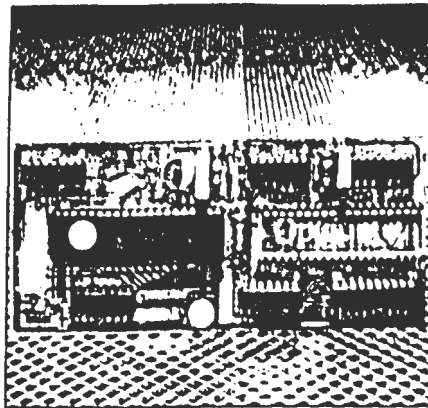
Viglen DSDFS

The Viglen DSDFS and Watford DDFS obviously have a common ancestry. Both boast the same enhancements to existing functions, the same new commands and utilities, even identical layout and operation for the disc sector editor. The only superficial difference I detected is that Watford's *HELP SPACE function is renamed *HELP GAPS in the Viglen DSDFS, but it performs in an identical manner. So, for the full range of new commands and utilities provided in the Viglen implementation, refer to the Watford DDFS list in table 2. The comments made in reference to the Watford DDFS apply equally well here. Though the benchmarks figures for the two systems are very similar, they're not identical. One reason for this could be that the Viglen DSDFS is almost certainly based on a different version number to that of the latest Watford DDFS.

Viglen are asking a good deal more for their DSDFS than their competitors, though (as with many suppliers) the price drops if disc drives are bought at the same time.

An interesting booklet was supplied for review with the system. While it gave a very clear and readable guide to using discs with the BBC micro, the document was geared towards the standard DFS, and made no reference to any of the features particular to the Viglen DSDFS.

Opus DDOS

I've already mentioned that the standard limit of 31 files per disc can be restrictive and lead to unusable storage space being left on discs. With a DDFS, a larger catalogue capacity becomes essential to minimise the risk of wasted disc space. While the other DDFSs go some way to improving matters by allowing 62 files per disc, the Opus DDOS adopts a more ambitious approach. The whole of the first track

Opus DDOS: an ambitious approach

on a double-density disc is given over to catalogue information, and can store up to eight directories (called 'volumes'), each of which can hold 31 files. This gives a potential maximum of 248 files per disc.

Each volume could be considered as a distinct 'logical' drive, and is identified by one of eight letters, A to H. A specific volume can be referenced by appending the appropriate letter as a suffix to the drive number, which is used in commands in the usual way, for example:

*LOAD ":1C.X.TEST" – load the file called "TEST" in directory "X" in volume "C" on drive 1.

*COPY 0A 0C TEST – copy file "TEST" from volume "A" on drive 0 to volume "C" on drive 0.

If not specified, the volume defaults to A. If the volume suffix is used with single-density discs, it's just ignored, since it has no meaning in such cases.

When a file is formatted, three volumes (A, B and C) are created, sharing the available disc space. The VOLGEN command allows further volumes to be set up (or deleted later) and the disc space available can be reallocated as appropriate. For example, a volume holding just machine code programs, or short demonstrations,

Command	Function
4080	allow 40-track discs on 80-track drive
DENSITY	(not mentioned in manual)
MCOPY	backup disc to one of different density
SROM	(not mentioned in manual)
STAT	show volume capacity and unused disc space
TAPEDISK	transfer program from tape to disc
XCAT	catalogue all files in all volumes of double density disc
FORMAT	format disc
VERIFY	check disc for corruption
VOLGEN	allocate volumes and/or change their sizes

Table 3. Extra commands in Opus DDOS

may afford to be considerably smaller than a volume holding long, word-processor files (though both volumes may still hold up to 31 files). Whenever VOLGEN performs these adjustments, any files on the disc are lost – so it's best to run it immediately after formatting or backing-up a disc.

Since the normal *CAT command only works on a single volume (default or specified), an extra command *XCAT (eXtended CATalogue) serves to list all files under all volumes on a disc.

Table 3 summarises the extra commands and utilities available with the Opus DDOS (in addition to the 'standard' vocabulary). A manual supplied with the review system gives an adequate description of the commands, but appears to relate to an old (or very new) release of the DFS software, since there are a few discrepancies between the commands in the EPROM (as listed by *HELP) and those in the manual. There was no explanation in the documentation for the 'DENSITY' and 'SROM' commands; conversely, a

	Acorn DFS	Watford DFS	E00 DFS	Watford DDFS	Opus DDOS	Viglen DSDFS
*SAVE 1K	1.3	1.5	1.3	1.2	0.8	1.2
*LOAD 1K	0.3	0.3	0.4	0.2	0.6	0.2
*SAVE 16K	2.9	3.1	3.0	2.0	3.0	2.0
*LOAD 16K	2.2	2.1	2.2	1.0	2.8	1.0
BPUT * 1000	3.5	3.5	4.9	3.0	3.2	3.4
BGET * 1000	2.5	2.5	3.5	2.6	2.1	2.6
PRINT Nos * 1000	6.1	9.7	13.8	8.9	5.9	8.9
INPUT Nos * 1000	4.7	8.5	11.9	8.3	4.9	8.2
PRINT STRING * 100	25.2	44.9	58.8	42.5	23.9	42.4
INPUT STRING * 100	23.2	43.3	55.2	41.6	22.9	41.6
WRITE RANDOM	60.7	67.1	64.7	69.7	49.9	58.4
READ RANDOM	37.7	41.7	43.6	40.7	37.2	40.7
AVERAGE	14.2	19.0	21.9	18.5	13.1	17.6

(Dual-density systems run in double-density mode)
Table 4. Disc benchmarks (rounded to nearest 0.1 second)

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further command, 'AUTO40', only appeared in the manual – it's meant to allow both 40 and 80 track discs to be used in an 80-track drive, without any further user intervention.

The Opus DDOS is also notable for its impressive speed – it was the fastest of all systems reviewed.

Conclusion

Of course, everybody's ideal DFS has all the most useful features and utilities you're likely to need, while still retaining 100 per cent compatibility with all disc software. Unfortunately, the best of all possible worlds is not currently obtainable, at least not in one DFS package. If you want to be certain of being able to run *all* disc software, including the increasingly complicated protected discs, the only DFS to offer this security is Acorn's. Admittedly, it's certainly not the best equipped DFS available, but if used together with a suitable disc utility ROM (eg, *Disc Doctor*), its deficiencies can be more than compensated for. Of course, this approach means finding the space and money for two ROMs instead of one, but the combination probably represents the nearest you're likely to get to the 'ideal DFS' outlined above – total compatibility together with an extensive range of facilities.

In the time I had the Watford DFS for review, and with a limited amount of proprietary disc software at my disposal, I did not encounter difficulties with compatibility. Nonetheless, the fact that the product differs from the Acorn standard means that compatibility problems could exist.

Watford operate an upgrade policy, which allows existing Watford DFS users to switch to the latest releases, in return for their old ROM plus a £5 'upgrade fee'. Owners of non-Watford DFS ROMs can also trade these in for a discount.

It must be said that Watford's DFS certainly offers a comprehensive range of facilities at a very attractive price. If you plan to buy each new upgrade however, then (at the rate they are producing them!) you could end up spending as much as you would for a different DFS plus disc utility ROM.

MRM's E00 DFS is very close to the standard, with the exception of the two restrictions mentioned earlier. It's not a particularly fast DFS, but if saving user RAM really is your prime concern, then it may be worth considering.

The BBC B+ is supplied with the new Acorn DFS 2.0. This includes the *FORMAT and *VERIFY commands. In addition, extra commands are provided including *FREE, *MAP and *FROMS. Acorn have given no indication as to when this will be available for BBC B owners.

As for the double-density systems, you're much more likely to encounter compatibility problems with certain protected discs (a number of Acornsoft games, for example). These may constitute a small percentage of available disc software, but if there are one or two specific programs which you simply must be able to use, be sure to check that they will run on any DFS you have in mind.

If you can live with this restriction, then any of the double-density filing systems offers particularly good value, in terms of cost per byte of disc storage. There's virtually nothing to choose between the Watford or Viglen DDFSs, apart from price. However, in spite of no built-in disc sector editor, for my money, the Opus DDOS stands out on two counts. First, it has a greatly increased capacity of 248 files per disc, and second, it's the fastest of all disc systems reviewed.

A couple of recent developments in the Acorn camp are of particular relevance to prospective or existing DFS users.

Any new disc interfaces supplied by Acorn dealers should now include a new software chip, the DNFS. This is a 16k ROM which incorporates two filing systems: DFS 1.2, and the network filing system, NFS 3.6. As the chip comprises two separate filing systems, the initial value of PAGE is set at &1B00, as opposed to &1900.

Version 1.2 is the latest DFS release for a considerable time, and is now to be regarded as the new standard disc filing system. Its most notable advantage over its predecessors is that it's faster, due to reduced disc head loading/unloading during disc operations. Unfortunately, I was not supplied with a DNFS ROM for evaluation in time for the review.

Existing DFS users who wish to upgrade to the DNFS can buy just the ROM

for £20.60 (inc VAT) from any Acorn dealer. (At present, Acorn do not offer a trade-in on existing Acorn DFS ROMs.)

A more radical Acorn development, the ADFS (Advanced Disc Filing System), is already available as an integral part of the Electron's Plus-3 disc expansion unit (see *Acorn User*, page 9, March '85). The ADFS adopts a hierarchical tree-structure for directories, which allows far more files per disc than the existing DFS (see the explanatory article on page 31, *Acorn User*, April '84). Furthermore – at least in the case of the Electron – the system supports both single and double-density discs.

There's every chance that any new 'BBC model C' will incorporate the ADFS, and that it will be possible to upgrade on the BBC B+ to the ADFS. Existing BBC micro owners may well also be given the chance to upgrade, using a plug-in extension board. We'll just have to wait and see – Acorn is saying nothing yet.

Clearly there are exciting developments afoot, and the DFS ROM market promises to be an interesting and hotly-contested one for quite a long time to come.

	Acorn DFS	Watford DFS	E00 DFS	Watford DDFS	Opus DDOS	Viglen DSDFS
Version no.	0.98	1.41	1.20	1.52	3.12	1.00
Single density	●	●	●	●	●	●
Double density				●	●	●
EPROM size	8k	16k	8k	16k	16k	16k
Maximum files open	5	5	4	5	5	5
Page (hex)	1900	1900	E00	1900	1900	1900
Maximum files/disc	31	31/62	31	31/62	31/248	31/62
Format in EPROM		●		●	●	●
Verify in EPROM		●		●	●	●
Disc editor		●		●		●
Price (inc VAT) EPROM only	—	£20.70	£24.95	—	—	—
Full upgrade kit	£105 approx	£102.35	—	£97.75	£99.95	£129
Kit if bought with drive(s)	—	—	—	—	£79.95	£105

Table 5. Comparison of various DFS features