Mailgateways at CERN – A critical review

Abstract

This paper contains a proposal for a new topology of the email gateway systems at CERN.
The motives for the change, basically concerning improvement of performance and management of the gateway, are also described.
An inventory of the current infrastructure, a summary of the user, operational and management requirements and of the evaluated software products follows to explain the restructuring considerations.

Contents

Abstract i

Part 1: Main points of this paper 1

1 Summary of recommendations 1

Part 2: Analysis 2

2 The current system. 2
2.1 Protocols 2
2.2 Software 2
2.3 Hardware 4
2.4 User population 5
2.5 Traffic patterns 5
2.6 Network connections 6
3 Requirements 6
3.1 Operational requirements 6
3.2 Management requirements 7
3.3 User requirements 7
3.4 Future requirements 8
4 Recommendations 8
4.1 Protocols to support internally to CERN 8
4.1.1 Goals 8
4.1.2 Measures: 9
4.1.2.1 replace PMDF by the Ultrix gateway. 9
4.1.2.2 phase out the EAN usage within CERN. 9
4.2 Protocols of preference with outside partners 9
4.2.1 Goals 9
4.2.2 Measures: 10

Part 3: Other software 11

5 Results from other software evaluation 11
5.1 DECnet – Ultrix/Internet Gateway 11
5.2 Jnet and Jmail from Joiner Associates 11
5.3 Soft – Switch from Soft – Switch Inc. 12
5.4 MAILbus from DEC 13
5.5 Mail400 from DEC. 13
5.6 Software Tools Mail Gateway from TGV Inc. 14
6 References 15

Part 1

Main points of this paper

The goal of this study is to improve the efficiency of the CERN internal electronic mail gateway system.

A summary of the recommendations for immediate actions is given first.

A description of the current status of mailgateways at CERN follows including the mail – and transport protocols they are supporting, and on which hardware they run.

Our operational experience and new needs for the future resulted in the requirements listed next to serve as input for tools' and procedures' development.

An analysis of a possible new configuration is presented and recommendations are given in detail.

A list of products is given in the end and their relevance to our requirements established after evaluation.

1. Summary of recommendations

We recommend the following changes:

- Replace the use of PMDF with the use of the DECnet – Ultrix/Internet Gateway
- Phase out the EAN usage within CERN
- Favour the use of SMTP on top of TCP/IP for external links

Part 2

Analysis

2. The current system.

In this chapter we describe what the current system is. This includes which protocols are used, which software that supports these protocols, on which hardware the software runs, the user population, the patterns for their mail traffic and which network connections CERN has internally and externally. Input for the current system description is based on reference 1.

2.1 Protocols

The following mail protocols are in use at CERN:

- MAIL – 11 proprietary protocol from DEC (internally, externally)
- Simple Mail Transfer Protocol (SMTP) an Internet standard (RFC822) (internally, externally)
- Batch SMTP, a 'batched' version of SMTP (internally)
- RSCS proprietary protocol from IBM (internally, externally)
- X.400 P1 with Domain Defined Attributes addressing (DDA) from CCITT (internally, externally)
- X.400 P1 with Standard Attributes addressing (SA) (externally)

These mail protocols have different features and addressing syntaxes.

The mail protocols run on top of different transport protocols:

- MAIL – 11 runs on top of DECnet
- SMTP runs on top of TCP/IP and DECnet
- BSMTP runs on top of TCP/IP
- RSCS runs on top of NJE, TCP/IP and SNA
- X.400 P1 runs on top of OSI, TCP/IP and DECnet
- UUCP runs on top of X.25, IP and async. lines

2.2 Software

The following software are in use at CERN:

- VMSmail running on VAX/VMS
- Sendmail running on Ultrix – 32
- rmail running on Ultrix – 32
- Berkeley Mail running on Ultrix – 32
- UBC_EAN 2.1 running on Unix
- UBC_EAN 2.1 running on VAX/VMS
- DFN_EAN 2.2 running on VAX/VMS
- PMDF v3.0 running on VAX/VMS
- MAIL running on VM

- MAILER running on VM

VMSmail running on VAX/VMS

VMSmail comes bundled with the VAX/VMS operating system at no extra cost. It is therefore used very much. VMSmail consists of a UA and an MTA. VMSmail is only running on top of DECnet and is using the DECnet mechanism called task – to – task communication. That implies direct connection between sender machine and receiver machine, and this is the main disadvantage with VMSmail.

VMSmail only supports the MAIL – 11 protocol, but it has an undocumented feature called the Foreign Mail Protocol Interface. With that you can interface other mail protocols to and from the user interface of VMSmail.

VMSmail is supported by DEC.

Sendmail running on Ultrix – 32

Sendmail is a general mail routing program, so it can be seen as an MTA. It supports different addressing syntaxes and different mailers. Each mailer can support different protocols.

Sendmail accepts SMTP directly.

Sendmail is supported by DEC.

rmail running Ultrix – 32

rmail is the interface between Sendmail and UUCP and is only an MTA. It comes bundled with Ultrix – 32.

rmail is supported by DEC.

Berkeley Mail running Ultrix – 32

Berkeley Mail is a User Agent and it comes bundled with most flavors of Unix operating systems, including Ultrix – 32. Berkeley Mail interfaces to Sendmail.

Berkeley Mail is supported by DEC.

UBC_EAN running on Unix

UBC_EAN is a public domain implementation of the X.400 (1984) protocols P1 and P2. It is therefore both a UA and an MTA.

UBC_EAN only supports the use of DDA addressing and it is therefore not a truly X.400 P1 compliant system.

UBC_EAN is not supported by UBC.

UBC_EAN running on VAX/VMS

UBC_EAN is a public domain implementation of the X.400 (1984) protocols P1 and P2. It is therefore both a UA and an MTA.

UBC_EAN only supports the use of DDA addressing and it is therefore not a truly X.400 P1 compliant system.

This version of UBC_EAN will not be supported in the future.

DFN_EAN running on VAX/VMS

DFN_EAN is an implementation of the X.400 (1984) protocols P1 and P2. It is therefore both a UA and an MTA.

DFN_EAN supports the use of DDA and SA addressing and it is therefore a truly X.400 compliant system.

DFN_EAN is supported by GMD.

PMDF running on VAX/VMS

PMDF is a public domain implementation of a general mail routing and delivery system. Its concept is similar to Sendmail. PMDF is only a MTA. VMSmail is used as the UA and PMDF is using the Foreign Mail Protocol Interface to VMSmail.

PMDF is supported by the user community and the author regular distributes patches.

MAIL running on VM

MAIL is a public domain implementation of a UA and was original written at MIT.

It is now supported by Rice Univeristy in Texas.

MAILER running on VM

MAILER is a public domain implementation of a MTA and was original written at Columbia University. MAILER relies on RSCS for the routing.

It is now supported by Princeton University.

2.3 Hardware

The hardware which currently runs the mail gateway system is:

- CERNVAX is a VAX8650 (Ultrix – 32) and runs Sendmail, UUCP, Berkeley Mail and UBC_EAN 2.1 (Cernvax is also known as priam).
- DXMINT is a DECsystem 3100 (Ultrix – 32) and runs Sendmail and UBC_EAN 2.1.
- VXGIFT is a microVAX – II (VAX/VMS) and runs PMDF 3.0 and UBC_EAN 2.1. It has the only X.25 interface to the outside world.
- UXCSB1 is a VAXserver 3600 (VAX/VMS) and runs DFN_EAN 2.2.
- UXCOMS is a microVAX – II (VAX/VMS) and runs UBC_EAN 2.1.
- CEARN is a IBM 4341 (VM/XA) and runs MAILER.

All these machines are connected to the CERN wide Ethernet.

2.4 User population

The main user population are based on the central services at CERN: The VAX Cluster (approx. 3500), VM service (approx. 3500) and Ultrix service (approx. 600).

A large user population located at 1000 other VAX'es, Apollo workstations, MacIntoshes etc. exists as well and requires its mail delivered directly.

Of the User Agents approx. 3500 users use VMSmail, 500 uses EAN, 100 use QuickMail, 3500 uses MAIL and 100 use Berkeley Mail or similar UAs on Unix.

We also have the commitment to operate EARN/BITNET < – > X.400 gateway for the Swiss Academic Community (Switch).

2.5 Traffic patterns

In this section we describe traffic figures between CERN hosts. This is because we want to find ways to reduce hops for mail amongst heavily used CERN machines, therefore, ease the work of the central gateway system and reduce delivery time.

We have no figures for internal CERNVM, BITNET – to – CERNVM and VMS – to – VMS traffic. This is not a problem as this traffic doesn't cross the gateway anyhow and rarely generates user support issues except for what concerns validity of addresses or reachability of certain domains or advanced features of the mail system.

By examining the flow of messages within a random week presenting no special problems we conclude on the following:

- mail to/from EAN hosts (routed in many different way depending on the origin and destination)is very low except PRIAM which is relatively high in both directions.
- mail to CERNVAX from VMSmail (routed to VXGIFT, DXMINT, CERNVAX) is high.
- mail to CERNVM from CERNVAX (routed to CERNVM directly with no extra hops) is high.
- mail to CERNVM from VMS mail (routed to VXGIFT, DXMINT, CERNVM) is high.
- mail to DGMAIL from CERNVM (routed to DXMINT, CERNVAX, DGMAIL) is high.
- mail to VMS mail users from other mail systems within CERN (routed to CERNVAX, VXGIFT or to DXMINT, VXGIFT) is low.
- mail to VMS mail users from CERNVM (routed to DXMINT, VXGIFT, VMS host) is high.
- mail to VMS mail users from Internet and BITNET hosts (routed to CERNVAX, VXGIFT, VMS host or to CEARN, DXMINT, VXGIFT, VMS host) is very high.

For what concerns destination domains outside CERN many alternative routes exist at the moment for most of them. Typical example is ".FR" which is reached via:

- EARN for VM and VMS users
- X.400 over X.25 for EAN users
- SMTP over X.25 for Unix users

This "plouralism" in choices can be considered positive from the point of view of provision of alternative routing possibilities. In some cases it, inevitably, results in asymetric routing. This can be unpleasant when "reply" is not possible (one of the paths is not available) and delivery times are very disproportional.

What can be said at this moment as general criteria of route reevaluation is that the aim is for:

- least expensive routes
- least protocol conversions
- least hops

If the proposal that comes later in this report is implemented, the aim for setting up new routes will be to use the IP links where possible and SMTP as the prefered mail protocol.

2.6 Network connections

CERN has connections to many different networks, both directly and indirectly through other networks.

Some of the more notable networks are:

- EARN/BITNET
- HEP DECnet
- Internet
- RARE X.400
- JANET

3. Requirements

The following requirements have been identified for a new mailgateway system. We have classified them in operational, user interface, future, management. The requirements are not prioritized. Some of the requirements are based on ref. 1, 2 and 3.

3.1 Operational requirements

- **Reliable hardware/software** Gateways operating as a single point of failure, must be more reliable than the networks they connect. The gateway system should normally be operational on a 24 hours per day, 7 days per week basis.
- **Intelligent retry mechanisms for mail waiting to be delivered** The retry mechanisms should be intelligent in order to act accordingly to the error messages received from the underlying network.
- **Intelligent handling of looping messages** Looping messages should be caught based on turn – around time, address – string reappearance over X times, etc.
- **Backup hardware** In case of failing hardware replacement hardware should be available in order to let the service continue.
- **Significant amounts of non – volatile storage** In order to cope with the large amount of traffic volume and transmit times for messages significant amounts of non – volatile storage should be available in case of temporary connection failures.
- **Queue and connection monitoring software** Unavailability of connections or messages queued for unexpectedly long delays should be warned to operational staff for further investigation. The issueing of warning messages should only happen when certain predefined thresholds are exceed.
- **Logging of relevant events** At a minimum it should be possible to determine the time a message was imported and exported from the gateway system, the message size, the unique message iden-

tifier, the originator and recipients(s).

- **Message Tracing Tools** Message tracing tools, based on the log data, can ease the trouble shooting task of identifying messages and their paths through the mail gateway system.
- **Statistics generation** Extensive log data after a number of days becomes indigestible and expensive to store. The data should be regularly analysed to produce statistics, archived in a compressed form. The most useful information shows trends in traffic flow such as most popular source/destinations, average number of messages and their size, estimated communication costs.
- **Configuration flexibility** It should be possible to poll connections, schedule calls for specified times of day, retry calls at specified intervals, select reverse charing.
- **Authorisation** A flexible mechanism should be available to prohibit unauthorised traffic, e.g. the use of the mail gateway system by external partners.
- **Simplicification** The mail gateway system should be able to run on only one dedicated machine with a sufficient configuration.

3.2 Management requirements

- **Unattended operation** The mail gateway system should be able to run normal operations without interference from operational staff.
- **Minimizing costs** The mail gateway system should use the most cost effective connections as possible.
- **Status review procedures** The technical choices of the mail gateway system should be subject of regular review based on new products and traffic patterns, e.g. twice a year.
- **Software backup solutions** Alternative software and/or routes should be available if the main software components of the mail gateway system or routes ceases to function.
- **Quick delivery of internal CERN mail** Internal CERN mail, e.g. from cernvm to vxcern, should be delivered as quickly as possible.

3.3 User requirements

- **The ability to reply directly to an incoming message** It should be possible directly to reply to incoming messages.
- **The ability to forward an incoming message** It should be possible to forward an incoming message to another user or a list of other users.
- **The ability to auto – forward messages** It should be possible to automatically forward all messages from one user to another.
- **The ability to use the same addressing scheme as at present (RFC822)** All User Interfaces should support the domain style addressing, e.g. user@host.domain.
- **The ability to use distribution lists**
- **The mail system should be fast** The User Interface and the transport system should be fast.
- **Connection to standard environment**The User Interface should make it possible to use the standard environment, e.g. editors, printers etc.
- **Simple address conventions** The conventions for forming addresses in the User Interface should be simple and the same no matter which type of network the receipient is connected to.
- **(No)Acknowledgement** The User Interface and transport system should support the use of acknowledgements.
- **Nicknames/Aliases** The User Interface should support the use of nicknames/aliases for often used recipients.

3.4 Future requirements

- **Interworking with coming Directory Systems (X.500 ?)** The mail gateway system should be able to take advantage of a coming Directory System, be it X.500 or another.
- **Interworking with coming public X.400 MHS systems using standard attributes addressing.**
- **Interworking with popular PC based mail systems** The mail gateway system should be able to interwork with the PC based mail systems used at CERN.

These different requirements have not been given any weight compared to each other. But the two basic requirements which weigh the most could be expressed as: **better service for the users** and **better service for the operational staff.**

4. Recommendations

In this chapter we analyze how the mail gateway system could be structured. We will start with the hypotheses that we have the system described earlier, and we want to interconnect it starting from scratch.

4.1 Protocols to support internally to CERN

As previously mentioned 4 mail protocols are used internally at CERN: MAIL – 11, SMTP, BSMTP, RSCS and X.400 P1.

What could be done to bring this number down and thereby reducing complexity ? A goal could be just to use SMTP and BSMTP protocols internally at CERN. Is that worth to be achieved ?

For X.400 P1 the mail traffic patterns show that it is internally mostly used to communicate with non – X.400 P1 DDA implementations through gateways. Therefore the users obviously can not use the advanced features of X.400 P1 and it can be removed.

It is not possible to remove MAIL – 11, since there exists a lot of VAX/VMS systems at CERN and there is a significant amout of traffic going with MAIL – 11.

RSCS is used between CERNVM and CEARN on a channel connection, so it is not possible to improve the service moving to SMTP.

4.1.1 Goals

- increase performance,
- maintain addressing conventions,
- reduce hops,
- avoid conversions as much as possible,
- make routes short and clear,
- favour the hosts with high traffic,
- reduce operation support effort.

4.1.2 Measures:

4.1.2.1 replace PMDF by the Ultrix gateway.

Advantages:

- better performance,
- no change on the user interface,
- well integrated to sendmail,
- less operation support requiring,
- running on DXMINT (the main gateway machine),
- backup solution available at no extra cost (CERNVAX or an Ultrix workstation with DECNET or a VMS machine (VXGIFT or VXCERN) running the new version of PMDF, i.e. 3.1).

Challenges:

- migration period with intense tests,
- increasing experience with the software.

4.1.2.2 phase out the EAN usage within CERN.

Advantages:

- less routing tables to maintain,
- less protocols to support (keeping SMTP and DECNET as the prefered ones),
- less hops,
- less user support effort.

Disadvantages:

- Removes the only X.400 compliant User Agent at CERN

Challenges:

- convince the EAN users to deregister from EAN,
- suggest to the unix EAN users a mail system with satisfactory functionality,
- redesign CERN internal routes.

4.2 Protocols of preference with outside partners

4.2.1 Goals

- minimise communication costs by exploiting existing leased lines,
- favour SMTP over TCP/IP and coordinate establishment of such links,
- push protocol conversion for partners with high traffic out of CERN,
- look for a better X.400 product with a RFC987 gateway in order to replace DFN_EAN and then discontinue UBC_EAN.

4.2.2 Measures:

- Agree with SWITCH and prepare the IP link to be able to relay BITNET traffic using SMTP instead of X.400.
- Evaluate alternative routes for other HEP and RARE partners to whom we now connect using X.400.
- Keep only one standard attributes' and one domain defined attributes' MTA in the gateway system .

Part 3

Other software

5. Results from other software evaluation

In this chapter we describe some relevante software products.

5.1 DECnet – Ultrix/Internet Gateway

DECnet – Ultrix/Internet Gateway consits of a gateway between the MAIL – 11, the CTERM and the DAP DECnet protocols and the Internet equivalent SMTP, TELNET and FTP.

The interesting part is the MAIL – 11/SMTP gateway. It consits of two programs: Mail11v3 for SMTP to MAIL – 11 and mail11dv3 for MAIL – 11 to SMTP. A further description can be found in ref.4 .

Why we propose it:

- High performance compared with PMDF
- No change in the user interface
- Well integrated with Sendmail
- Less operation support requiring
- Could run on DXMINT.

5.2 Jnet and Jmail from Joiner Associates

Jnet is a product which lets a VAX running VAX/VMS participate in BITNET/EARN by providing the NJE protocol family. Jnet is supported on BSC/370, DECnet, OSI, SNA and TCP/IP network connections. TCP/IP is supported by using either MultiNet or WIN/TCP products. Jnet does support mail functionality by itself, but only to BITNET/EARN and no domain style addressing.

To overcome this limitation Joiner has announced Jmail. Jmail will gateway between the following mail systems/protocols: DEC Message Router, DEC MAIL – 11, BITNET/EARN, UUCP and SMTP. A follow – on product is Jmail – MHS, which interfaces Jmail to the Novells NetWare and other LAN products which uses the MHS protocol.

Why we don't propose it:

- Unknown functionality, since the product isn't released

5.3 Soft – Switch from Soft – Switch Inc.

Soft – Switch (SSW) is a serie of products from Soft – Switch Inc. in the US. Soft – Switch Inc. is one of the leading suppliers of products to interconnect multi – vendor electronic mail systems, permitting for the exchange of messages, fully editable documents and binary files.

Soft – Switch products are based on a concept with one or several centrals and gateways and bridges around the central. The central is implemented on either IBM VM or IBM MVS in the products Soft – Switch Central/VM (SSW Central) or Soft – Switch Central/MVS. The two centrals support the same services, except that SSW central/MVS supports a TSO based user interface. In the future SSW Central will be able to run under UNIX.

SSW Central is a MTA in X.400 terms and provides document translation, routing, logging, access control, directory functions and access functions for gateways and bridges. Other services which SSW Central supports are Distributed Printing and Library Services.

Access to SSW Central is accomplished in two ways. Either through a gateway or through a bridge. SSW supports gateways to X.400, SMTP, IBM SNADS, IBM PROFS, Wang MAILWAY and SSW DAD.

DAD is the protocol with which the bridges communicate with the central. Through the DAD Gateway SSW supports the following protocols DEC Message Router, DEC VMSmail, HP Desk, MCI Mail, MHS (NetWare Version) and Wang OFFICE. All the bridges are based on software (MAILbridge Server) located in the native environment of the protocol, e.g. MAILbridge Server/DEC located in a VAX running VAX/VMS. All MAILbridge Server products support several native systems behind a single bridge, e.g. a whole DECnet network.

Through the SNADS and DAD gateways SSW supports the following PC mail protocols 3+Mail, Banyan Mail, Higgins, The Coordinator, cc:mail, Framework III and The Network Courier.

Soft – Switch Central uses a extended IBM SNA Distribution Services (SNADS) protocol in the communication between to centrals in order to be able to support X.400 and RFC822 addresses.

The document translation service supports documents in the following formats IBM DCA RFT, IBM DCA FFT, IBM EBCDIC, ASCII, DEC DX, Wang WWPS, MultiMate, NBI and Xerox. Whenever a document in one format has to be sent to a user who uses another format SSW Central will take care of the conversion. SSW also supports the transmission of binary files, that means files which will not be converted.

Address conversion between the different formats is based on the SSW Centrals Directory Services. SSW Central supports auto registration of senders of messages who are not in the directory.

Why we don't propose it:

- Expensive
- Heavy due to very elaborate document handling/conversion capabilities, which are not necessary in our environment and support for protocols that we do not use.
- No RFC987 gateway.

5.4 MAILbus from DEC

MAILbus is DECs family of products for electronic mail. It consits of Message Router and of several gateways between Message Router and other electronic mail systems MRX to X.400, MR/S to IBM SNADS, MR/P to IBM PROFS, MR/T to Telex, MRGATE to DEC VMSmail and Ultrix Mail Connection to SMTP. MAILbus also contains a programming interface to the Message Router, called Message Router Programmers Kit. Message Router and its gateways all runs under VAX/VMS.

Message Router uses a Distributed Directory System (DDS) to translate between the different addressing formats found on the MAILbus: Message Router, SNADS, X.400 and PROFS. For every user going from Message Router to one of these gateways a record needs to be found in the DDS.

Message Router is a MTA in X.400 terms. The messages that Message Routers exchange between each other are based on the NBS version of the CCITT X.400 recommendations, but the protocols which are used are DEC internal.

As UA's one can use VMSmail, ALL – IN – 1 or Mail400.

Why we don't propose it:

- All recipients of X.400 mail needs to be defined in the DDS/MR directory in order to translate their X.400 address to a Message Router address.
- No RFC987 gateway.

5.5 Mail400 from DEC.

MAIL 400 is a Package Application Software Solution (PASS) providing a mail system interface (User Agent) fully compliant with the CCITT X.400/84 Recommendations for electronic mail on VAX/VMS.

MAIL 400 uses the pure "X.400 Standard Attribute Addresses" (SAA) to define an Originator/ Recipient name, making its users to become themselves members of the X.400 Message Handling System (MHS), i.e. they can be addressed from any other MHS site via SAA. RFC822 style addresses can be optionally used, too.

An appropriate configuration of the transport system provides an effcient X.400 routing scheme over the Message Router and DECnet. Only one host on DECnet is required to install MRX, but any host on DECnet installing MAIL 400 becomes a full member of the X.400 MHS. A full connectivity with any other non X.400 message Handling system is obtainable, provided there is an appropriate trasnparent gateway on the transport system.

By using this package users are able to send and receive mail messages with any other user of the Message Handling System, regardless where those users are located or which kind of system (hardware and software) they are actually using.

MAIL 400 provides the following features:

- Menu driven user interface.
- File cabinet to store messages and documents.
- Creation of mail messages requesting and checking the standard X.400 addressing format (Short Hand Notation).

- Option to address the messages with RFC822 notation.
- Edit, print, delete of messages and documents.
- Creation of documents to be sent later as attachements.
- Sending, Forwarding and Answering (replying) of messages.
- Sending of documents.
- Filing of messages and attachements.
- Attach and detach documents to/from messages.
- Distribution lists
- Deferred delivery.
- Auto forwarding.
- Auto replying.
- Importing and exporting VMS files.
- Importing VMS mail messages
- File cabinet Management options.
- Management options for:
  User Accounts
  Printers
  Messages

Why we don't propose it:

- It is new and unproven
- All recepients of X.400 mail need to be defined in the DDS/MR directory in order to translate their X.400 address to a Message Router address.

5.6 Software Tools Mail Gateway from TGV Inc.

STMG is a PMDF look-a-like written by Bertrand Buclin at EPFL, CH. It supports DECnet, TCP/IP and X.25 networks and VMSmail, BSMTP over RSCS, PSImail, SMTP, TELL for SDSC or MFEnet and X.400 (UBC-EAN v2.1). It runs under VAX/VMS v5.0 or later and have full support for VAXclusters.

STMG has built-in support for the Nameserver and includes a RFC987 gateway. STMG also has a built-in load balancing system, which can be setup accordingly to message size, retry and not-delivery messages.

Why we don't propose it:

- New
- Requires UBC_EAN for the X.400

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