



IRIS-Domaincheck-Client (IRIS-DCHK-Client) starting from version 0.1.1

User-Guide

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1.11	09.09.2009	SWA / DENIC eG	<p><i>Chapter 6.1 Mode A: Call with IRIS URI(s):</i> Error correction: Command line parameter may also be stated BEFORE the IRIS URI(s).</p> <p><i>Chapter 6.2 Mode B: Call with Command Line Parameters:</i> new parameter -x. <code>cli-iris-client.jar</code> remained to <code>iris.jar</code>.</p>
1.12	03.11.2009	SWA / DENIC eG	Table 7-1 Domain Status: Example including motor vehicle number plate removed for <code>invalidName</code> status.

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2 Introduction to the User Guide

2.1 Target Group

The target group of this User Guide is all users of the IRIS-Domaincheck-Client.

2.2 Objectives of the User Guide

The Guide informs the user how a domain availability query is processed and how the IRIS-DCHK-Client is installed and operated.

2.3 Preconditions for Using the User Guide

No particular knowledge is required to use the User Guide.

2.4 Conventions

The following conventions apply for this document:

This is an (important) note.

- ▶ This is an action step
- ☑ This is the result of one or several actions steps.
- > This is an input in the command line.

This is how names of domains, servers, parameter values and other data objects are highlighted.

This is how source codes and program outputs are displayed.

Names of external documents or webpages are printed *in italics* in the text and are followed immediately by their reference number. Example: *RFC4711 [3]*. In the chapter References you find the source data of the corresponding document under that number.

Technical terms from RFC documents are printed in SMALL CAPITALS. Example: REGISTRY, AUTHORITY.

3 Introduction

The IRIS-Domaincheck-Client is a means to make a query on domain availability in accordance with *RFC5144 [5]*. The query uses the functional protocol DCHK. The underlying technical protocol is IRIS Lightweight Using Compression (IRIS-LWZ). IRIS-LWZ is a UDP transfer protocol linked to IRIS (see *RFC4993 [4]*). IRIS is an XML text protocol that defines queries and results for diverse registry information services (for detailed information see *RFC3981 [2]*).

The Client is operated via the command line and you can choose between the following input modes:

- Mode A: input of one or more IRIS Uniform Resource Identifier (IRIS URI)
- Mode B: input of command line parameters

For detailed information on handling see Chapter 6.

3.1 Workflow of a DCHK Query

Figure 3-1 displays the workflow of a domain availability query.

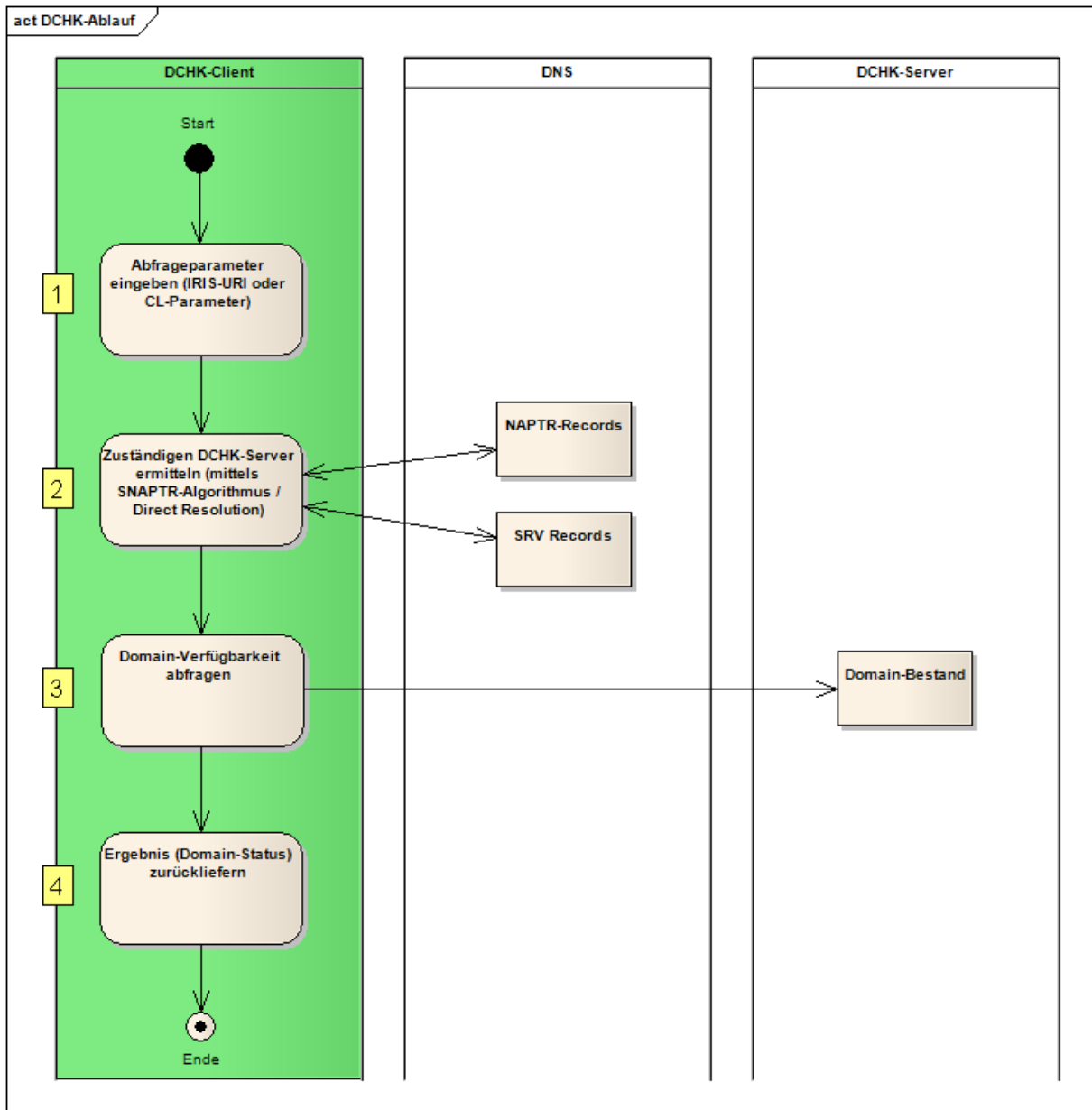


Figure 3-1: Workflow of domain check

Explanation of Figure 3-1 by way of an example:

1. A caller wants to query the availability of the domain `example-domain.de`. He does not know the server to which the query must be addressed. He only knows the responsible AUTHORITY for `.de` domains, which is `de`. He calls on the IRIS-DCHK-Client and submits the following IRIS URI as a query:
`iris:dchk1//de/domain-name/example-domain.de`
2. To be able to retrieve information about the domain, the Client must first identify the DCHK server that is authoritative for `de`. The server is determined by carrying out DNS queries with the S-NAPTR-algorithm. (For detailed information see *RFC3958 [1]*). As a result of the DNS queries it is found that the DCHK server authoritative for `de` is `dchk.denic.de`, for example, and that it runs on the standard port.
3. The Client retrieves the status of the domain from the authoritative DCHK server (`dchk.denic.de`).
4. The Client outputs the result of the query in XML format in the command line:

```
Querying iris:dchk1//de/domain-name/example-domain.de yields:
<?xml version="1.0" encoding="UTF-8"?>
<iris1:response xmlns:iris1="urn:ietf:params:xml:ns:iris1">
  <iris1:resultSet>
    <iris1:answer>
      <urn:domain authority="de" entityClass="domain-name"
        entityName="example-domain.de" registryType="dchk1"
        xmlns:urn="urn:ietf:params:xml:ns:dchk1"
        xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:type="urn:domainType">
      <urn:domainName>example-domain.de</urn:domainName>
      <urn:status>
        <urn:active/>
      </urn:status>
      <urn:lastDatabaseUpdateDateTime>2007-07-
25T16:40:49+02:00</urn:lastDatabaseUpdateDateTime>
    </urn:domain>
  </iris1:answer>
</iris1:resultSet>
</iris1:response>
```

The Client does not validate the XML output against the corresponding XML schema for DCHK [8]. It is up to the caller to validate the output, if necessary, and to transform it into other formats. For explanations on the XML output refer to Chapter 6 - Operation.

3.2 Extensibility of the Client

The Client is also designed as a general IRIS Client that is able to carry out any queries phrased as IRIS URI (see *RFC3981 [2], Chapter 7*). Corresponding services that can deal with other transfer protocols or other IRIS Registry Types have not (yet) been implemented. Other services can also be developed by the user him/herself by implementing specific service interfaces of the library and by placing them in the classpath of the Java program.

4 System Requirements

The IRIS-DCHK-Client needs a Java Runtime Environment (JRE) version 6 or higher. So the operating system of your computer system must support a JRE version 6 or higher. If you work with the JRE by Sun Microsystems, the following operating systems are currently available: Solaris, Windows and Linux (32 and 64 bit respectively). For detailed information on the operating systems supported by Sun refer to the *Release Notes on Java 6 SE [7]*. JREs can be obtained from providers like Sun Microsystems.

5 How to Install the Executable JAR File

- ▶ Install a JRE version 6 or higher on your computer system (if you have not already done so). A JRE is available free of charge for example from Sun Microsystems as a free download (see *Java SE Downloads [6]*).
- ▶ Download the file `iris-client-<version no.>.zip` from the DENIC website (<http://www.denic.de>) and save it in a directory of your choice.
- ▶ Unzip the zip file. (During unzipping a new directory with the name of the zip file is generated automatically, e.g. `iris-client-0-0-5`.)

Test the installation as described below:

- ▶ Open a command window of your operating system.
- ▶ Switch to the newly generated directory (see above).
- ▶ Enter the following command in the command line:

```
> java -jar iris.jar -?
```

- If the following output is displayed, your installation of the IRIS-DCHK-Client has been successful.

```
Generic IRIS client command line program.
```

```
It provides two modes of operation:
```

```
[...]
```

If an error message is displayed instead of the above output, you may have installed the wrong Java version or Java may not be stored on the correct execution path. For further error messages and information on error recovery refer to Chapter 8 - Error Handling.

6 Operation

The Client supports two input modes: In mode A you state at least one IRIS URI and specific optional command line parameters when calling the Client. In mode B you enter exclusively command line parameters upon calling. Below you find a description how to operate the Client in each mode.

6.1 Mode A: Call with IRIS URI(s)

The following syntax is required for calling the IRIS-DCHK-Client in mode A:

```
> java -jar iris.jar [command line parameters] [IRIS-URI-1] [IRIS-URI-2 IRIS-URI-3 ...]
[command line parameters]
```

You must state at least one IRIS URI. If you enter several IRIS URIs, state one after the other separated by an empty space respectively.

Several URIs in one call are **not** combined to one request. The Client sends a separate request to the server for each URI.

The structure of every IRIS URI is as follows (variables in <pointed brackets>, mandatory data in **bold type**):

iris<.protocol>:<**registry type**>/<resolution>/<**authority**>/<entity class>/<entity name>

The individual components of the IRIS URI have the following meaning:

Table 6-1: IRIS URI components

URI component	Meaning	Potential values	Mandatory / Optional data
iris	States the name of the IRIS URI schema.	iris	mandatory
<protocol>	The IRIS transfer protocol to be used	.lwz (default value) Note: Other transfer protocols are currently not implemented in the Client.	optional*
<registry type>	The URN of the REGISTRY that is to be addressed. Every REGISTRY serves a specific function like a DOMAIN REGISTRY or an ADDRESS REGISTRY. (Source: <i>RFC3981 [2]</i>)	dchk1 Note: Other REGISTRY TYPES are currently not implemented in the Client.	mandatory
<resolution>	The technique to be applied by the Client to locate an AUTHORITY. (Source: <i>RFC3981 [2]</i>)	direct (default value), top, bottom	optional*

URI component	Meaning	Potential values	Mandatory / Optional data
<authority>	Indicates the AUTHORITY from where information shall be retrieved. An AUTHORITY is a reference to a server or a set of servers containing information. (Source: <i>RFC3981 [2]</i>)	<domain name>, <domain name>:<Port>, <IP adress>, <IP adress>:<Port>	mandatory
<entity class>	A group of ENTITIES of the same type or with a common set of characteristics. (Source: <i>RFC3981 [2]</i>)	iris (default value), domain-name, idn (intended for INTERNATIONALIZED DOMAIN NAMES (IDN)) Note: If domain-name is used, an IDN domain should be entered as an ACE string.	optional*
<entity name>	An identifier used to refer to a single ENTITY within an ENTITY CLASS. (Source: <i>RFC3981 [2]</i>)	id (default value), Full name of ENTITY (e. g. example-domain.de)	optional*

*If you fail to state an optional component, the Client automatically falls back on the corresponding default value.

In addition to one or several IRIS URI(s) you may enter specific command line parameters. For the parameters permitted in mode A refer to Table 6-2: Command line parameters in Chapter 6.2. You may enter the command line parameters either before or after the IRIS URI(s).

Application example:

You want to query the status of the domain `example-domain.de`. You know neither the server name nor the port of the DCHK server. Instead you enter `de` as the AUTHORITY to be queried.

- ▶ Open a command window on your system.
- ▶ Switch to the directory where you have filed the `iris.jar` file.
- ▶ Enter the following command into the command line:

```
> java -jar iris.jar iris:dchk1//de/domain-name/example-domain.de
```

The Client now determines the authoritative DCHK server for the AUTHORITY `de` and sends it the following request in conformity with the IRIS-LWZ protocol (see *RFC4993 [4]*):

```
<request xmlns="urn:ietf:params:xml:ns:iris1"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="urn:ietf:params:xml:ns:iris1 iris.xsd" >
```

```
<searchSet>
  <lookupEntity
    registryType="urn:ietf:params:xml:ns:dchk1"
    entityClass="domain-name"
    entityName="example-domain.de" />
  </searchSet>
</request>
```

(Note: The above request payload is preceded by a binary payload descriptor, which is not displayed here.)

The following XML output is delivered as a result of the query:

```
Querying iris:dchk1//de/domain-name/example-domain.de yields:
<?xml version="1.0" encoding="UTF-8"?>
<iris1:response xmlns:iris1="urn:ietf:params:xml:ns:iris1">
  <iris1:resultSet>
    <iris1:answer>
      <urn:domain authority="de" entityClass="domain-name"
        entityName="example-domain.de" registryType="dchk1"
        xmlns:urn="urn:ietf:params:xml:ns:dchk1"
        xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:type="urn:domainType">
        <urn:domainName>example-domain.de</urn:domainName>
        <urn:status>
          <urn:active/>
        </urn:status>
        <urn:lastDatabaseUpdateDateTime>2007-07-
25T16:40:49+02:00</urn:lastDatabaseUpdateDateTime>
        </urn:domain>
      </iris1:answer>
    </iris1:resultSet>
  </iris1:response>
```

Comments on the result:

The data printed in bold in the above XML output are to be understood as follows:

The domain **example-domain.de** was **active** at the time stamp **2007-07-25T16:40:49+02:00**. The latest update of the database from which the result was retrieved was executed at the above time stamp.

For a list of the potential domain statuses refer to Chapter 7 - Domain Status.

6.2 Mode B: Call with Command Line Parameters

The following syntax is required for calling the IRIS-DCHK-Client in mode B:

```
> java -jar iris.jar [command line parameters]
```

The following command line parameters are available:

Table 6-2: Command line parameters

Parameter (Syntax)	Meaning	Example	Mandatory / Optional data	Permissible in mode
-?	Output help on command line parameters.	-?	optional	A and B
-a <AUTHORITY>	See Table 6-1: IRIS URI components in Chapter 6.1.	-a de	mandatory	B
-c <ENTITY CLASS>	See Table 6-1: IRIS URI components in Chapter 6.1.	-c domain-name	optional	B
-h	Output help on command line parameters (identical with -?).	-h	optional	A and B
-n <ENTITY NAME>	See Table 6-1: IRIS URI components in Chapter 6.1.	-n example-domain.de	optional	B
-nr	Deactivates the resolution of the AUTHORITY.	-nr	optional	A and B
-p <PROTOCOL>	States the IRIS transfer protocol to be used.	-p lwz (default value) Note: Other transfer protocols are currently not implemented in the Client.	optional	B
-r <RESOLUTION>	See Table 6-1: IRIS URI components in Chapter 6.1.	-r direct	optional	B
-t <REGISTRY TYPE>	See Table 6-1: IRIS URI components in Chapter 6.1.	-t dchk1	mandatory	B
-v	Outputs additional debugging information.	-v	optional	A and B
-x <SCOPE:KEY=VALUE>	Has an impact on the	-x	Optional	A und B

Parameter (Syntax)	Meaning	Example	Mandatory / Optional data	Permissible in mode
[,<SCOPE:KEY=VALUE>] ...	behaviour of specific components of the DCHK service by handing over the corresponding control parameters.	lwz:auth=de, lwz:mrl=1024 Explanation: SCOPE "lwz" = component "lwz". KEY "auth" = authority for LWZ requests, here "de". KEY "mrl" = maximum length of response to LWZ requests, here 1024 bytes.		

Application example:

You want to query the status of the domain müller.de. Please note that this is an IDN domain. You know neither the server name nor the port of the DCHK server. Instead you enter de as the AUTHORITY to be queried.

- ▶ Open a command window on your system.
- ▶ Switch to the directory where you have filed the iris.jar file.
- ▶ Enter the following command into the command line:

```
> java -jar iris.jar -a de -c domain-name -n müller.de -t dchk1
```

- The following result in XML-format is delivered in response to the query:

```
Querying iris:dchk1//de/domain-name/müller.de yields:
<?xml version="1.0" encoding="UTF-8"?>
<iris1:response xmlns:iris1="urn:ietf:params:xml:ns:iris1">
  <iris1:resultSet>
    <iris1:answer>
      <urn:domain authority="de" entityClass="idn"
        entityName="müller.de" registryType="dchk1"
        xmlns:urn="urn:ietf:params:xml:ns:dchk1"
        xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:type="urn:domainType">
        <urn:domainName>xn--mller-kva.de</urn:domainName>
        <urn:idn>müller.de</urn:idn>
        <urn:status>
          <urn:active/>
        </urn:status>
        <urn:lastDatabaseUpdateDateTime>2007-07-
25T16:40:49+02:00</urn:lastDatabaseUpdateDateTime>
      </urn:domain>
    </iris1:answer>
  </iris1:resultSet>
```

```
</iris1:response>
```

Note: Strictly speaking you should have entered `idn` instead of `domain-name` for ENTITY CLASS, since the entity class is an IDN domain. But the Client has recognized that the ENTITY NAME designates an IDN domain and has used `idn` as ENTITY CLASS in the request to the server.

For a list of the potential domain statuses refer to Chapter 7 - Domain Status.

7 Domain Status

An availability query made with the IRIS-DCHK-Client can deliver the following domain statuses. It is a subset of the statuses defined in *RFC5144* [5].

Table 7-1: Domain Status

Status	Meaning
<code>active</code>	The domain is registered and connected. (Corresponds to <code>connect</code> status in whois.)
<code>inactive</code>	The domain is registered, but there is not DNS entry for it. (Corresponds to <code>failed</code> status in whois.)
<code>invalidName*</code>	<ul style="list-style-type: none"> The syntax of the domain name is invalid. Example: <code>§%&() %\$.de</code>. (Corresponds to <code>invalid</code> status in whois.) <p>OR</p> <ul style="list-style-type: none"> The syntax of the domain name is valid, but DENIC's Domain Guidelines prohibit registration of that syntax. (Corresponds to <code>invalid</code> status in whois and <code>blocked</code> status in ENUM-whois.)
<code>nameNotFound*</code>	The domain is available. (Corresponds to <code>free</code> status in whois.)

* No status according to *RFC5144* [5], but an error message according to *RFC3981, Chapter 4.2* [2]. In whois, it is traditionally output as status.

8 Error Handling

Below you find a list of the errors that may occur when the software is used. It states the potential cause of every error and gives information on how to eliminate the error.

Table 8-1: Technical Errors

Output	Cause of error	Error recovery
Exception in thread "main" java.lang.UnsupportedClassVersionError: Bad version number in .class file at java.lang.ClassLoader.defineClass1(Native Method) [...]	You installed a wrong Java version on your system.	Install the Java version that is required for the Client, see Chapter 4 - System Requirements.
The "java" command is either spelled in the wrong way or could not be found.	Java is either not installed on your system or placed in another execution path.	Check whether Java is installed correctly on your system and re-install, if necessary.

Table 8-2: Technical / Content Errors

Output	Cause of error	Error recovery
Configuration error: Parameter "iris:error" inappropriate to build a valid IRIS URI: Given URI not parsable: iris:error	The format/schema of the IRIS URI transmitted to the Client is faulty.	Provide the Client with an IRIS URI of correct schema (see Chapter 6.1 - Mode A: Call with IRIS URI(s))
Internal error with URI iris:dchk1//de/domain-name/example-domain.de java.nio.channels.UnresolvedAddressException at sun.nio.ch.Net.checkAddress(Unknown Source) [...]	Either the DNS entries of the stated AUTHORITY are not available or the DNS entries exist but the authoritative DCHK server does not respond.	Try to use another AUTHORITY or enter name and port - if known - of the corresponding DCHK server as AUTHORITY.
Querying URI iris:dchk1//de/contact/example-domain.de failed de.denic.iris.client.request.UnsupportedRegistryTypeEntityClassException: No payload generator handling entity class "contact" available at de.denic.iris.client.request.impl.AbstractEntity	You have stated an invalid parameter value (e.g. ENTITY-CLASS contact).	Use valid parameter values (see Chapter 6 - Operation).

Output	Cause of error	Error recovery
ClassDispatchingIrisRequestPayloadGenerator [...]		
<pre> Querying iris:dchk1//de/domain- name/-example-domain.de yields: <?xml version="1.0" encoding="UTF-8"?> <iris1:response xmlns:iris1="urn:ietf:pa rams:xml:ns:iris1"> <iris1:resultSet> <iris1:answer/> <iris1:invalidName/> </iris1:resultSet> </iris1:response> </pre>	<p>The syntax of the domain name is invalid (see also Chapter 7 - Domain Status).</p>	<p>Check and correct the domain name you used for the query.</p>

9 References

- [1] Daigle, L. and A. Newton, "Domain-based Application Service Location Using SRV RRs and the Dynamic Delegation Discovery Service (DDDS)", RFC3958, January 2005.
- [2] Newton, A. and M. Sanz, "IRIS: The Internet Registry Information Service (IRIS) Core Protocol", RFC3981, December 2005.
- [3] Newton, A. and M. Sanz, "IRIS: A Domain Registry (dreg) Type for the Internet Registry Information Service (IRIS)", RFC3982, January 2005.
- [4] Newton, A., "A Lightweight UDP Transfer Protocol for the Internet Registry Information Service", RFC4993, August 2007.
- [5] Newton, A. and M. Sanz, "A Domain Availability Check (DCHK) Registry Type for the Internet Registry Information Service (IRIS)", RFC5144, February 2008.
- [6] Sun Microsystems, Java SE Downloads, available under: <http://java.sun.com/javase/downloads/index.jsp>
- [7] Sun Microsystems, Java SE 6 Supported System Configurations, available under: <http://java.sun.com/javase/6/webnotes/install/system-configurations.html>
- [8] XML-Schema for DCHK, available under: <http://www.iana.org/assignments/xml-registry/schema/dchk1.xsd>

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