Avoiding email spoofing and tampering with DKIM

Besides SPF, there is another protocol that ensures sent emails have not been modified during their journey, and that the sender is really sending the email from the address listed in the email header. This is **DKIM**, DomainKeys Identified Mail.

DKIM uses cryptographic signing to ensure the content has not been modified during the journey, and the sender domain is really what it pretends to be.

How DKIM works

When the mail administrator of the *example.com* domain wants to use DKIM to allow the recipients to check the content of the email has not been modified, he needs to take the following actions:

- Create a public/private cryptographic key pair;
- Publish a **DNS TXT DKIM** record containing his public key.

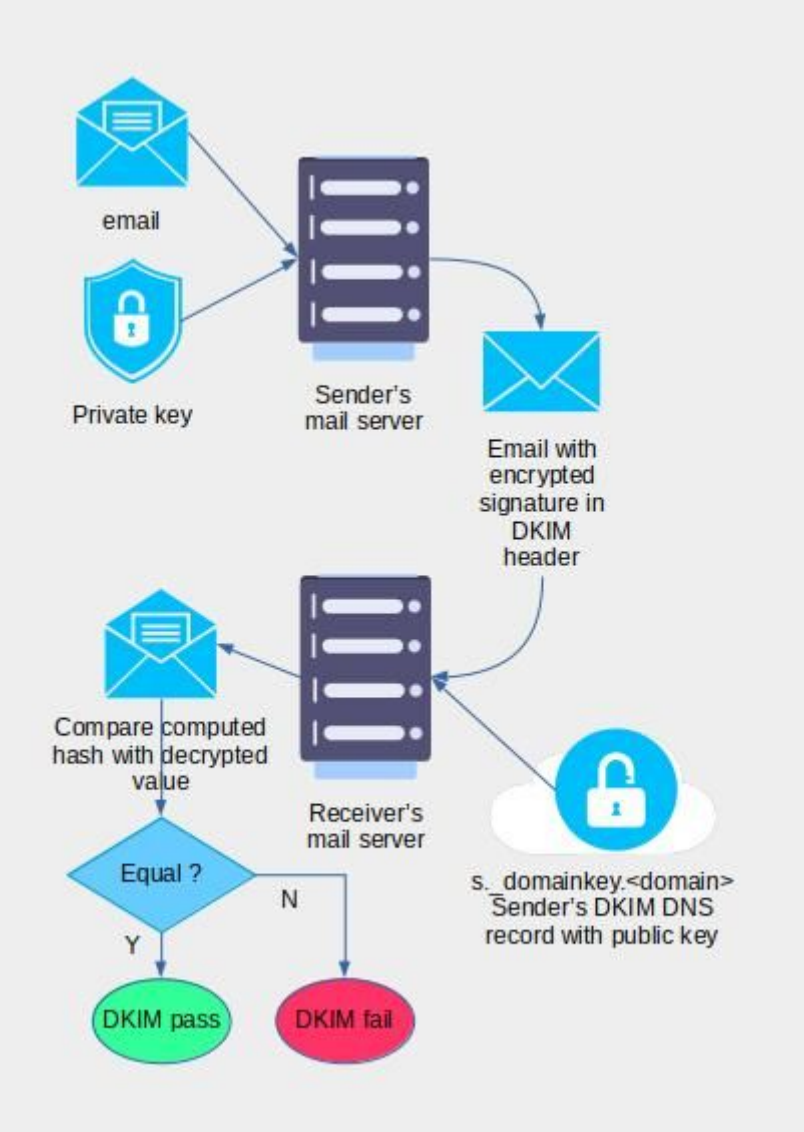
Then, he and other mail administrators of domains receiving emails from the *example.com* domain need to enable DKIM so the email handling software can sign and verify the emails.

Note: if a mail server is not configured to check DKIM, no defense against tampering will be put in place even if the sender has a DKIM record.

Let's assume *user1@example.com* sends a mail to *user2@otherdomain.com*. When DKIM processing is enabled, the following things happen:

- The sender server in the *example.com* domain (the signer) computes a hash of a list of headers, and a hash of the email body;

- It encrypts the hashes with its private key, creating a signature;
- It writes a ***DKIM-Signature*** header into the mail containing the list of headers protected by the signature, the signature itself, and a selector, which is the first part of the DNS TXT record containing its public key;
- The receiving server (the verifier) locates the selector in the DKIM header;
- It queries DNS to receive the DKIM record of the sending domain (in our case: *<selector>._domainkey.example.com*);
- It extracts the sender's public key from the DNS DKIM record;
- It decrypts the signature;
- It performs the same hash operations on the list of headers protected by the signature and on the email body;
- It now compares the 2 hash values;
- If they are identical, an ***Authentication-Results:*** header is added to the email with a dkim status '`pass`';
- If not, the ***Authentication-Results:*** header is added to the email with a dkim status '`fail`', and the mail is subject to the DKIM fail policy of the mail handler. Generally, it is marked as spam, junk, or is quarantined.



The DKIM-Signature header

This is an example of a DKIM-Signature header created by the *outlook.com* (Microsoft) mail provider:

```
DKIM-Signature: v=1; a=rsa-sha256; c=relaxed/relaxed;
d=outlook.com; s=selector1; h=From:Date:Subject:Message-
ID:Content-Type:MIME-Version:X-MS-Exchange-SenderADCheck;
bh=J5xVXlIPB8b3aQVmIOVS4pAqIH4oOaHCb3LgLetuS1s=;
b=OSRH95fo/UTLgZrvDcO5B8HF306wPd5WZ76iZu9vOtRVgAXgPJEWjUJsqcmxtRn
n4ZnKhEpEfBx16XLMBbIebYfAK7NPdchpSv2yAfpqjmCkLotnvG/rltpuz9qqW/
6vxdzxCgvoxw1DPpFA+Qh0Zs95P5k86h7w6EgXpsEh3jx5rU4eR0qIRoSOTUqdRHu
LXXb4zO96ftdNT7mneSkImRBhQbi6XSwLaJhW+Gm6Mkh/1/
KdbwF+pgKT2JmhPA+QDYhGENJpN601mjFLojOm9AwlY0AGmc0K6L80ESzULq3yvRW
MrmyHEATN0fOVrzFkwasyLujWd/+HedfgWtgaTg==
```

- ***v=1***: means the format complies with DKIM version 1 (the current one).

- ***a=rsa-sha256***: means that the algorithm used to compute the hashes is SHA-256. SHA-1 is also supported.
- ***c=relaxed/relaxed***: means that the canonicalization used for the headers and the body is 'relaxed'. Canonicalization is the beautifying process applied to the texts before the hash is computed. *Simple* means no change (except deleting blank lines), *relaxed* means that the header names are converted to lowercase, extraneous spaces are deleted...
- ***d=outlook.com***: this is the original sending domain from the From: header. It will be used to retrieve the DNS DKIM record.
- ***s=selector1***: this is a name that must be prepended to *_domainkey.<domain>* to find the DNS DKIM record. A domain can have multiple DKIM records, they must be distinguishable uniquely by their selector.
- ***h=From:Date...***: this is the list of headers that will be used to compute the header hashes, and therefore the headers that will be protected by the signature. For protection to be really effective, it should contain at least the *From:* and *To:* headers.
- ***bh=J5...***: this is the hash of the canonicalized body part of the email.
- ***b=OSRH...***: this is the signature, i.e. the result of the encryption by the private key of a value composed of the domain, the selector, and the hashing value obtained by hashing the headers and the hashed body. In short, the signature is obtained by the following actions:
  - body-hash = hash(canonicalized body)
  - data-hash = hash(headers in list, DKIM-Signature header name, body-hash)
  - signature = crypt(domain, selector, data-hash)
    The signature is converted to base64.

Other tags can be used, but these are the most common.
You can find the complete syntax of the DKIM headers and records in RFC 6376.

Setting up DKIM for a domain

A DKIM record is a DNS (Domain Name System) TXT record containing the public key and optionally the key type (the default is a RSA key).

The general syntax of an DKIM record is the following:

```
<selector>._domainkey.<domain> TXT "v=DKIM1; k=rsa; p=<public key in base64 representation>"
```

Usually, your email or domain provider provides an easy interface to create your DKIM records.
Otherwise the Easydmarc site offers an easy DKIM record generator and some explanation.

Note that DKIM does not require the setup of a complex public key infrastructure; a simple public/private key pair is needed. Of course, you must protect your private key like your crown jewels.

Finding the DKIM record for a domain

As the DKIM record is a DNS TXT record, you can get it with the following commands:

```
dig -t txt <selector>._domainkey.<domain>
nslookup -ty=txt <selector>._domainkey.<domain>
```

Example: if you receive a mail with the following DKIM-Signature header:

```
DKIM-Signature: v=1; a=rsa-sha256; c=relaxed/relaxed;
d=mail.datanews.be; s=sim; x=1712235864; i=@mail.datanews.be;
h=from:to:subject:date:reply-to:message-id:list-unsubscribe:
list-unsubscribe-post:feedback-id:list-id:mime-version: content-
type; bh=K2G3f0De2u9k7cjGRlQb/DT4b3UjMOTHgwV3JhL/n5g=;
b=MLyccGY84pMjl9fJ685sn2N/dTjKFIauN8CuFgxReCULTGtAgk7zmx87WAMNon
6htQ4d52+bPNMXedtP3mc1HkZdN179O3DI/vFrqQV2m3xDDQj/EGef3aPaW8abxC
tlqSyXm07xrTpuhxx42LYIXvQay27QTbZ3BiQcWViOWk5HP3WZGmFVndy7ak4wgv
Hzsa/1x98z6hhEQEEEecSkPcj5+/TQ1izgVnpmoordUsGkx+P3gjbBPqk36l5FD+
g8lwW+SfuKTv7KmqAaGKwoUZHvmlMI5wh6zfmbe4l/nynCl5jAT8pzeWdwglLTa1
7W9RcVED1VlCIO2AntmSeNgA==
```

you have to lookup the following DNS TXT record: *sim._domainkey.mail.datanews.be.*

```
nslookup -ty=txt sim._domainkey.mail.datanews.be
Server: 9.9.9.9
Address: 9.9.9.9#53
Non-authoritative answer:
sim._domainkey.mail.datanews.be text = "k=rsa;
p=MIIBIjANBgkqhkiG9w0BAQEFAAOCAQ8AMIIBCgKCAQEAo9TT29ItqqnMwOHdMKv
3jsVoG7UZmVhm/VsXvxBFdCCjM/
t816OvNhbmtSNwNRbSMM8AzHO0O5qIFKLeFOKqe+hVv15yJZ8AQTuU4lJxqEM/
lFpMOTJ/
+IqWhzCdu33GWGdA3wYx8Ntl9gLno7wY5I6PDBJvaiPiXn3uYNwwxaTu38UXYbqbn
yP0jh0dmiGapk+ZQj5szK"
"SzNzZJ9R9ymtKsz2mKe0bjsqLiNhK1oDFOJUxsN4qwwED8k/e4lnnmALepyWuSMN
k2vxW+uWdm2eA0RyljrC+I0DabF0qlfM+GJT01jgYrKr4YVsVw0IDOsujbh/
zWcWOyDszRAYrZBQIDAQAB"
```

You can also use the following free websites to find DKIM records:

- MXToolbox
- EasyDmarc

Checking DKIM results in email headers

The DKIM protocol adds ***`Authenticated-Results:`*** headers in the emails it processes.

The general syntax is:

```
Authentication-Results: <authenticating server> dkim=<result>
<explanation of result with list of checked headers>
```

where <result> is *pass* or *fail*.

Let's check a real world mail header. This is an email sent from *pltrash2@outlook.com* to *pltrash2@gmail.com*. The DKIM-Signature is written by the *outlook.com* mail server (Microsoft), and is verified by the *gmail.com* server (Google).

```
Delivered-To: pltrash2@gmail.com
Received: by 2002:a05:7412:220e:b0:106:1c01:d29c with SMTP id
r14csp30940rda;
Fri, 29 Mar 2024 11:16:11 -0700 (PDT)
X-Google-Smtp-Source:
AGHT+IHZ0MeAmsne8D6AaAPxBy7Y8L0KDX+Zfz95KJwiNu/N/WslkzA3nIeS8dp70
7ySuPIjX5yJ
X-Received: by 2002:a05:6870:b28c:b0:22a:1e39:8bfa with SMTP id
c12-
20020a056870b28c00b0022a1e398bfamr3114970oao.25.1711736171497;
Fri, 29 Mar 2024 11:16:11 -0700 (PDT)
ARC-Seal: i=2; a=rsa-sha256; t=1711736171; cv=pass;
d=google.com; s=arc-20160816;
b=0WiDEJ2lsPKPd9yXUqzW5lMsBJu+Q8DXae45pt0tv/
FnQD8DIt4fI0XQ9O8RRDEJYK
EkmNeq8BnqNvwTVNCzXrGsBcpT5c+0ALq7hMipt4QpVjQFj29hd4/
b4kt5yuAdr0OheY
OBsvG7YNBRcAHvoF5+BtV4l/Ch4A6ROLzVyh/
JPIBuAPWuh4Q7lRI2ymGFR1ex5ub0sh
MG86oyJY33d9jPBj5M7Xjmo4TkrQbdZaw3ia3cJkjNsIoS0+gt5VAtRr3GStmHjZ7
YUn
wRG70R9BAU6gio3ymLydZTa92qwaNfBot3KSgV2XsuUuUbly3lZiPotFGrwCF3CqH
wet
e3oQ==
ARC-Message-Signature: i=2; a=rsa-sha256; c=relaxed/relaxed;
d=google.com; s=arc-20160816;
h=mime-version:content-transfer-encoding:msip_labels:content-
language
:accept-language:message-id:date:thread-index:thread-
topic:subject
:to:from:dkim-signature;
bh=J5xVXlIPB8b3aQVmIOVS4pAqIH4oOaHCb3LgLetuS1s=;
fh=H8fS/F1Xi7k6c76u5mat11UzewD7stRXC+xTg8ayz9I=;
b=CTETjwm02n/YObWmGhbcsHv7Hqixz8dVbmIRgJMzdoIiUcDI/xK/
J6YoN07zaonWo1
```

```
5WcbThwZipLC/
bK83NqIDOduQ6f24hwNqfh9M4xyMAxH7xLDfBRPxF7YBY3diKqnhn29
QSPX8kVDc4jay4bCCdiGHVvgHOU+wrJr+AynAoU8SwKxH/
zxNvcJpjxdxB58ZWPvXV7G
tMn87T79KGDVYZidhebuB2EqX49sUzsnk3HfyZyc9rILcJSJnzcvI4tiPzzpex9JW
p8l
Juvwc9f0eITu0jEGTsKv0RwYPkKTm09/
vbk+gUFFbJneAlwJxkKlloqUxfH1atRKhKPp
r5dA==;
dara=google.com
ARC-Authentication-Results: i=2; mx.google.com;
dkim=pass header.i=@outlook.com header.s=selector1
header.b=OSRH95fo;
arc=pass (i=1);
spf=pass (google.com: domain of pltrash2@outlook.com designates
2a01:111:f403:2e0d::800 as permitted sender)
smtp.mailfrom=pltrash2@outlook.com;
dmarc=pass (p=NONE sp=QUARANTINE dis=NONE)
header.from=outlook.com
Return-Path: <pltrash2@outlook.com>
Received: from EUR03-DBA-obe.outbound.protection.outlook.com
(mail-dbaeur03olkn20800.outbound.protection.outlook.com.
[2a01:111:f403:2e0d::800])
by mx.google.com with ESMTPS id ec27-
20020a05622a5b9b00b00432c7306e0csi1006434qtb.4.2024.03.29.11.16.1
1
for <pltrash2@gmail.com>
(version=TLS1_2 cipher=ECDHE-ECDSA-AES128-GCM-SHA256
bits=128/128);
Fri, 29 Mar 2024 11:16:11 -0700 (PDT)
Received-SPF: pass (google.com: domain of pltrash2@outlook.com
designates 2a01:111:f403:2e0d::800 as permitted sender) client-
ip=2a01:111:f403:2e0d::800;
Authentication-Results: mx.google.com;
dkim=pass header.i=@outlook.com header.s=selector1
header.b=OSRH95fo;
arc=pass (i=1);
spf=pass (google.com: domain of pltrash2@outlook.com designates
2a01:111:f403:2e0d::800 as permitted sender)
smtp.mailfrom=pltrash2@outlook.com;
dmarc=pass (p=NONE sp=QUARANTINE dis=NONE)
header.from=outlook.com
ARC-Seal: i=1; a=rsa-sha256; s=arcselector9901; d=microsoft.com;
cv=none;
b=RbRY3osi22pGFg1gRVysVuiL6or4+LRx1xnYftE1PVQeCAxFeucoGp9q7PKqM1B
```

```
Ftsrq2gGnAXMPpD8m/i3gBIrgbMuZdw5Cbo9YMIaACh2c0D6xyVr/
gcphYLQgqdNRts4rQscDGgbhCFSe/
7chHHJUiuhe9rGSaV7VO10n6TdfS8FAYNLoijoR1+hJNQKxyYgizTI6q2e5qtIO7h
bdUo3Qu25pYEiAPQockmViNBm/
o68DtSD+CYdBEOEd6FLiMMin8o+ixnj2UnVNFO+4WZF2godMTOMp5VbIAHKuTl2rh
R5SBUSWk8HOsp6dQAYDR2YYMV0wfCXq1e+AzAmqFA==
ARC-Message-Signature: i=1; a=rsa-sha256; c=relaxed/relaxed;
d=microsoft.com; s=arcselector9901; h=From:Date:Subject:Message-
ID:Content-Type:MIME-Version:X-MS-Exchange-AntiSpam-MessageData-
ChunkCount:X-MS-Exchange-AntiSpam-MessageData-0:X-MS-Exchange-
AntiSpam-MessageData-1;
bh=J5xVXlIPB8b3aQVmIOVS4pAqIH4oOaHCb3LgLetuS1s=;
b=GoCHS+cXfoc7vMbVtJx0hRue1MoRtNfTGC1ek6UvKwsPCoIL7uRUP+aUA0/Lwqz
G5Gzh6qzWzjJ9+zI1l8Swq3gF+FK289PUzDuWMsTC3TEnyb+ththbk66Ll7ItlE6w
QS/
TKBALG2VHxRpv9O7E27v1q+8DxJ1vVXkYicZcjJqRXNaDapbbXuBGJaDWSB2TRjXw
S+aikpc5mHqC+o7mEZ8RB06wldhdOuTin9olgoJSRrOi5d7fcLxPwfAg2rIXeoR+T
h3P2gVKPxOmZlDj//+ztITVbFr5ZyBp0shks/2a2+JklApujzDx7hsweexQLd/
Y8v/BjNmJXR476RFLNw==
ARC-Authentication-Results: i=1; mx.microsoft.com 1; spf=none;
dmarc=none; dkim=none; arc=none
DKIM-Signature: v=1; a=rsa-sha256; c=relaxed/relaxed;
d=outlook.com; s=selector1; h=From:Date:Subject:Message-
ID:Content-Type:MIME-Version:X-MS-Exchange-SenderADCheck;
bh=J5xVXlIPB8b3aQVmIOVS4pAqIH4oOaHCb3LgLetuS1s=;
b=OSRH95fo/UTLgZrvDcO5B8HF306wPd5WZ76iZu9vOtRVgAXgPJEWjUJsqcmxtRn
n4ZnKhEpEfBx16XLMBbIebYfAK7NPdchpSv2yAfpqjmCkLotnvG/rltpuz9qqW/
6vxdzxCgvoxw1DPpFA+Qh0Zs95P5k86h7w6EgXpsEh3jx5rU4eR0qIRoSOTUqdRHu
LXXb4zO96ftdNT7mneSkImRBhQbi6XSwLaJhW+Gm6Mkh/1/
KdbwF+pgKT2JmhPA+QDYhGENJpN601mjFLojOm9AwlY0AGmc0K6L80ESzULq3yvRW
MrmyHEATN0fOVrzFkwasyLujWd/+HedfgWtgaTg==
Received: from AS8P189MB1621.EURP189.PROD.OUTLOOK.COM
(2603:10a6:20b:393::12) by GV1P189MB2107.EURP189.PROD.OUTLOOK.COM
(2603:10a6:150:57::19) with Microsoft SMTP Server
(version=TLS1_2, cipher=TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384) id
15.20.7409.39; Fri, 29 Mar 2024 18:16:09 +0000
Received: from AS8P189MB1621.EURP189.PROD.OUTLOOK.COM
([fe80::c7fb:d192:40d8:2f36]) by
AS8P189MB1621.EURP189.PROD.OUTLOOK.COM
([fe80::c7fb:d192:40d8:2f36%3]) with mapi id 15.20.7409.042; Fri,
29 Mar 2024 18:16:09 +0000
From: Philippe Leclercq <pltrash2@outlook.com>
To: pl_trash <pltrash2@gmail.com>
Subject: DKIM test email
Thread-Topic: DKIM test email
```

```
Thread-Index: AQHaggUsJ9Gmfe8zpEiMmMD/JwvuoQ==
Date: Fri, 29 Mar 2024 18:16:09 +0000
Message-ID:
<AS8P189MB1621D4551CA36F99656602B78E3A2@AS8P189MB1621.EURP189.PRO
D.OUTLOOK.COM>
Accept-Language: en-GB, en-US
Content-Language: en-GB
X-MS-Has-Attach:
X-MS-TNEF-Correlator:
msip_labels:
x-ms-exchange-messagesentrepresentingtype: 1
x-tmn:
[jzXPG0c9g+ZXCMDUkE1sJnz8V6w5/VOHjiSZ7Yk8wbBh49VldkKgtOJy8bBY4Cbw
]
x-ms-publictraffictype: Email
x-ms-traffictypediagnostic: AS8P189MB1621:EE_|GV1P189MB2107:EE_
x-ms-office365-filtering-correlation-id: 13f067fd-5979-4993-8e46-
08dc501c4f1d
x-microsoft-antispam: BCL:0;
x-microsoft-antispam-message-info:
0MUOxJBN710avHpn9oTutzg/5eAygeMDZ0V1oZOHEphHEMiSgxNZTt0Mibe6iqn76
N+qQRWDR+mBeMdAEQApPbPlI7I/vu/k3/w0ZWJ091Cn9Nl/ZJQ5E46hxOc+B/
vYE0HrILa0sPLSViHOs0M23MKh7TmznSdCBQuFeih8dvqbFPdpycGL2GZSBxA6OWH
C1kLUdySCZWydul560jjxIRH6XVtzeNn6kcfHJrHiLvOUlL3UQM5j7nSQU1MKJHc2
zhyv9VZ2kAqH6bJZiXk7avffyuZQyj30vO7mtLq0Xqd2fmLekMMuKp/
KUoRht5Ibe9TqqaeQJDT0hkjtPbLnBlSvwz9DgZVIXss1zVENS7dhXiBBGaiF2l90
axlYaMnw4S0iuDEfwZ51B9hclRkzlsX70rZGnRKi6Fztj1CodgAb0Qy/
vtZLDs6NKOEpc0NAZLb3JRTGqJEs93TVnBFXykyiiPtUKmQwoZfWm+a5dPRcigCpb
fCkoWNLIjVhA5U7gEGIk3CRVLGMyBOy0kKFvSI+X8xPue3bqlVEpsnzoIWPFIaIhu
tOKMHfqtUMisNj
x-ms-exchange-antispam-messagedata-chunkcount: 1
x-ms-exchange-antispam-messagedata-0:
/U+Ey2sZ+myOqtdTC4Ye4oCsQHDecnA4asFpK+ujg4xc3UbaPO3db6Uth9/jZJctD
Th33z8FyNQFeHDhJRdQ2FMU/QN2pII8PblSYsUWRo4SA/
cocAb7Sd5W0TyAZaUGzC2xHvnsQbwKTzWSS6NzQNy25QnZrNjQIW40N7FE/
Wg4UexGy2ryYA4dwHUVSF5m/HfrHQ9qppcvo/
3T7mp0FH6TqpNt+s+Cmfm4tlxnnliMt7+wnMt4J6Se+RcMqjGmZNZoRYplEp4zc1O
PgbiJVKYpQi9G9AayT5b69avJkolOA7XzPGRIjXUge6OxbkIsHQET4PAAtnTCeXJX
/
eJXPbR8NDr+s3D7TB7ZgLABoEJQNuqXowQcyuPvfz68diM7c94T18YyCKDsUjIbbg
JzNrT9dSS40HVUEVaCNrx+2WyakHdd1OjwbWSvWEvLpfKQ6MwuESq5sfXnuOr7e+K
k6Wxtmgl5yKYzCfcAKYkoMgNkppEVNGxX/
7ko8Ik0hMH4Ik4j8onI71k5L+zdYs4eiDSFo0Y8yU2H7wiyZVDcYEe81qDQSi5UIx
Xf13t6zP7tgArFUh2qrKjtn9UTGyJuuI2ot6aeN1wKJNStYWnODefr+g2ACcCcv9E
d5sqMz8kFplUX92RDCT+v7b8TTjUap3cmVrtP/
```

```
XiGXCGFuiZwenm1xJ4t1GBv8dd6anEytoQByLHGj0v1Z973uJepuehkkNDtvJObqm
KDMEGcjFIotwrbzXmY39oYW6lQt+czeV+IV4O+wNftGBODNyvs4aln6mx9jmzCSKw
fA9eWHyy54R4FqCAxAnnpGoIUZ3tzErnpvprjGLWDYHfnE1D0U3rSiWIgpwtimIzI
qT6XHBzfrIL+OAjIgJ4+GycgaHPFGDZZOfQYT0/
buP+d83+MkupkDyapHoD8fT2eYRYq+J06IQgrJ6XTdLnsa+aCxR0tc7u1HmAv+onI
XKOlWOH88XrmD7CzK4647n8TGPwCULP358TfieTKW0GqZttrFbRHbslFRv4WPh0Pf
otD+YA/Ng433+y4fKCNg6oeuVPNJARhM/
v03xSX+ihZXUguIi+YgVXrQgN4HpHk3E+7/SfkHeZgxnhdEl5t/xpaNDlP7E/
ly4FOj40uEp0iJbDjYSynADDl9DlHw8JGitk7zLJIBuY4iIjLBt31zlNrCfDKfyFx
n5HSVRWJ8yzr7vSLbYuJA39W0vRPn7sWMKyRGI67I3vJFssJwJ7UowpBynSJ9/
r+b6rEAhlRrB1YiyR98by91VWNpOlLWANtvMm9xfeFE629EQ==
Content-Type: text/plain; charset="iso-8859-1"
Content-Transfer-Encoding: quoted-printable
MIME-Version: 1.0
X-OriginatorOrg: outlook.com
X-MS-Exchange-CrossTenant-AuthAs: Internal
X-MS-Exchange-CrossTenant-AuthSource:
AS8P189MB1621.EURP189.PROD.OUTLOOK.COM
X-MS-Exchange-CrossTenant-RMS-PersistedConsumerOrg: 00000000-
0000-0000-0000-000000000000
X-MS-Exchange-CrossTenant-Network-Message-Id: 13f067fd-5979-4993-
8e46-08dc501c4f1d
X-MS-Exchange-CrossTenant-rms-persistedconsumerorg: 00000000-
0000-0000-0000-000000000000
X-MS-Exchange-CrossTenant-originalarrivaltime: 29 Mar 2024
18:16:09.5991 (UTC)
X-MS-Exchange-CrossTenant-fromentityheader: Hosted
X-MS-Exchange-CrossTenant-id: 84df9e7f-e9f6-40af-b435-
aaaaaaaaaaaa
X-MS-Exchange-Transport-CrossTenantHeadersStamped: GV1P189MB2107

DKIM test email.
```

The ***DKIM-Signature*** header is:

```
DKIM-Signature: v=1; a=rsa-sha256; c=relaxed/relaxed;
d=outlook.com; s=selector1; h=From:Date:Subject:Message-
ID:Content-Type:MIME-Version:X-MS-Exchange-SenderADCheck;
bh=J5xVXlIPB8b3aQVmIOVS4pAqIH4oOaHCb3LgLetuS1s=;
b=OSRH95fo/UTLgZrvDcO5B8HF306wPd5WZ76iZu9vOtRVgAXgPJEWjUJsqcmxtRn
n4ZnKhEpEfBx16XLMBbIebYfAK7NPdchpSv2yAfpqjmCkLotnvG/rltpuz9qqW/
6vxdzxCgvoxw1DPpFA+Qh0Zs95P5k86h7w6EgXpsEh3jx5rU4eR0qIRoSOTUqdRHu
LXXb4zO96ftdNT7mneSkImRBhQbi6XSwLaJhW+Gm6Mkh/1/
KdbwF+pgKT2JmhPA+QDYhGENJpN601mjFLojOm9AwlY0AGmc0K6L80ESzULq3yvRW
MrmyHEATN0fOVrzFkwasyLujWd/+HedfgWtgaTg==
```

The ***Authentication-Results*** header is:

```
Authentication-Results: mx.google.com;
flyordie.com text = "v=spf1 ip4:82.192.93.216 ip4:82.192.93.217
ip4:82.192.93.218 ip4:208.167.241.84 -all"
Authentication-Results: mx.google.com;
dkim=pass header.i=@outlook.com header.s=selector1
header.b=OSRH95fo;
arc=pass (i=1);
spf=pass (google.com: domain of pltrash2@outlook.com designates
2a01:111:f403:2e0d::800 as permitted sender)
smtp.mailfrom=pltrash2@outlook.com;
dmarc=pass (p=NONE sp=QUARANTINE dis=NONE)
header.from=outlook.com
```

The verifier (or authenticating server) is *mx.google.com*, the Gmail mail server.

The result is pass, the domain and selector used for retrieving the DNS DKIM record are *outlook.com* and *selector1*.

Let's check the *selector1._domainkey.outlook.com* TXT record:

```
nslookup -ty=txt selector1._domainkey.outlook.com
;; Truncated, retrying in TCP mode.
Server: 9.9.9.9
Address: 9.9.9.9#53
Non-authoritative answer:
selector1._domainkey.outlook.com canonical name =
selector1._domainkey.outbound.protection.outlook.com.
selector1._domainkey.outbound.protection.outlook.com text =
"v=DKIM1;k=rsa;p=MIIBIjANBgkqhkiG9w0BAQEFAAOCAQ8AMIIBCgKCAQEAvWyk
trIL8DO/+UGvMbv7cPd/Xogpbs7pgVw8y9ldO6AAMmg8+ijENl/
c7Fb1MfKM7uG3LMwAr0dVVKyM+mbkoX2k5L7lsROQr0Z9gGSpu7xrnZOa58+/
pIhd2Xk/
DFPpa5+TKbWodbsSZPRN8z0RY5x59jdzSclXlEyN9mEZdmOiKTsOP6A7vQxfSya9j
g5"
"N81dfNNvP7HnWejMMsKyIMrXptxOhIBuEYH67JDe98QgX14oHvGM2Uz53if/SW8M
F09rYh9sp4ZsaWLIg6T343JzlbtrsGRGCDJ9JPpxRWZimtz+Up/
BlKzT6sCCrBihb/Bi3pZiEBB4Ui/
vruL5RCQIDAQAB;n=2048,1452627113,1468351913"
```

In this case, the DNS DKIM record is a CNAME or an alias, pointing to the real record *selector1._domainkey.outbound.protection.outlook.com.*
In this one, we can find the public key used by google to decrypt the signature.

Remember: DKIM checks the entire email has not been modified, and ensures that it has been signed by a server belonging to the domain in the ***From:*** header.