PGP: What, Why, When, Which, How, and More...

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What We Will Cover

- (Briefly) What PGP is
- Why to use PGP
- When to use PGP
- Which *kind* of PGP to use and when (Traditional vs PGP/Mime)
- How to use PGP
- PGP Web of Trust
- Comparisons to X509/SMIME

What We Won't Cover

- How encryption works
- How digital signatures work
- How PGP differs, cryptographically, from other methods

What is PGP?

- Pretty Good Privacy
- I'm not a history professor
- Non-centralized

WHY?

- Why should I use PGP?

Why: What Can I Do With It?

- Encrypt data to yourself or others
- Digitally verify both unencrypted and encrypted data: authenticity of content and author

- Protect your data
- Protect yourself

Let's see how...

Why: Protecting Your Data

- Keep your passwords in one secure place

  gpg –encrypt passwords.txt

  Creates passwords.txt.gpg

  gpg –decrypt passwords.txt.gpg

  With a passphrase and the key (2-piece auth!), this dumps the contents to stdout
- Assumes you have keys setup

Why: Protecting Your Data

- Encrypted email – without the key and the passphrase – no one can read that email

- Lots of support:
  - Thunderbird+Enigmail
  - Outlook+GPGol
  - Apple Mail+GPGMail
  - Mutt
  - Pine+Pine Privacy Guard
  - Evolution

Why: Protecting Yourself

- Managers: Directives can't be modified or forged
- Employees: Have proof directives were sent

- “Shutdown server X”
- “Sure, give away my ticket, I can't make it”
- “You have to remove file X to break the deadlock”
- “Peter is the new guy, he should be granted access to the data center.”

WHEN?

- When should I use PGP?

When: Encryption

- When you need it:

- Distribute new passwords
- Encrypt your personal password store
- Directives with sensitive data
- Credit card numbers
- Personal messages having to go through untrusted 3rd parties
- Telling your girlfriend in the next office something, erm, “personal” via work email

When: Signing: Sometimes

- The *sometimes* argument

- Signed messages came from you
- Signed messages weren't modified in transit

- Unsigned messages might be from you, might not
- Unsigned messages might be modified in transit, might not

- Still vectors for attack

When: Signing: Always

- The *always* argument

- All messages are from you, unmodified
- Unsigned messages can just be /dev/null'd, or treated with high-suspicion
- Why not sign?

- But... what about all that ugliness? What about people who can't do PGP verification? And what kind of PGP to use?

WHICH?

- Which type of PGP email should I use?

Which: Traditional vs PGP/Mime

- Traditional, aka, “clear-signed” - just a PGP header and footer, and a signature below that – all in the body of the email or document.
- PGP/Mime splits the body and the signature up so the user only sees the body if he doesn't have PGP support (plus a small attachment)

Which: Traditional

```
-----BEGIN PGP SIGNED MESSAGE-----
Hash: SHA1

this is text
-----BEGIN PGP SIGNATURE-----
Version: GnuPG v1.4.2 (GNU/Linux)

iD8DBQFDeF2TN5XoxaHnMrsRAv3TAJ9uhsXwvjGORVw166wQuwH8ElceNQCePwiG
0LEN3fzdySwp7OBDZXf8SkE=
=6jIy
-----END PGP SIGNATURE-----
```

Which: PGP/Mime

this is text

- assuming MIME support (everything but Outlook Express)

Which: Traditional

- PROS
- Simple: Just text in the body
- Anything can read the message
- Don't need MIME or modern mail readers
- Can be easily verified by news readers, web-based readers, etc.

  CONS
- Messy – hard to read the message without PGP support
- Obsolete

Which: PGP/Mime

- How does it work? Split the message into two parts using MIME:

- Body:
  Content-type: text/plain
  (implies Content-disposition: inline)
- Signature:
  Content-type: application/pgp-signature
  Content-disposition: attachment

- RFC's 3156, 2015, 2046

Which: PGP/Mime

- PROS
- Anything with MIME support sees the message clearly, with the signature as an insignificant attachment (for PGP-inept)
- Can sign a forwarded message with a signature in it easily (using MIME-encapsulation)
- Looks cleaner

- CONS
- Non-MIME compliant readers have trouble

Which: Application/PGP

- Horrible wanna-be standard replaced by PGP/Mime
- Takes a **traditional-signed message**
- Body is Content-type: application/pgp and Content-disposition: inline

- Almost **nothing** displays properly. Only mutt 1.4x ever supported it. Mutt 1.4x used this when set to “traditional”...

Which: The Decision

- The decision should ultimately be based on who your readers are:
- What mail client is most common? What other mail clients are used?
- Are they going to be doing verification? Can they install a plugin?
- Once you have that...

Which: Support

CLIENT	TRADITIONAL	APPLICATION/PGP (mutt 4x only?)	PGP/MIME
Outlook (2k & 2k3)	Displays message (with extras)	Does not display message	Displays message
Outlook Express	Displays message (with extras)	Does not display message	Does not display message Can't even double-click to view - must download and open separately
Thunderbird	Displays message (with extras)	Displays message IF "display attachments inline" is set	Displays message
Thunderbird + Enigmail	Displays & verifies message	Displays & verifies message IF "display attachments inline" is set	Displays & verifies message
Pine	Displays message (with extras)	Does not display message	Displays message
Pine + Pine Privacy Guard	Displays & verifies message (with extras)	Does not display message	Displays message
Mutt	Displays & verifies message	Displays & verifies message	Displays & verifies message
Apple Mail	Displays message (with extras)	Does not display message	Displays message
Apple Mail + GPG Mail	Displays & verifies message (with extras)	Does not display message	Displays & verifies message
Eudora	*unknown*	*unknown*	*unknown*

Which: No, Really Phil, Which one?

- Assuming the people who will be verifying can handle either, how do you piss off the PGP-inept the least?
  If most recipients use:
- **Outlook Express**: (they need help) Traditional so they can see your email (but consider only signing as needed)
- **Outlook/Pine** (where most people aren't verifying): PGP/Mime – they'll see a clean message inline
- **Outlook/Pine** (with most people verifying): Traditional – only way plugins can verify/decrypt
- **Thunderbird/Netscape/Mail/Mutt**: PGP/Mime – clean and verifiable

HOW?

- I now know Why, When, Which – and I like it!
  But how do I do it?

How: Get PGP

- Windows: GnuPG for windows: gnupg.org
- Linux/Solaris/BSD: GnuPG: gnupg.org
- Mac: MacGPG: macgpg.sf.net

How: Create Keys

- $ gpg –gen-key
- Type:
  (1) DSA and Elgamal (default)
  (2) DSA (sign only)
  (5) RSA (sign only)
- Size: 1024 - 4096
- Expiration
- Real Name, Comment, Email
  Phil Dibowitz (Work Key) phil@example.com
- Pass**PHRASE**

- More details at http://www.phildev.net/pgp/

How: Now What?

- Now you can:
  Encrypt/decrypt/verify/sign files and keys

- OK, but what about email?!

How: MUA Level

- **Thunderbird**: Enigmail (enigmail.mozdev.org)
- **Apple Mail**: GPGMail (www.sente.ch)
- **Mutt**: Included
- **Outlook**: GPGol (www.g10code.com)
- **Pine**: Pine Privacy Guard (quantumlab.net)
- **Evolution**: Included

Install instructions:
http://www.phildev.net/pgp/

How: MUA Level

- Configure GnuPG: (in ~/gpg.conf):
  keyserver pgp.mit.edu #only one!
  keyserver-options auto-key-retrieve
  Most MUA support multiple servers, i.e. enigmail.
  Add as many as you want. pgp.com is good.

- In your MUA Plugin:
- Traditional or PGP/Mime?
- Sign by default?
- Verify by default!

TRUST

- Who do I trust, how do I trust them, and why?

Trust: Intro

- Unlike in x509/SSL, trust isn't controlled by one authority
- Down with the man! No expensive certificates!
- Multiple signatures == better verification
- Verification by people YOU trust
- More trust requires more work
- Multiple “levels” of signing enable fine-grained trust
- Private and public trust

Trust: Implicit vs Explicit

- Signing someone's key indicates some level of trust and/or verification of identity
- You can also add local “trust”
- If a key you receive is signed by a key you have signed, there is implicit trust there
- If a key you receive is signed by a key you have locally trusted, there is implicit trust
- Signing a key is also implicit trust
- Explicit trust is rarely used, but neat.

Trust: Signing Keys

- **Why**: To vouch for the identity of one whose identity you have checked.
- **When**: Key signing parties, at the office, when you meet someone interested, etc.
- **How**: Check 2 forms of ID, check key fingerprint, and optionally check the email address, then sign the key and send it to them

Trust: Verifying Identity

- **ID**: At least one photo ID, usually two forms of some ID. You're saying to the world this key belongs to a person!
- **Fingerprint**: Verify the key you're signing has the fingerprint they have on their **local** copy.
- **Email**: (optional) encrypt an email to them with a secret word of your choosing and a number they chose. They must email you back the word and a number you chose.

Trust: Actually Signing

- gpg –sign-key $KEYID --ask-cert-level

  Trust options:
- (0) I will not answer. (default)
- (1) I have not checked at all.
- (2) I have done casual checking.
- (3) I have done very careful checking.

- Email or gpg –send-key

- In gpg.conf: “ask-cert-level”

Trust: Local Trust

- To add local trust: gpg –edit-key $KEYID
- From the gpg shell, “trust”
  Trust options:
- (1) I don't know
- (2) I do NOT trust
- (3) I trust marginally
- (4) I trust fully
- (5) I trust ultimately

- “save”

Trust: Local Trust

- In general, only trust your keys at 5
- If you know someone does a very thorough job verifying identify, trust them at 4, and you'll trust keys they sign even if you haven't signed their key, or your sig expires
- Local trust is in a trustdb, no one sees it

- Local signing is another way to do local trust, we won't cover it...

Trust: Calculated Trust

- So.. uh, this key is signed at 3 by a key that's signed at 2 by a key that's trusted by my key, which means I, uhm, what?
- It's complicated, and infinitely tunable, but by default...
- A key is trusted if it meets **both**:
  1. It is signed by enough valid keys, meaning one of the following:
     * You have signed it personally,
     * It has been signed by one fully trusted key
     * It has been signed by three marginally trusted keys
  2. The path of signed keys leading from K back to your own key is five steps or shorter.

Trust: Example 1

- Phil signs Stewie (full)
- Stewie signs Peter (full)
- Peter signs Brian (full)
- Brian signs Meg (full)
- Meg signs Lois (full)

- Phil trusts all of them

Trust: Example 2

- Phil signs Stewie (marginal)
- Phil signs Meg (marginal)
- Phil signs Peter (marginal)
- Meg signs Chris (full)
- Stewie signs Chris (full)

Phil doesn't yet trust Chris...

- Peter signs Chris (full)
- Phil trusts Chris

Trust: Example 3

- Phil signs Stewie (full)
- Stewie signs Meg (full)
- Meg signs Peter (full)
- Peter signs Brian (full)
- Brian signs Lois (full)
- Lois signs Chris (full)

- Phil trusts everyone **except** Chris

Trust: Example 4

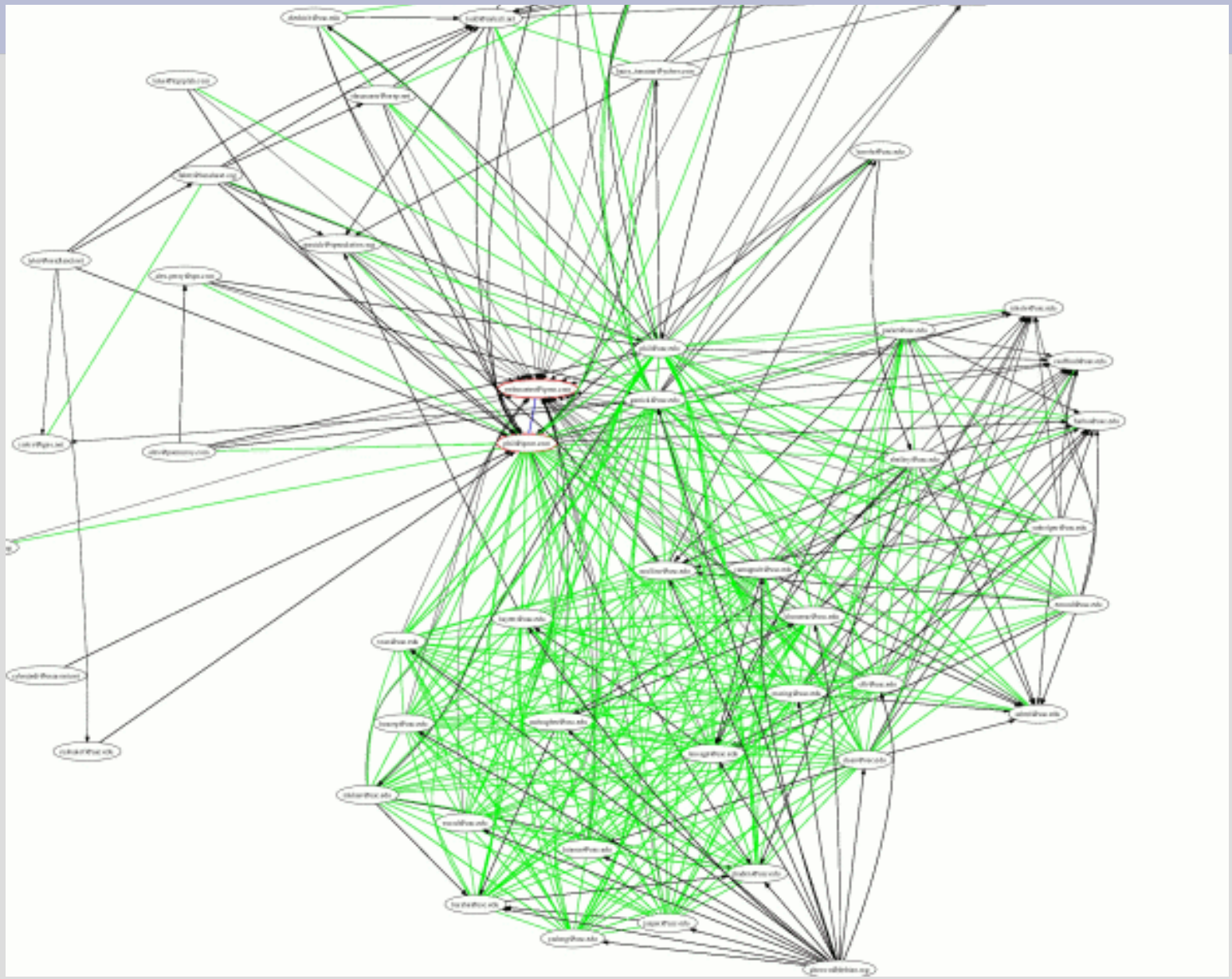
- Phil signs Brian (marginal)
- Phil signs Peter (marginal)
- Brian signs Peter (marginal)

- Phil trusts Peter since he directly signed it, even though it's “marginal”

Trust: Tunables

- --max-cert-depth n
  How deep the chain go and still be trusted
- --completes-needed n
  How many completely trusted keys are needed
- --marginals-needed n
  How many marginally trusted signatures are needed

Trust: Web of Trust



Trust: Web of Trust

Trust: Signatures

```
$ gpg –list-sigs phil@ipom.com
pub   1024D/A1E732BB 2003-09-12
uid                  Phil Dibowitz <phil@ipom.com>
sig 3        A1E732BB 2004-11-20  Phil Dibowitz <phil@ipom.com>
sig 3     X  8CAFF3DF 2003-09-12  Phil Dibowitz <phil@usc.edu>
sig 3     X  96E6F473 2003-09-12  Garrick Staples <garrick@usc.edu>
sig 2     X  819FD62E 2003-09-24  S. Tyler McHenry <tyler@nerdland.net>
sig 3     X  E65FF97B 2003-11-03  Ted Faber <faber@lunabase.org>
sig 3        A1E732BB 2003-09-12  Phil Dibowitz <phil@ipom.com>
sig 3     X  808D0FD0 2003-11-24  Don Armstrong <don@donarmstrong.com>
sig 3     X  FEA48B61 2003-11-24  Garrick Staples <garrick@speculation.org>
sig 3     X  A4B1D0D4 2003-11-25  John Mullins <mullins@usc.edu>
sig 3     X  5811ED5F 2003-11-25  Carl Hayter <hayter@usc.edu>
sig 3     X  EBA65398 2003-11-25  Asbed Bedrossian <asbed@usc.edu>
sig 3     X  FC2FC9F0 2003-11-26  Chet Burgess <cfb@usc.edu>
sig 3        AE127015 2003-11-23  Todd A. Lyons (Cannonball) <todd@mrball.net>
sig 3     X  6AFD6695 2003-12-01  Linda Savage <lsavage@usc.edu>
sig 3        C730C0E4 2003-12-04  Harry Tanama (nick name pr0gm3r)
<harry_tanama@yahoo.com>
sig 3     X  398D7394 2003-12-05  Brian Emord (no one) <emord@usc.edu>
...
```

Trust: The Pretty Picture

- I know geeks like the nifty pictures...

- $ gpg –list-sigs | sig3 -d 2 -s 'phil@ipom.com webmaster@ipom.com' >keys.dot
- $ neato keys.dot -Tps -o keys.ps -v -Goverlap=scale -Gsplines=true
- $ convert keys.ps keys.jpg
- $ rm keys.ps keys.dot

- Wtf are “sig3” and “neato”?

Trust: Helper Utilities

- sig3 – Written by USC's Carl Hayter
  Takes the output of gpg –list-sigs and creates a data file. Originally sig2dot.
- sig3 is written in Perl, and I'll ask Carl if I can post it online
- neato is part of the graphviz package
  Takes data files and creates postscript plots.
- Convert is part of ImageMagick

COMPARISON: X509/SMIME

- How does it compare?

Comparison: X509/SMIME

- SMIME requires a certificate authority for your X509 certificates
- One entity must be trusted by everyone, or it doesn't work
- Usually costs money
- SMIME signatures are **vastly** longer...

Comparison: X509/SMIME

- MIAGCSqGSIb3DQEHAqCAMIACAQExCzAJBgUrDgMCGgUAMIAGCSqGSIb3DQEHAQAAoIIGFjCCAs8w
ggI4oAMCAQICAww++jANBgkqhkiG9w0BAQQFADBiMQswCQYDVQQGEwJaQTElMCMGA1UEChMcVGhh
d3RlIENvbnN1bHRpbmcgKFB0eSkgTHRkLjEsMCoGA1UEAxMjVGhhd3RlIFBlcnNvbmFsIEZyZWVt
YWlsIElzc3VpbmcgQ0EwHhcNMDQwNTA0MDMyMDAyWhcNMDUwNTA0MDMyMDAyWjBDMR8wHQYDVQQD
ExZUaGF3dGUgRnJlZW1haWwgTWVtYmVyMSAwHgYJKoZIhvcNAQkBFhF3YXNzYUBtZW1waGlzLmVk
dTCCASIwDQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBANm8wiPSE3aeqFpA2o/adOYCZa2T7oHi
fjZE8IIK2EXtgcBZmC2AmmPvPQTtU3sB4AV4bBaKT75qefvNQMSYS2mZjTuCiUSFvLgL8J/pTwBf
GWquvXJH+Q57e1mqkSTKoqSRWwA2GsZ1u7YytAaeiyB5p3FiWHC/zOT8V0CB9NYFqn4rNvL5NlEn
keK4y42/aMDX0XdywR+Bep1vUfRMBIIudq/f49hLUgDbfuY5x44Z/RXbjBH6eCIhCmyhgmRD/fcg
/cHwkwESa4Hisz3UErTsrZShEkuloG8W5SJSRFzXh3hqOibQxiU2bN0Gq3q9UD3kBFuXOuG2PGVL
oha/QfUCAwEAAaMuMCwwHAYDVR0RBBUwE4ERd2Fzc2FAbWVtcGhpcy5lZHUwDAYDVR0TAQH/BAIw
ADANBgkqhkiG9w0BAQQFAAOBgQAhUi7KCwfeiJy/4ndpV2IHr4Tw2mt2QMkGrVFC9OgzD10BuNDX
UD4y7qnHVbzZbavIsomxZ4HtNX0NLYNQKTRL2WtSeT2NAIaGSFHXGJDQAHfYX6+ZLnP7MKRU4Ovv
OssPf/rQH71qMtOhnDoGXYpFrpjefQLPoGnmo+PvDz6SGDCCAz8wggKooAMCAQICAQ0wDQYJKoZI
hvcNAQEFBQAwgdExCzAJBgNVBAYTAlpBMRUwEwYDVQQIEwxXZXN0ZXJuIENhcGUxEjAQBgNVBAcT
CUNhcGUgVG93bjEaMBgGA1UEChMRVGhhd3RlIENvbnN1bHRpbmcxKDAmBgNVBAsTH0NlcnRpZmlj
YXRpb24gU2VydmljZXMgRGl2aXNpb24xJDAiBgNVBAMTG1RoYXd0ZSBQZXJzb25hbCBGcmVlbWFp
bCBDQTErMCkGCSqGSIb3DQEJARYccGVyc29uYWwtZnJlZW1haWxAdGhhd3RlLmNvbTAeFw0wMzA3
MTcwMDAwMDBaFw0xMzA3MTYyMzU5NTlaMGIxCzAJBgNVBAYTAlpBMSUwIwYDVQQKExxUaGF3dGUg
Q29uc3VsdGluZyAoUHR5KSBMdGQuMSwwKgYDVQQDEyNUaGF3dGUgUGVyc29uYWwgRnJlZW1haWwg
SXNzdWluZyBDQTCBnzANBgkqhkiG9w0BAQEFAAOBjQAwgYkCgYEAxKY8VXNV+065yplaHmjAdQRw
nd/p/6Me7L3N9VvyGna9fww6YfK/Uc4B1OVQCjDXAmNaLIkVcI7dyfArhVqqP3FWy688Cwfn8R+R
NiQqE88r1fOCdz0Dviv+uxg+B79AgAJk16emu59l0cUqVIUPSAR/p7bRPGEEQB5kGXJgt/sCAwEA
AaOBIDCBkTASBgNVHRMBAf8ECDAGAQH/AgEAMEMGA1UdHwQ8MDowOKA2oDSGMmh0dHA6Ly9jcmwu
dGhhd3RlLmNvbS9UaGF3dGVQZXJzb25hbEZyZWVtYWlsQ0EuY3JsMAsGA1UdDwQEAwIBBjApBgNV
HREEIjAgpB4wHDEaMBgGA1UEAxMRUHJpdmF0ZUxhYmVsMi0xMzgwDQYJKoZIhvcNAQEFBQADgYEA
SIzRUlPqCy7MDaNmrGcPf6+svsIXoUOWIJ1/TCG4+DYfqi2fNi/A9BxQlJNwPP2t4WFiw9k6GX6E
sZkbAMUaC4J0niVQlGLH2ydxVyWN3amcOY6MIE9lX5Xa9/eH1sYITq726jTlEBpbNU1341YheILc
IRk13iSx0x1G/11fZU8xggLnMIIC4wIBATBpMGIxCzAJBgNVBAYTAlpBMSUwIwYDVQQKExxUaGF3
dGUgQ29uc3VsdGluZyAoUHR5KSBMdGQuMSwwKgYDVQQDEyNUaGF3dGUgUGVyc29uYWwgRnJlZW1h
aWwgSXNzdWluZyBDQQIDDD76MAkGBSsOAwIaBQCgggFTMBgGCSqGSIb3DQEJAzELBgkqhkiG9w0B
BwEwHAYJKoZIhvcNAQkFMQ8XDTA1MDEyMDIyMDYzOVowIwYJKoZIhvcNAQkEMRYEFLeURow5kCT/
PIjvxQDkcsaWenQ5MHgGCSsGAQQBgjcQBDFrMGkwYjELMAkGA1UEBhMCWkExJTAjBgNVBAoTHFRo
YXd0ZSBDb25zdWx0aW5nIChQdHkpIEx0ZC4xLDAqBgNVBAMTI1RoYXd0ZSBQZXJzb25hbCBGcmVl
bWFpbCBJc3N1aW5nIENBIENBgMMPvowegYLKoZIhvcNAQkQAgsxa6BpMGIxCzAJBgNVBAYTAlpBMSUw
IwYDVQQKExxUaGF3dGUgQ29uc3VsdGluZyAoUHR5KSBMdGQuMSwwKgYDVQQDEyNUaGF3dGUgUGVy
c29uYWwgRnJlZW1haWwgSXNzdWluZyBDQQIDDD76MA0GCSqGSIb3DQEBAQUABIIBAI5DZx5NbAg2
0cvrNT74279t6xvspYudfuK81Ryb8ZAJ3152iIKgSpTZroWIvUSzOLj+t3YnRvy7Fb2ZtClkj+dS
vvy+Y1YegzVB33DW1huhjF6t9RQEYYy1xkWir0VJxSMAiyYlmrOIBo2pJXQU85RrzvF1NCAmak8j
AlWDVzdyp4XBvQvs4LtfOgajf4QIkkOXtOVHxDgFDJqxodf03UJ/etZVwep6OBgOaz0cm+K4F6Dh
8hZq9/rSsOedZQ1C5s4vt1Ysz7dztR6N9bdCs1+UKjManw7kjZhcAWIbRlAznmkmNNpRfJMDOxbq
ebGZMAArT9pTIgHXn1zhsdV/mXAAAAAAAAA=

Comparison: X509/SMIME

- Recall the PGP sig:

iD8DBQFDeF2TN5XoxaHnMrsRAv3TAJ9uhsXwvjGORVw166wQuwH8ElceNQCePwiG
0LEN3fzdySwp7OBDZXf8SkE=
=6jIy

- Which would you rather have attached to an email?

Comparison: X509/SMIME

- SMIME has been around for a long time – support in Netscape 4
- Never caught on
- I2 trying to revive it

- Potentially useful when one entity **is** trusted by everyone.

- Many other **great** uses for X509 and SSL...

More Info / Sources

- All of this information – with less brevity – and MUCH more is available at my PGP site:
  http://www.phildev.net/pgp/
- RTFM:
  http://www.gnupg.org/gph/en/manual.html
- RFC 3156: MIME Security with OpenPGP
- RFC 2015: MIME Security with Pretty Good Privacy (PGP)
- RFC 2046: Multipurpose Internet Mail Extensions (MIME) Part Two: Media Types

Fin

- I'm finally done!
- Questions?
- Comments?
- Heckles?
- Concerns?

Thanks for coming!