Crypto News 2018

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for BLU.org annual keysigning
Sept 19, 2018

0. Agenda

1. Crypto News Review
2. Annual Historical Vignette
3. How To Reminder for GPG/PGP Key-signing
4. GPG/PGP Key-signing

1. Crypto in the news since last year

- Crypto means Cryptography.
  - See previous rant about “crypto coins”
    http://blu.org/cgi-bin/calendar/2018-may
  - Crypto isn’t magic sauce. If you haven’t studied the flaws in prior cryptography, you shouldn’t be inventing new crypto.
    (*And if you have, how about you give this talk next year*?)
  - Tony Arcieri @bascule commend
    Eventually the cryptocurrency space will come to understand Kerckhoffs’ Principle
    retweeting @Haaroony
    Cryptokitties Ethereum contract genetic algorithm cracked by Erays
    https://www.usenix.org/system/files/conference/usenixsecurity18/sec18-zhou.pdf
-

News – WPA2 Krack

- "Key Reinstallation Attacks"
- 10 CVE's - one per protocol problem, not per vendor. *uh oh.*
  - **generic protocol flaw**
  - found TEN instances of different WPA1/WPA2 protocols.
  - A reply attack on a specific step.
  - That should have been checked to prevent replay but ... the implementors have frequently failed to test for reply there.
  - Possibly because using standards proof of concept code unthinkingly ...
- Links
  -
  - * https://www.krackattacks.com/
  - * http://www.commitstrip.com/en/2017/10/16/wpa2-vulnerability-just-a-small-update/
  - * https://arstechnica.com/information-technology/2017/10/severe-flaw-in-wpa2-protocol-leaves-wi-fi-traffic-open-to-eavesdropping/
    - "KRACK works by targeting the four-way handshake that's executed when a client joins a WPA2-protected Wi-Fi network. Among other things, the handshake helps to confirm that both the client and access points have the correct credentials. KRACK tricks the vulnerable client into reinstalling an already-in-use key. The reinstallation forces the client to reset packet numbers containing a cryptographic nonce and other parameters to their initial values. KRACK forces the nonce reuse in a way that allows the encryption to be bypassed.'
  - * https://arstechnica.com/information-technology/2017/10/how-the-krack-attack-destroys-nearly-all-wi-fi-security/
  - * "Android 6 & Linux particularly vulnerable"; macOS & OpenBSD easier than in paper w/new bits.
- * Side note: what can be compromised before VPN connect by built-in clients https://arstechnica.com/information-technology/2015/06/even-with-a-vpn-open-wi-fi-exposes-users/

News: Prepare for (post)Quantum Crypto

- 2001: factored the composite integer 15 with 7 qubits (NMR)
- 2011: same algo factored 21. (on optics)
- 2011: factored 143 using 4 qubits
  (big enough for ONE factor; NMR)
  [arXiv-quant-ph-1111.3726-quantum-factoring.pdf]
- 2011: D-Wave selling 128 qubit openly
- 2013: NASA/Google got two 512-qubit machines
- 2017: Google has announced a separate 72-qubit design "Bristlecone;
- 2018: D-Wave claims to be selling a 2kqubit computer D:Wave 200Q for "only" $15M.
- 2019: plans for 4kqb ...
-
- uh oh
-
- good news is NIST has been planning ahead ... RFC 2016 ...
- https://csrc.nist.gov/projects/post-quantum-cryptography
-
- MS released https://github.com/Microsoft/PQCrypto-VPN which is OpenVPN-on-SSL with Frodo/SIKE/Picnic based on post quantum safe maths.
- https://www.microsoft.com/en-us/research/project/post-quantum-cryptography/
-

News: Quantum Key Distribution

- Works somewhat but not nearly as concerning as Quantum computing
- GCHQ on Quantum Key Distribution (via Schneier)
-
- 2018.08.01 The UK's GCHQ delivers a brutally blunt assessment of quantum key distribution:
-
- QKD protocols address only the problem of agreeing keys for encrypting data. Ubiquitous on-demand modern services (such as verifying identities and data integrity, establishing network sessions, providing access control, and automatic software updates) rely more on authentication and integrity mechanisms -- such as digital signatures -- than on encryption.
-
- QKD technology cannot replace the flexible authentication mechanisms provided by contemporary public key signatures. QKD also seems unsuitable for some of the grand future challenges such as securing the Internet of Things (IoT), big data, social media, or cloud applications.
-
- Bruce: "I agree with them. It's a clever idea, but basically useless in practice. I don't even think it's anything more than a niche solution in a world where quantum computers have broken our traditional public-key algorithms. Read the whole thing. It's short."
-
- https://www.schneier.com/blog/archives/2018/08/gchq_on_quantum.html
- https://www.ncsc.gov.uk/whitepaper/quantum-key-distribution

News: More Vulns / attacks

- Sidechannel
  - Changes for libgcrypt20:i386 version: 1.6.5-2ubuntu0.5
  - * SECURITY UPDATE: memory-cache side-channel attack on ECDSA signatures
  - - debian/patches/CVE-2018-0495.patch: add blinding for ECDSA in
  - cipher/ecc-ecdsa.c.
  - - CVE-2018-0495
  - - http://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2018-0495
  - - https://nvd.nist.gov/vuln/detail/CVE-2018-0495
- SPECTRE Variants continue to appear
  - e.g. Add Spectre Variant 2 protection for family 17h AMD processors (CVE-2017-5715)
    - - Backport to xenial. THIS IS A FIRMWARE CHANGE !!!
- Huge Dirty Cow CVE-2017–1000405
  - The Dirty COW patch was itself broken for THP (transparent huge pages)
    - http://www.theregister.co.uk/2017/12/04/dirty_cow_sequel_huge_dirty_cow_patched/
    - http://www.openwall.com/lists/oss-security/2017/11/30/1
    - https://medium.com/bindecy/huge-dirty-cow-cve-2017-1000405-110eca132de0
- BT privancy commonly vulnerable to intentionally weak device
  - https://www.kb.cert.org/vuls/id/304725
  - Vulnerability Note VU#304725
  - Bluetooth implementations may not sufficiently validate elliptic curve parameters during Diffie-Hellman key exchange
  - CWE-325: Missing Required Cryptographic Step http://cwe.mitre.org/data/definitions/325.html
  - CVE-2018-5383
  - variant of the "Invalid Curve Attack"
  - https://www.bluetooth.com/news/unknown/2018/07/bluetooth-sig-security-update
  - thaidn @XorNinja 11:58 AM - 24 Jul 2018
    - https://twitter.com/XorNinja/status/1021786823524110336
    - https://www.kb.cert.org/vuls/id/304725 -> beautiful attack. a point has two coordinates x and y, but the protocol only validated x. replace y with 0, the public key becomes (x, 0) which always has order 2. this forces the shared secret to be the point at infinity with probability of 25%
    - Why only checked x? Maybe the designers thought that because the y-coordinate of the shared point is discarded, it's fine not to check the y-coordinate of the public keys. A subtle misunderstanding leads to total collapse of an otherwise secure protocol
  - Matthew Green @matthew_d_green 24 Jul 2018
    - https://twitter.com/matthew_d_green/status/1021805830860156930

    - Contributory behavior is such a common requirement in Diffie-Hellman based protocols that I rarely see real-world protocols that don't break due to bad point/pubkey validation.
    - Roughly speaking, there's "classical Diffie-Hellman", which assumes that the contributors' key share contributions are authenticated somehow. In these protocols, you can usually trust the key shares, because if you don't — it means one of the endpoints is evil.
    - But then there's a whole class of protocol that does retrospective authentication. That is, they don't authenticate the key shares — but use the output of the DH exchange to authenticate things after the fact.
    - So for example, Bluetooth pairing codes or ZRTP shared authentication words, or TLS Finished messages when used for channel binding (including the triple handshake attack). All require contributory behavior.
    - In these protocols, if an attacker can inject a bogus keyshare that results in a known shared DH secret, then can often break the crap out of the protocol. And it keeps happening.

2. Crypto History
One time Pad (OTP), BRIDE/BOURBON/VENONA, Russian Spies, Vint Hill Station

~~TOP SECRET~~
DECLASSIFED

Vint Hill Farms Station


MAY USE
FULL LANE
TAI CHI
THE
COLD WAR
MUSEUM
VONTAMON
GENERAL STORE
eat in
take ou
NEXT TO

Signage

HMDB?


FF 14
VINT HILL FARMS STATION
In June 1942 the U.S. Army established a top-secret post at Vint Hill Farms to intercept enemy radio transmissions. These barns housed the monitoring station. The Signal Corps' cryptographic school, which taught personnel to encode, decode, and translate messages, was moved here. Pvt. Leonard A. Mudloff is credited with intercepting a message here from Oshima Hiroshi, the Japanese ambassador to Germany, on 10 Nov. 1943. It described German coastal fortifications in western France, troop strengths, and contingency plans. The "Oshima intercept" was a crucial contribution to the planning for D-Day, the Allied invasion of Europe. The post operated through the Cold War, closing in 1997.
DEPARTMENT OF HISTORIC RESOURCES, 2015

Vint Hill Farms Station

The Listening Post

In 1942, Vint Hill Farms was purchased by the Department of the Army for $127,500, as a quiet and secure place for the Signal Intelligence Service.

By July of that year, Vint Hill Farms Station began operations and officially took over the role, directives and name of “Monitoring Station No.1” as the first soldiers of the 2nd Signal Service Battalion arrived.

The Barns in 1940

The original large barn, former home to Shorthorn cattle, was selected to be the home of signial intelligence operations. Vint Hill Farms Station was engaged in communications intelligence and served as a cryptologic installation providing support to the National Security Agency and to the Army.

Japanese-American Soldiers

Diverse companies of translators were stationed at Vint Hill during the war. It was a Vint Hill Morse Code operator who intercepted a coded transmission between Tokyo and Berlin indicating the location of fortifications along the French coast, contributing to the success of the Normandy invasion.

This map illustrates the Army’s original plans for development of Vint Hill Farms Station

Vint Hill Farms Station

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Women Working for Victory

The formation of the Women's Army Corps (WAC) offered a golden opportunity to solve the manpower shortage created by male operators being sent overseas. The art of Morse intercept, or "ditty bop," required intelligence and patience, not muscles.

In 1943, WAC's reported to Vint Hill Farms Station to attend classes. The women's presence produced a noticeable change in the enlisted men. They no longer had to be reminded to shave, and the sale of aftershave quadrupled at the PX. Men and women worked side-by-side on shifts, called "tricks", which were eight hours long and were rotated to provide round the clock coverage.

Arlington Hall Station in the 1940s

One Time Pad

- Multiple discovers, multiple uses
  - Vernam Mauborgne, 1917-1919, teletype tape first!
  - Post ww1 (into WW2)
    - super-encipherment pads
    - German Foreign Office & USSR dip, GRU/KGB
  - WW2
    - Marks/SOE & GCCS/BP pads
    - SIGSALY voice, Sturgeon tape
  - Coldwar
    - Shannon proof
    - SIGTOT & Hotline
    - pads in Cuban stores on Grenada
    - Pocket OTP – Unix, Brit Forces

RERUN 2009

http://en.wikipedia.org/wiki/One-time_pad

Unbeakable?

Theory *vs* Practice
    Implementation flaws

Public Key
Moore's lap, time = factors
Software bugs
Session key protected, but is session cipher safe?
Block Ciphers
computationally, practically
Software Bugs
Sophisticated structural & statistical attacks

OTP
Russians and Germans dupped One Time Pads in WWII (VENONA, GEE)
German GEE OTP
    mechanically non-random
Machine key-stretching
computationally, practically
Indicator group / Nonce key
Complications can be simplifications
On-air training with simplified procedures
Slowly tightening practice

RERUN 2009

Cribs and Collisions

Detecting two *text* messages in same key

```
LQSQC YDGMK EHEAG PCKMY EGOBS HUNBK GJTSU
LQSQL CTSMP MRTMV BLZGI RAXWW KVZGL PBDFY

UQYPC XZLJE ARVBU ADVEH GCJTR MUQZT LB
WGTXW DXLRK KQGYH SWPCH GCBSG SOSDT W

NOTEA LSOTH ATTHE WHOLE RANGE IDEAI SRATH
NOTET HATTR DOESN OTDOR EGULA REXPR ESSIO

ERUNP ORTAB LEBET WEENC HARAC TERSE TS
NCHAR ACTER CLASS ESSUC HASDO RLOWE R
```

Crib – start is easiest but can drag

Higher Collision rates detect synchronized key-streams. Even detects reuse of aperiodic keys. Putting two or more in depth will cancel key, allow riffing

Defense = Compress
no more or less common chars, chars no longer forced to byte align so 'depth' hader

Cribbing works with any key system ... if trial key can be extended which can signal if crib was matched for real.

OTP Applications

- Clear Text
  Single encipherment of text (letter pad)
  - SOE replacement for poems, “Between Silk & Cyanide”
- Cipher Text
  Super-encipherment of cipher
  - Straddling Checkerboard (number pad)
  - Transposition, Playfair, etc (letter pad)
- Code Groups
  super-encipherment of code groups (Encicode)
  - Number pad common, letter less so

Soviet OTP Usage

- Illegals – OTP, miniature, with Straddling Checkerboard
- Diplomatic cables – Codebook & OTP
  - GRU (Sov. Army MI)
  - NAVAL GRU
  - Trade (ZET)
    - Low intrinisic interest but stereotyped, voluminous, and weakened further
  - Diplomatic (ZDJ)
  - NKVD/KGB Station Chief under legal cover
  - All 4-number, single-part codes, with spell ciphers and garbleproof numberals

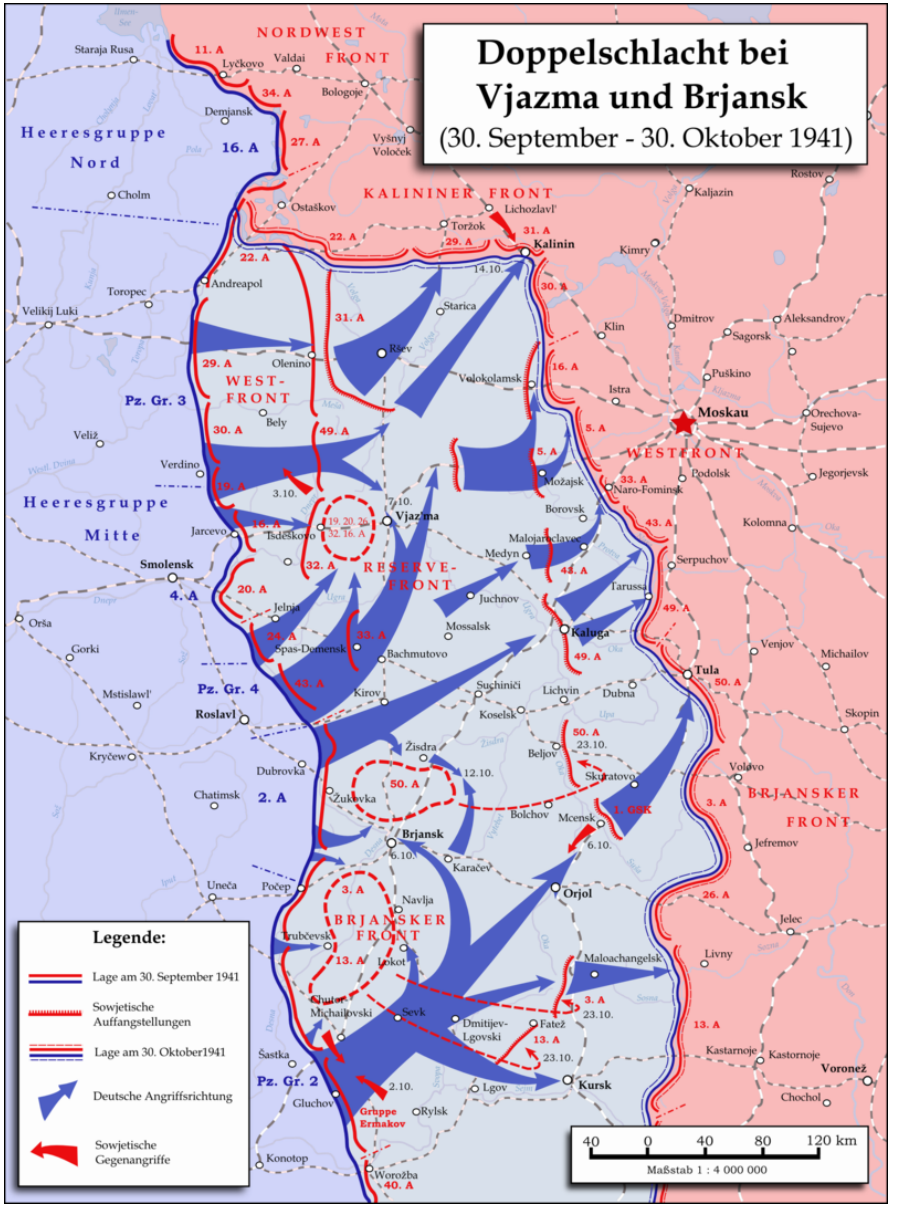
- Vint Hill stayed open after WW2 to monitor Soviet radio teletype and morse code
- But most of the messages we’re discussing were sent by Cable as Diplomatic traffic and copied by ASA at WU DC&NYC cable offices
- SIS/SSA/ASA Arlington Hall in sorting messages discovered some OTP messages reused OTP pages!

Soviet Practice

- Russian Copulation – stereotypes harder
  - Split message randomly and swap halves, with separator
- Encipher indicator in message
  - As with Enigma, this was added later, after break, oops

Unbreakable in theory but ...

- OTP must be ONE TIME
  - If not … find the dups!
  - 1942 cheat.
    - Carbon paper?
  - Voluminous ZET cheat
    - RED REVERSE
- codebook's spell cipher
- Single-part code weaker than 2-part



By Memnon335bc - Own work, CC BY 3.0, https://commons.wikimedia.org/w/index.php?curid=7840321

How Found?

- Keypunch leading 16x5=80 figures on cards
- Search for coincidences or common differences
- Looking for common prefixes of message (or simple short additive tables)
  - Found common additive OTP pages instead!
- Noticed long Trade messages reused sheets immediately, Top to Bottom then Bottom to Top

Book Breaking

- First find codes for parts of message; Numerals; Letters for spelling.
- In One Part Code, the code values are in numeric order as the words/phrases are in alphabetic order: HINT!
-

Who

- “Gene” Gabreel - 1st analyst on BRIDE/VENONA
- LT R Hallock - “Depth” and pattern in Trade code
- Frank Lewis expands break for first partial decryption in 1943
- Genevieve Feinstein – pad indicator finds depth
- Cecil Phillips - patterns in KGB encidode
- Lucille Campbell – KGB
- Meredith Gardner – book breaker
- Robert Lamphere - FBI CI
-

More Hidden Figures?

In the spring of 2018, Angeline Nanni revisited Arlington Hall, where the Venona team got cracking. It is now on the National Register of Historic Places. (Maggie Steber / VII Photo)

From Smithsonian article ...

Meredith Gardner (left)

… true context

DECLASSIFED

Featured in NSA Venona history ...

Mildred Hayes VENONA linguist/analyst for more than twenty-five years. She closed the VENONA effort on I October 1980.

Gloria Forbes (left). She began processing Soviet diplomatic messages in mid-1943 and continued to supervise this and related activities for

52

Joan Malone Callahan, the first U.S. VENONA analyst/linguist to serve at GCHQ 1949 to 1954. She became project supervisor and principal customer interface in 1954 when Meredith Gardner replaced her in the United Kingdom.

Arlington Hall bowling team of cryptanalysts ca. 1947. Standing (left to right): Cecil Phillips, Bill Lutwiniak, Paul Derthick. Below: (left to right) Frank Lewis, Louise Derthick. (All except Louise worked at some time on VENONA-related

51

Gene Grabeel, 1st Analyst

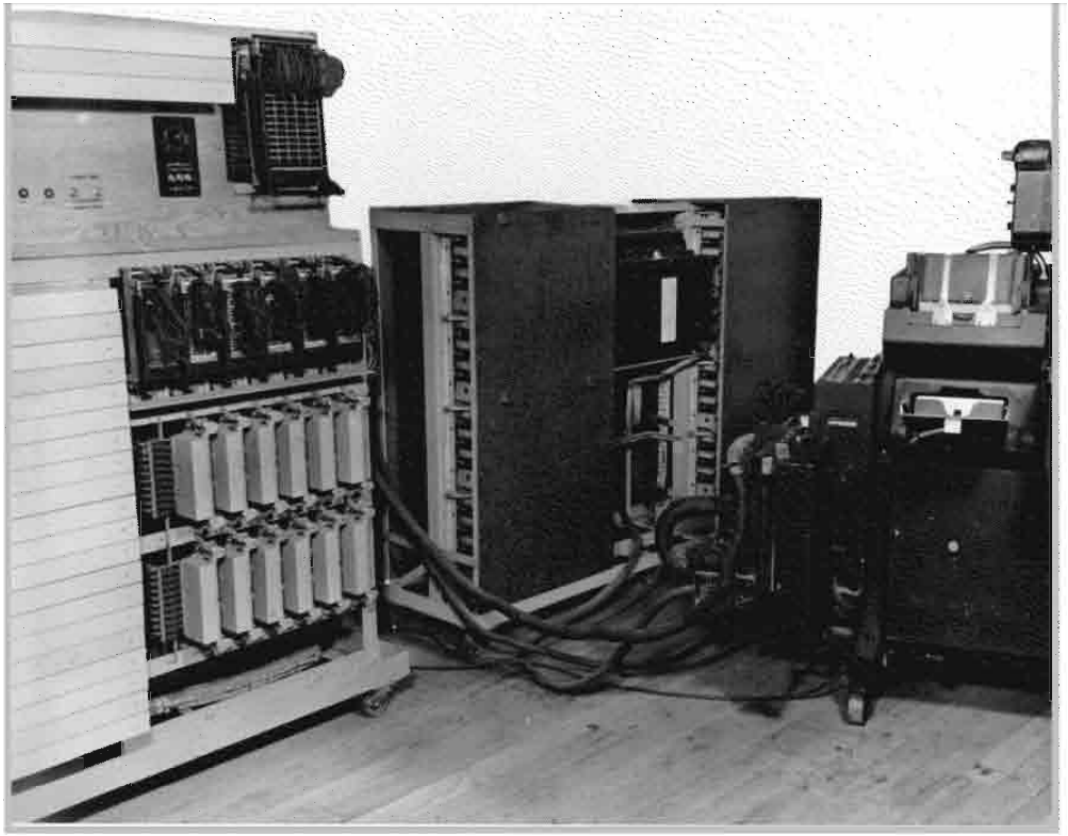
Gene Grabeel received a citation rom the NSA for her work on Venona. (Maggie Steber / VII Photo)

Gene Grabeel (right) She began work on Soviet diplomatic messages on I February 1943 and continued working the problem until the late 1970s.

Computer History (1)

SIS “Slide Run”

- IBM 405 Tabulator +
- relay circuits
- Counters
- Plugboards (PROM)
- telephone crossbar relays
- Statistical tests
- Conditional print



) Slide Run

Computer History (2)

- Many other special purpose devices
- General purpose electronic computers late 40s early 50s
  - ERA ATLAS, a von Neumann machine, 16k words = 64kB (huge for the day!)
    - Interlacing on drum!
  - ABNER – general purpose plus special instruction sets
    - arbitrary-base carryless-add
    - crib-dragging
    - block transfer and block loop operation;
    - stream operations.

Public Release

Public Release of VENONA translations (1995 – 1996)

- 1. Soviet atomic bomb espionage
- 2. New York KGB messages of 1942 and 1943
- 3. New York and Washington KGB messages of 1944 and 1945
- 4. San Francisco and Mexico City KGB messages; GRU New York and Washington messages; Washington Naval GRU messages
- 5. KGB and GRU messages from Europe, South America, and Australia
- 6. Messages inadvertently left out of the previous five updates of previously issued translations. Updates some translations by restoring names that had been protected for privacy reasons in the original releases.

Also, UK GCHQ released COMINTERN messages 1934-37 (MASK) and 1943-43 (ISCOT).

3. GPG/PGP Key Signing

- A quick HOW TO

4. Key Signing

Seq	Key ID	Owner	Fingerprint	Size	Type
1	5640D33F	John Abreau (Personal email)	87B1 6003 9962 0824 0406 8B93 B184 3040 5640 D33F	4096	RSA
2	C9039A2B	Braulio Carreno (Sep 2018)	1357 E187 E888 412B 99E0 ABA2 AE18 9974 C903 9A2B	4096	RSA
3	7493DAEC	James R. Doyle	F0B5 2E03 C020 DFE5 BA3D 7491 FB35 AF4D 7493 DAEC	2048	RSA
4	4340F598	Andrew Holden	F218 F449 0895 29A5 7A46 F094 3114 7708 4340 F598	4096	RSA
5	87145445	Elliott Mitchell	8A19 58D2 7E3D DDF4 7BA6 41D1 B375 37D0 8714 5445	3072	DSA
6	6FA9E1F9	George Mitchell	35D3 3864 792D B095 B990 A657 C111 12DE 6FA9 E1F9	4096	RSA
7	41936952	William Ricker (Boston)	090F 3675 F519 C3D3 A5D8 E763 9CD4 CB6D 4193 6952	4096	RSA
8	6E0D8E7D	Goh Wei Zhong (non-primary email address)	109F FC0C C1BD B1EC 2C54 B6B1 DCC1 B708 6E0D 8E7D	4096	RSA

Key#3 on the list is RSA **2048** with expiration date in **2030**.
This key is not considered safe. We do NOT recommend signing it.

```
pub   rsa2048/7493DAEC 2018-05-05 [SCA] [expires: 2030-05-05]
uid                [ unknown] James R. Doyle <rockymtnmagic@gmail.com>
sub   rsa2048/2408FE78 2018-05-05 [E] [expires: 2030-05-05]
```

Instruction email said,

* We will NO LONGER sign RSA or DSA 1024b keys (or shorter). Obsolete.
* We will NOT sign RSA 2048b keys without expiration dates
  or with expiration dates beyond 2020.
* Use RSA 4096 or ed25519 for gpg2 –gen-key

(*Alas the keyserver or signup utility doesn't have new enough GPG2 to do ed25519 yet. I tried.*)