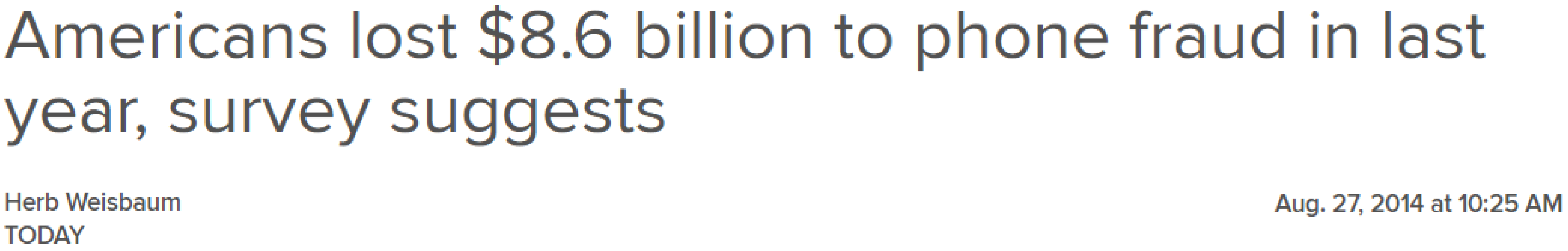
ITU Kaleidoscope 2016

ICTs for a Sustainable World

TOWARD AUTHENTICATED CALLER ID TRANSMISSION: THE NEED FOR A STANDARDIZED AUTHENTICATION SCHEME IN Q.731.3 CALLING LINE IDENTIFICATION PRESENTATION

Huahong Tu, Adam Doupé, Ziming Zhao, and Gail-Joon Ahn
Arizona State University
tu@asu.edu

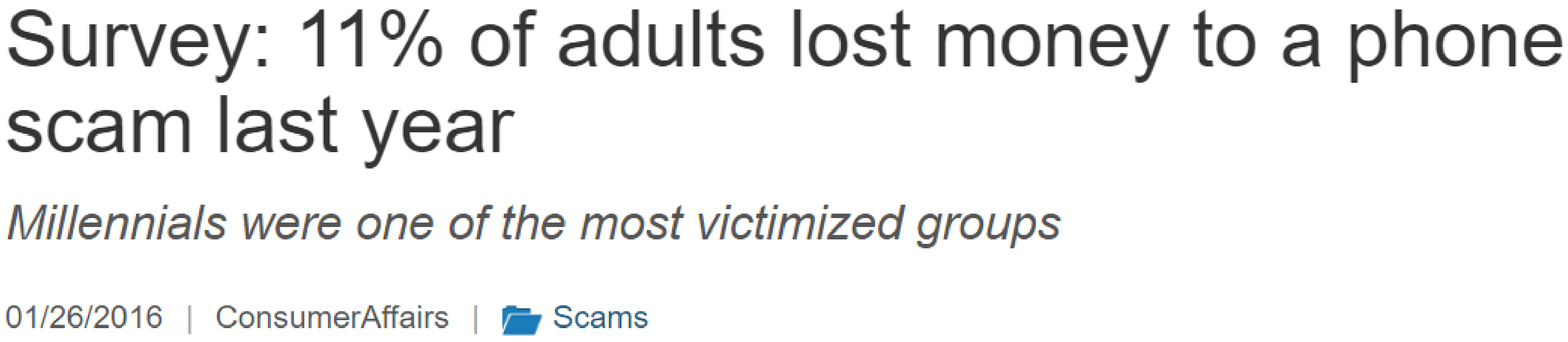
Bangkok, Thailand
14-16 November 2016



Americans lost $8.6 billion to phone fraud in last year, survey suggests

Herb Weisbaum
TODAY

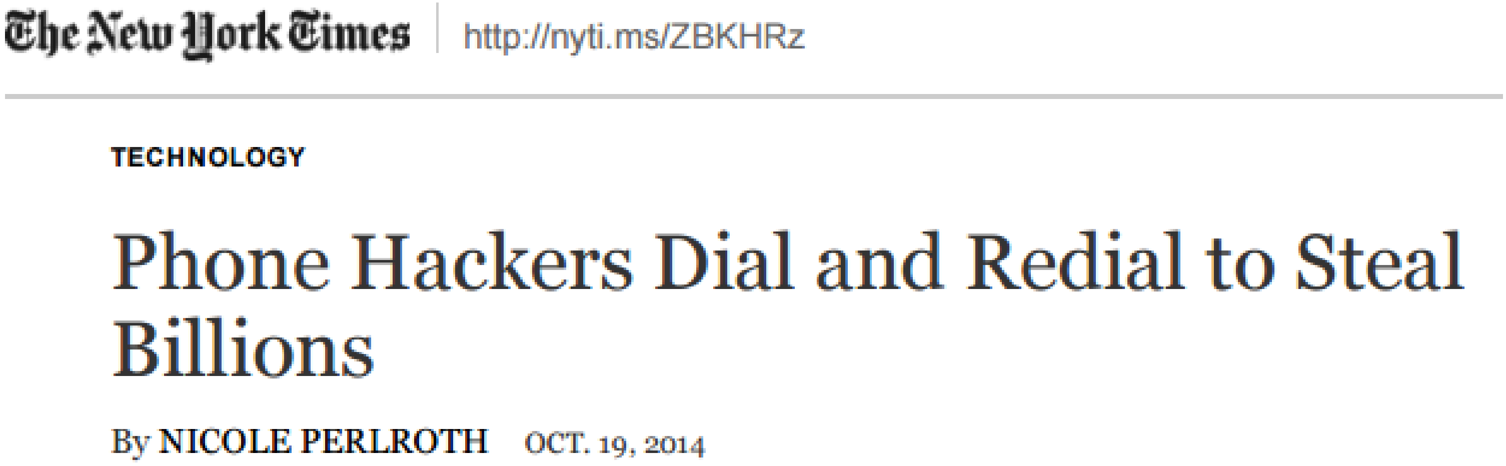
Aug. 27, 2014 at 10:25 AM



Survey: 11% of adults lost money to a phone scam last year

Millennials were one of the most victimized groups

01/26/2016 | ConsumerAffairs | Scams



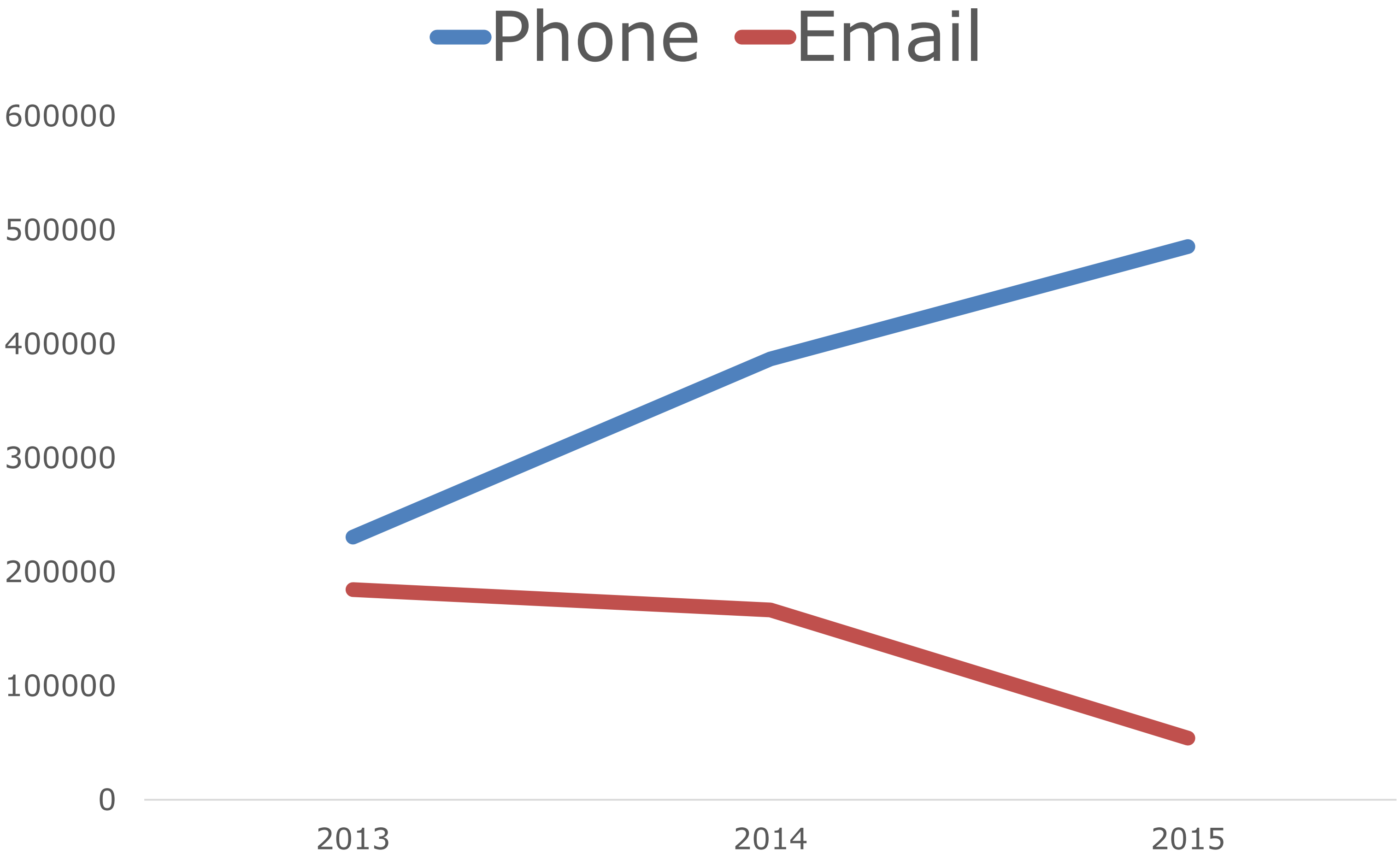
The New York Times | http://nyti.ms/ZBKHRz

TECHNOLOGY

Phone Hackers Dial and Redial to Steal Billions

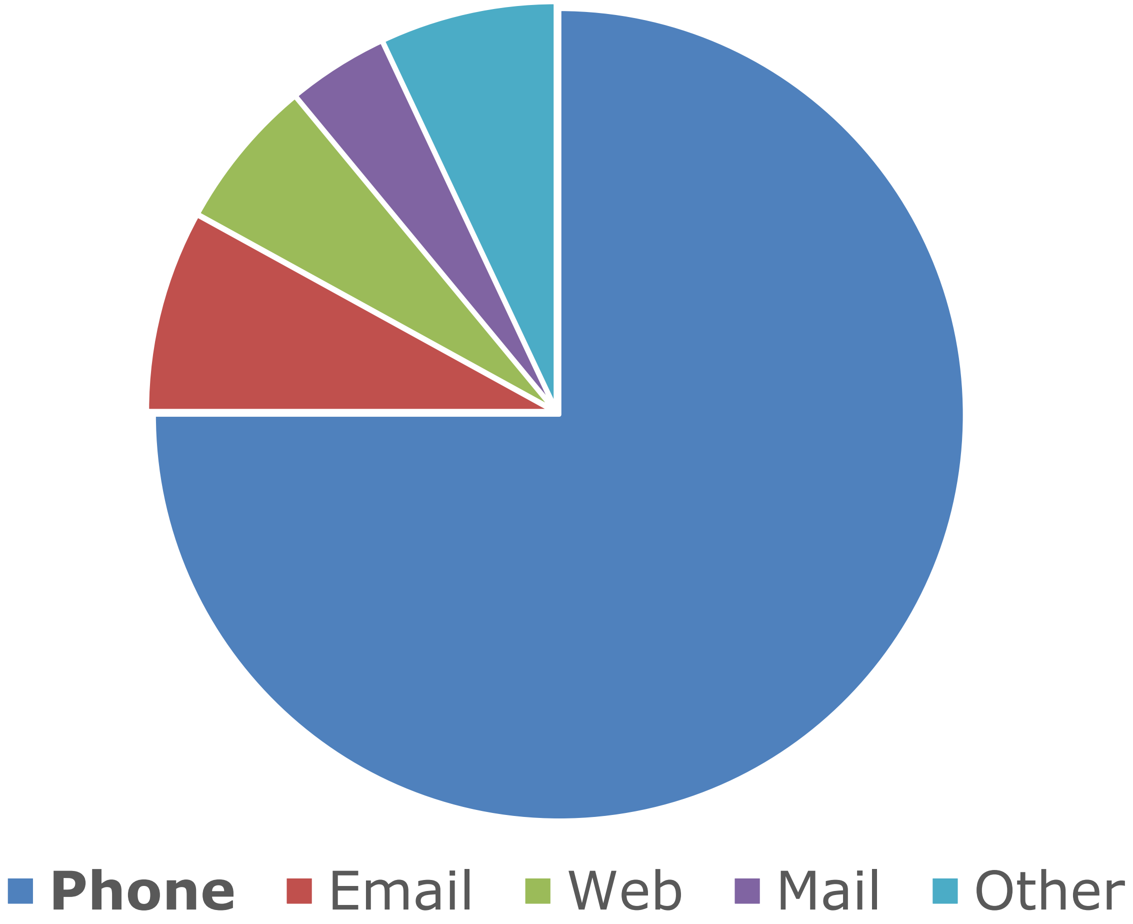
By NICOLE PERLROTH OCT. 19, 2014

Fraud Complaints by Method of Contact 2013-2015

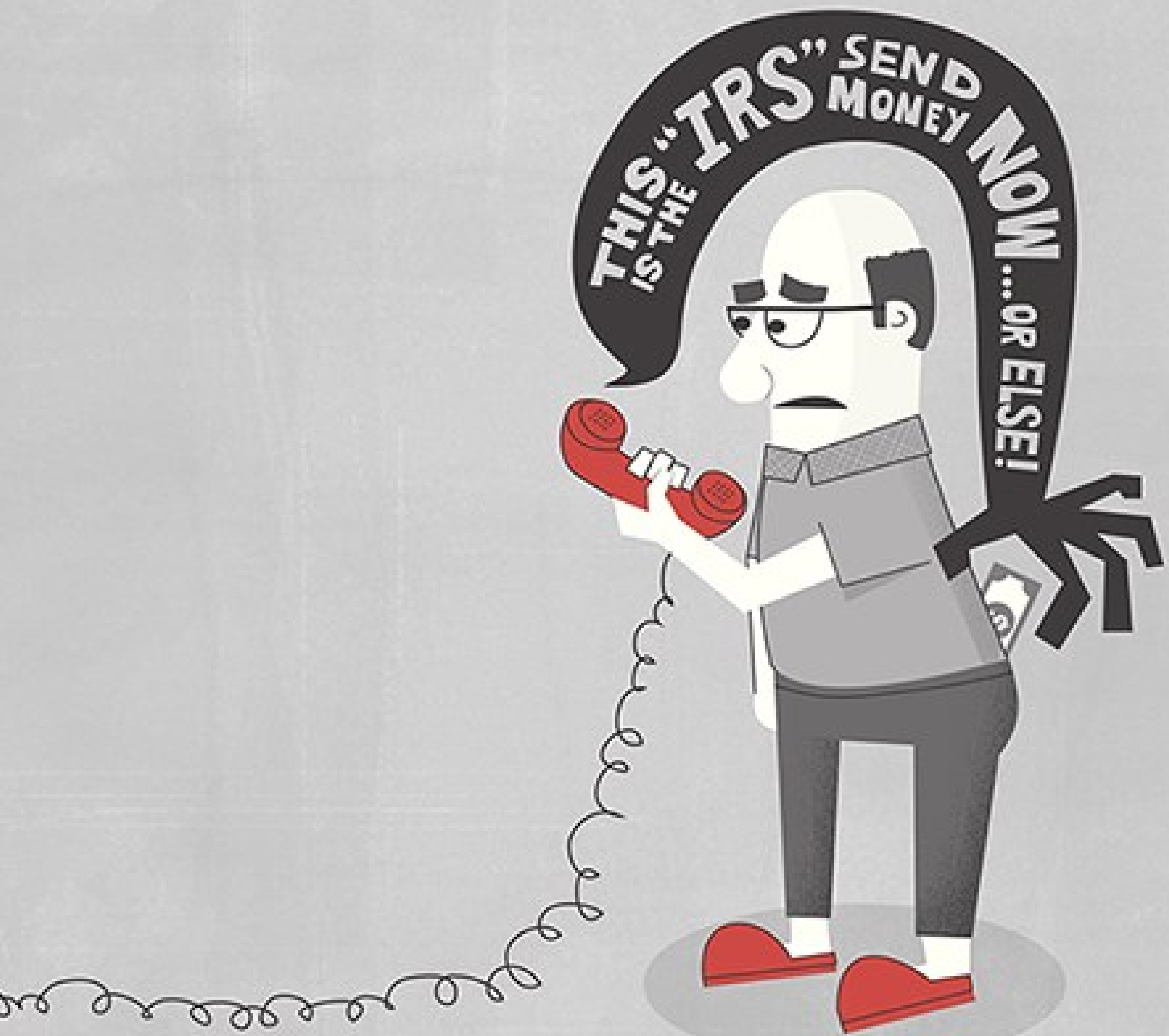


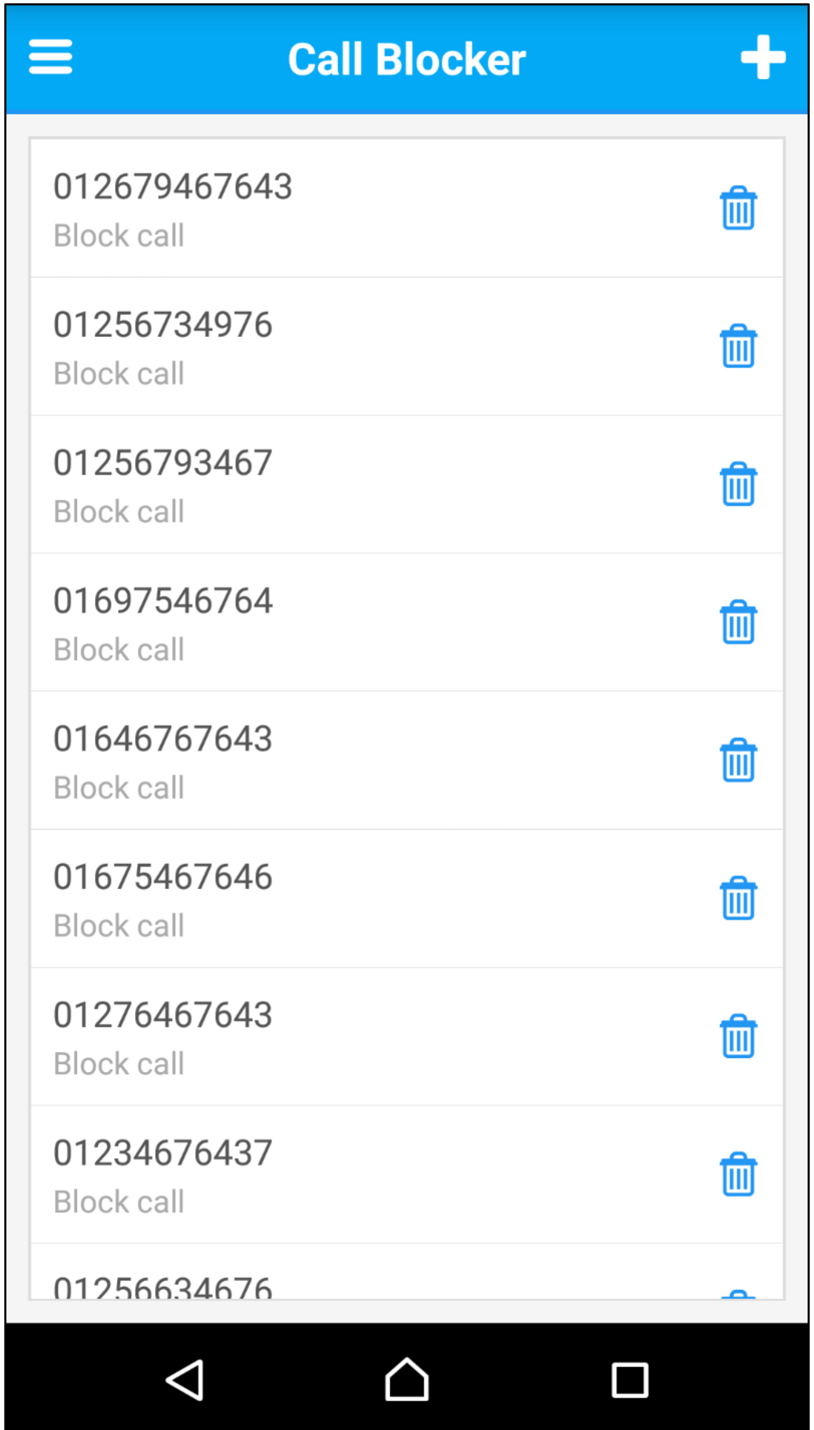
Data source: FTC Consumer Sentinel Data Book CY2015

Fraud Complaints by Method of Communication in 2015



Data source: FTC Consumer Sentinel Data Book CY2015


THIS IS THE "IRS" SEND MONEY NOW ...OR ELSE!



Call Blocker

012679467643
Block call

01256734976
Block call

01256793467
Block call

01697546764
Block call

01646767643
Block call

01675467646
Block call

01276467643
Block call

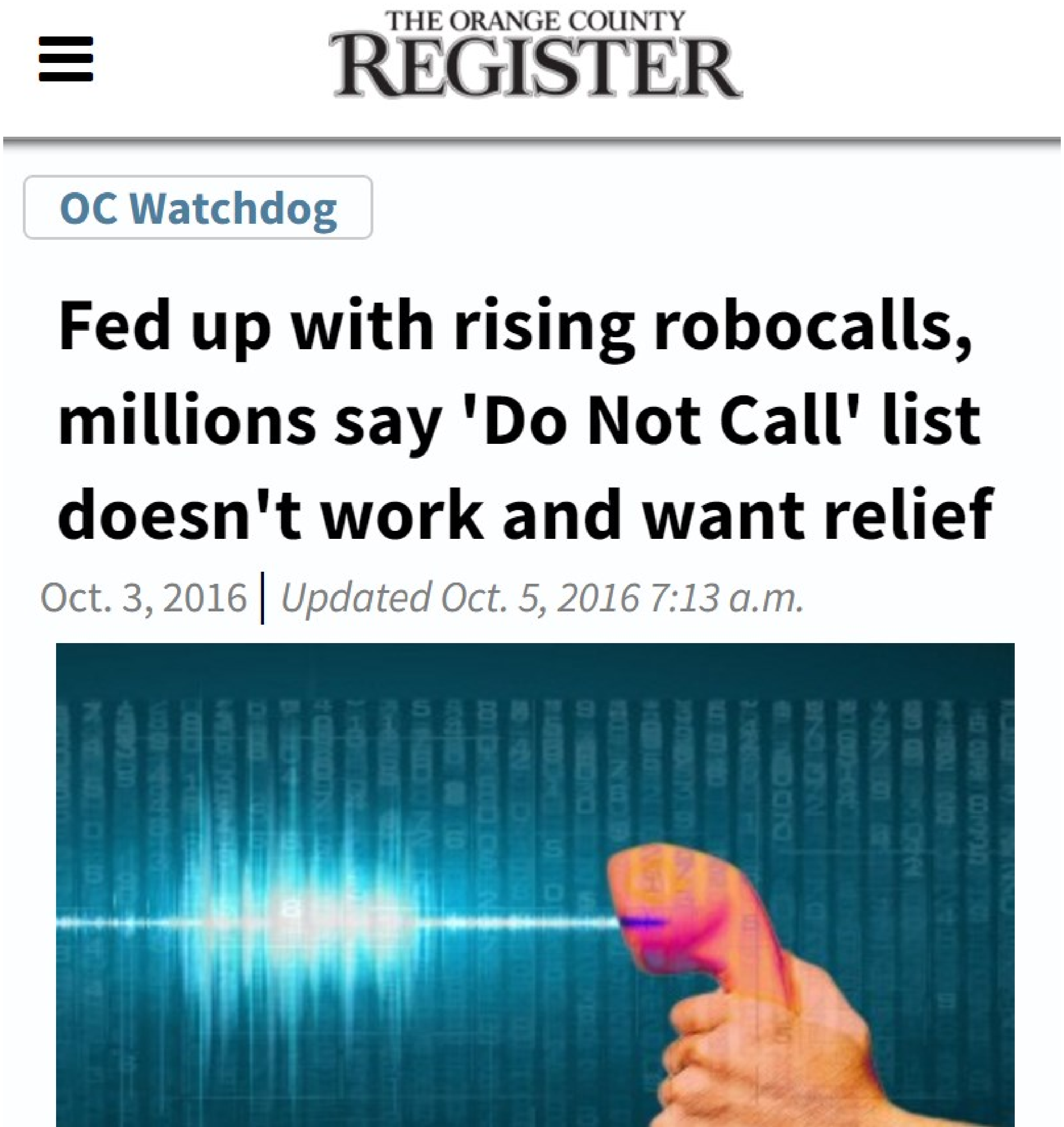
01234676437
Block call

01256634676

NATIONAL

DO NOT CALL

REGISTRY



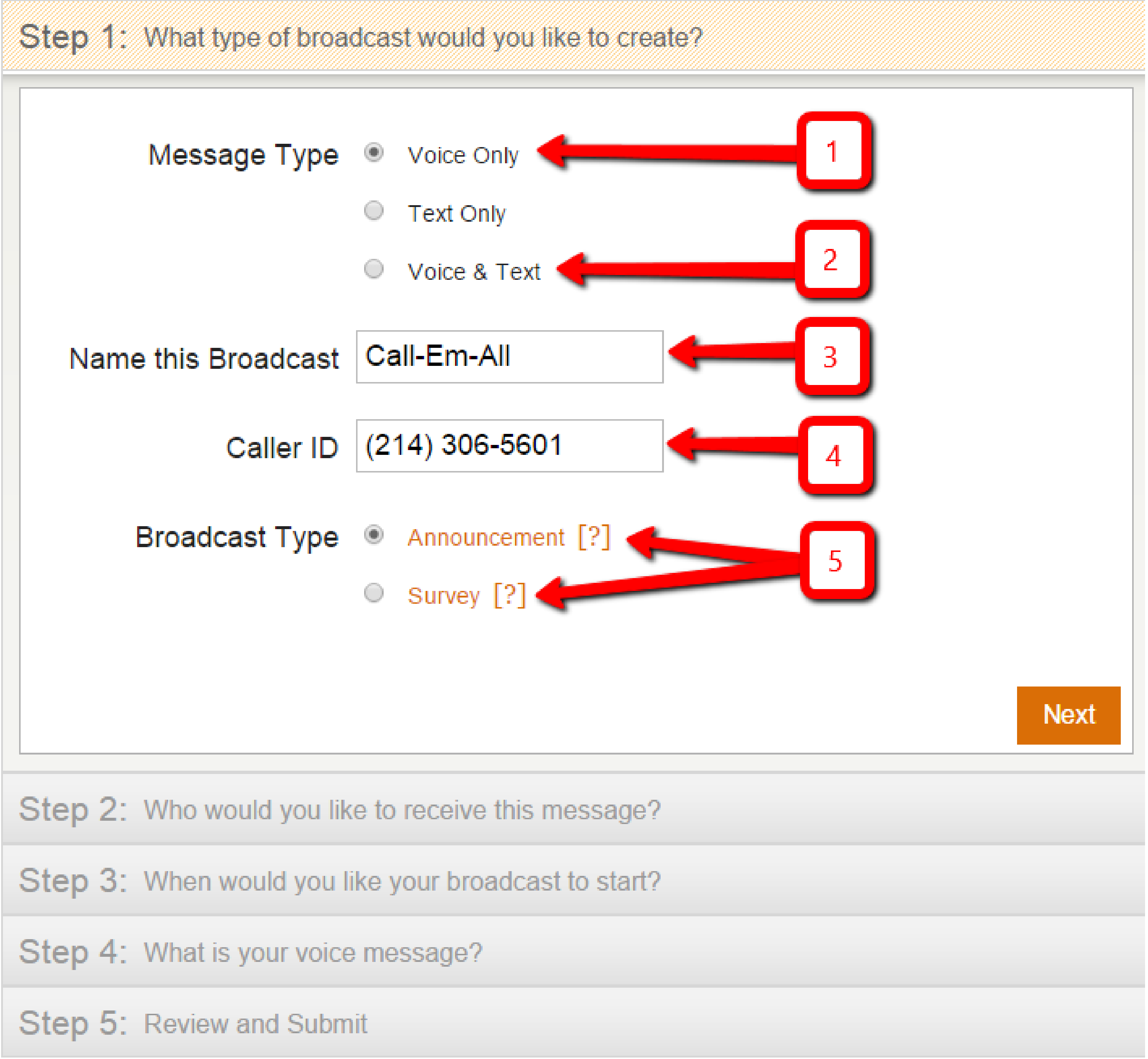
THE ORANGE COUNTY
REGISTER

OC Watchdog

Fed up with rising robocalls, millions say 'Do Not Call' list doesn't work and want relief

Oct. 3, 2016 | *Updated Oct. 5, 2016 7:13 a.m.*

CALLER ID
10:24 PM
HAVE YOU BEEN
SPOOFED?
◀ REVIEW ▶
DELETE



Step 1: What type of broadcast would you like to create?

Message Type ● Voice Only ○ Text Only ○ Voice & Text

Name this Broadcast: Call-Em-All

Caller ID: (214) 306-5601

Broadcast Type ● Announcement [?] ○ Survey [?]

Step 2: Who would you like to receive this message?

Step 3: When would you like your broadcast to start?

Step 4: What is your voice message?

Step 5: Review and Submit

Recommendation Q.731

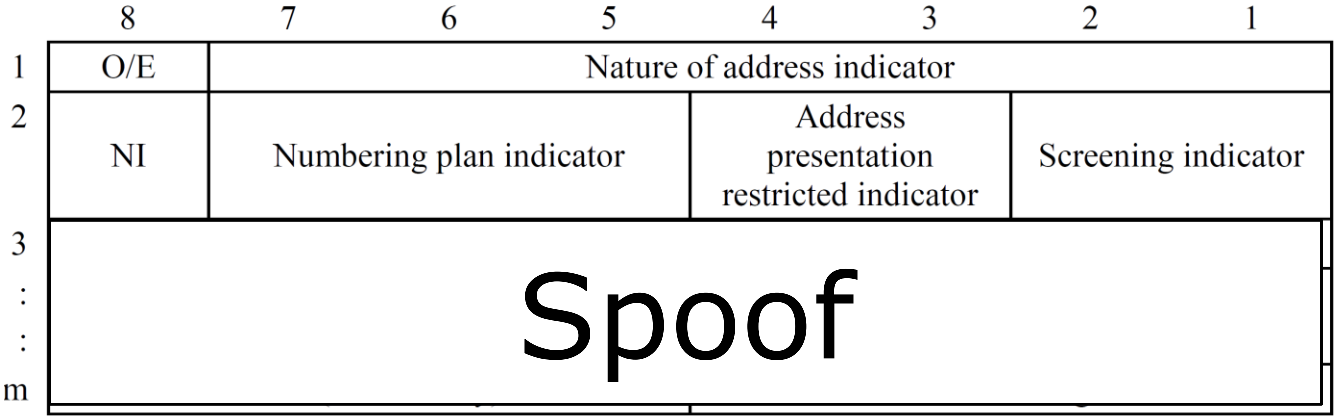
STAGE 3 DESCRIPTION FOR NUMBER IDENTIFICATION SUPPLEMENTARY SERVICES USING SIGNALLING SYSTEM No. 7

	8	7	6	5	4	3	2	1
1	O/E	Nature of address indicator						
2	NI	Numbering plan indicator			Address presentation restricted indicator		Screening indicator	
3	2nd address signal				1st address signal			
: :								
m	Filler (if necessary)				*n*th address signal			

Figure 11/Q.763 – Calling party number parameter field

Recommendation Q.731

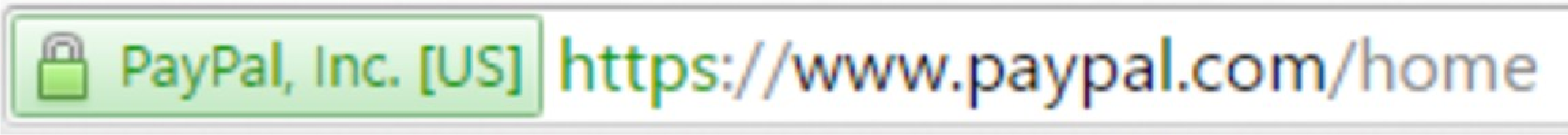
STAGE 3 DESCRIPTION FOR NUMBER IDENTIFICATION SUPPLEMENTARY SERVICES USING SIGNALLING SYSTEM No. 7



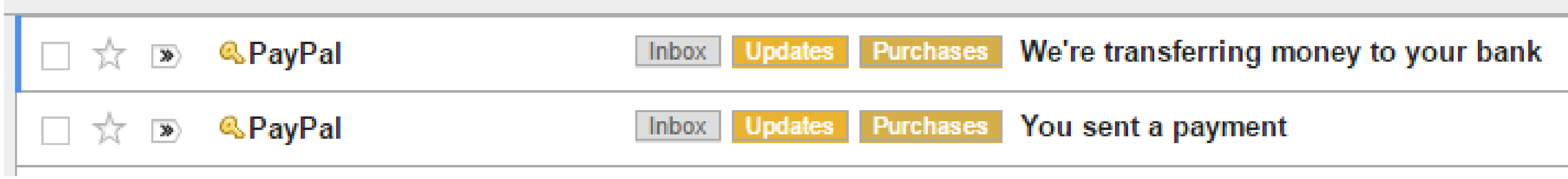
	8	7	6	5	4	3	2	1
1	O/E	Nature of address indicator						
2	NI	Numbering plan indicator			Address presentation restricted indicator		Screening indicator	
3	Spoof							
:								
:								
m								

Figure 11/Q.763 – Calling party number parameter field

Why Security Indicators Matter

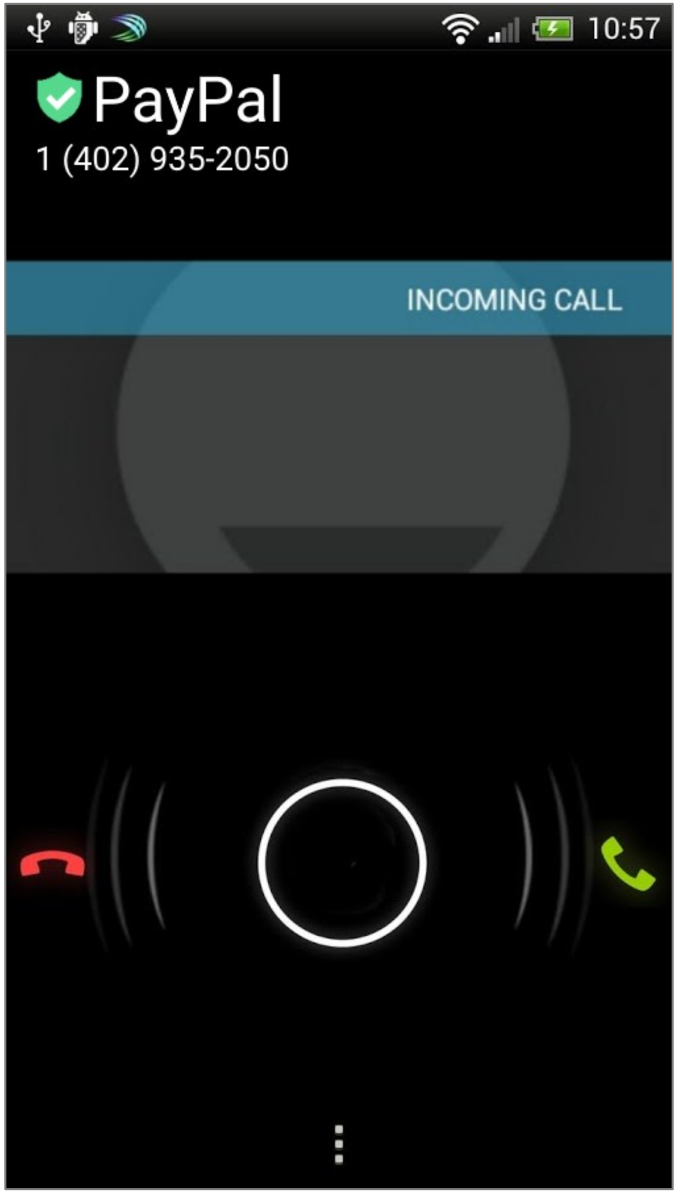


PayPal, Inc. [US] https://www.paypal.com/home

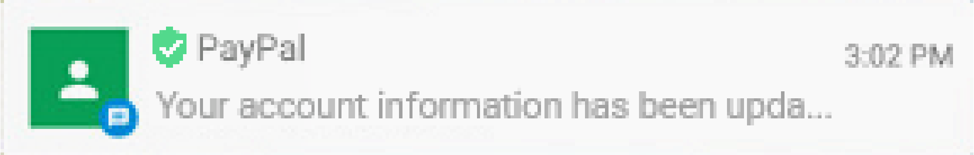


□ ☆ PayPal Inbox Updates Purchases We're transferring money to your bank

□ ☆ PayPal Inbox Updates Purchases You sent a payment



10:57
PayPal
1 (402) 935-2050
INCOMING CALL

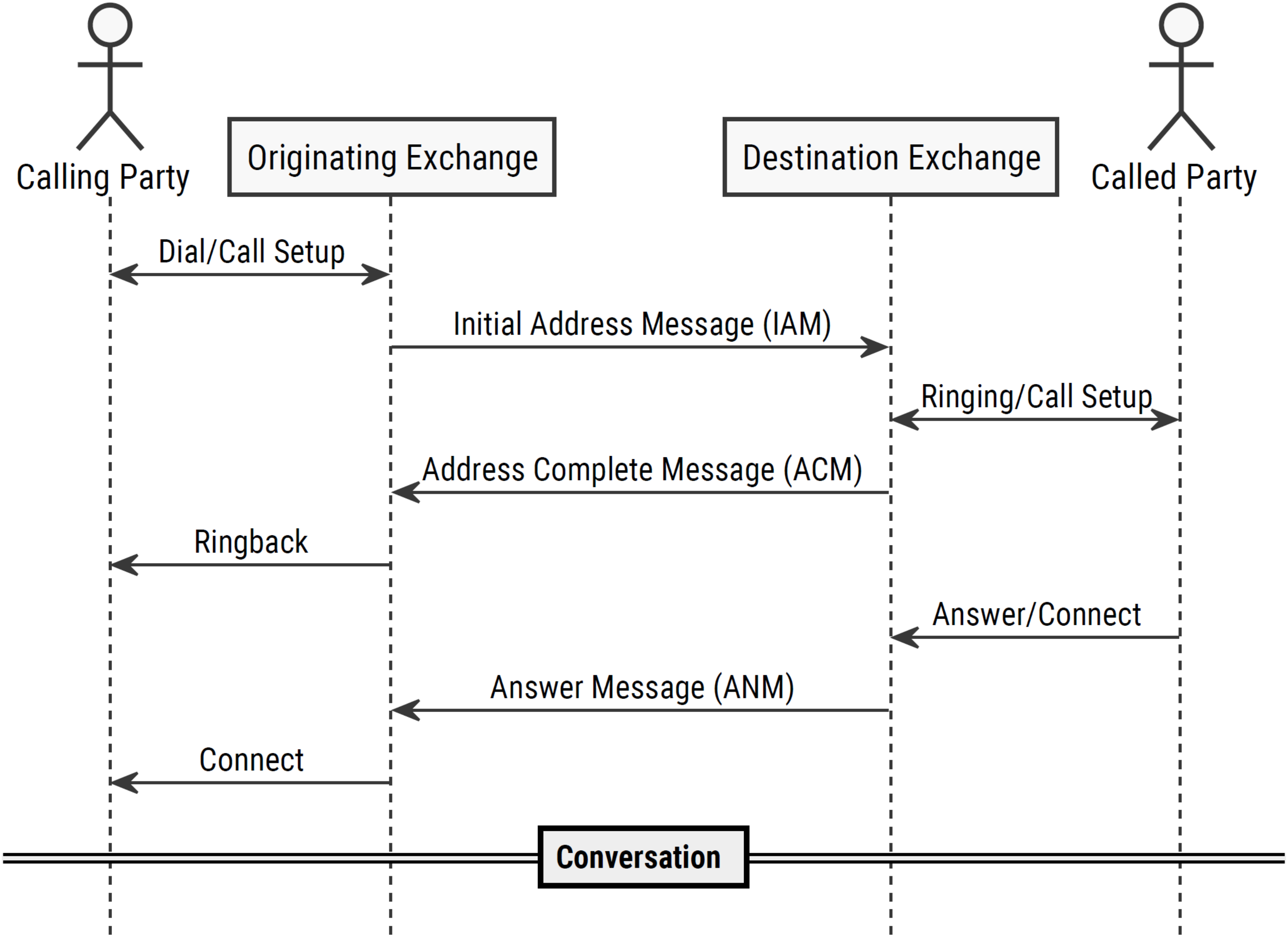


PayPal

3:02 PM

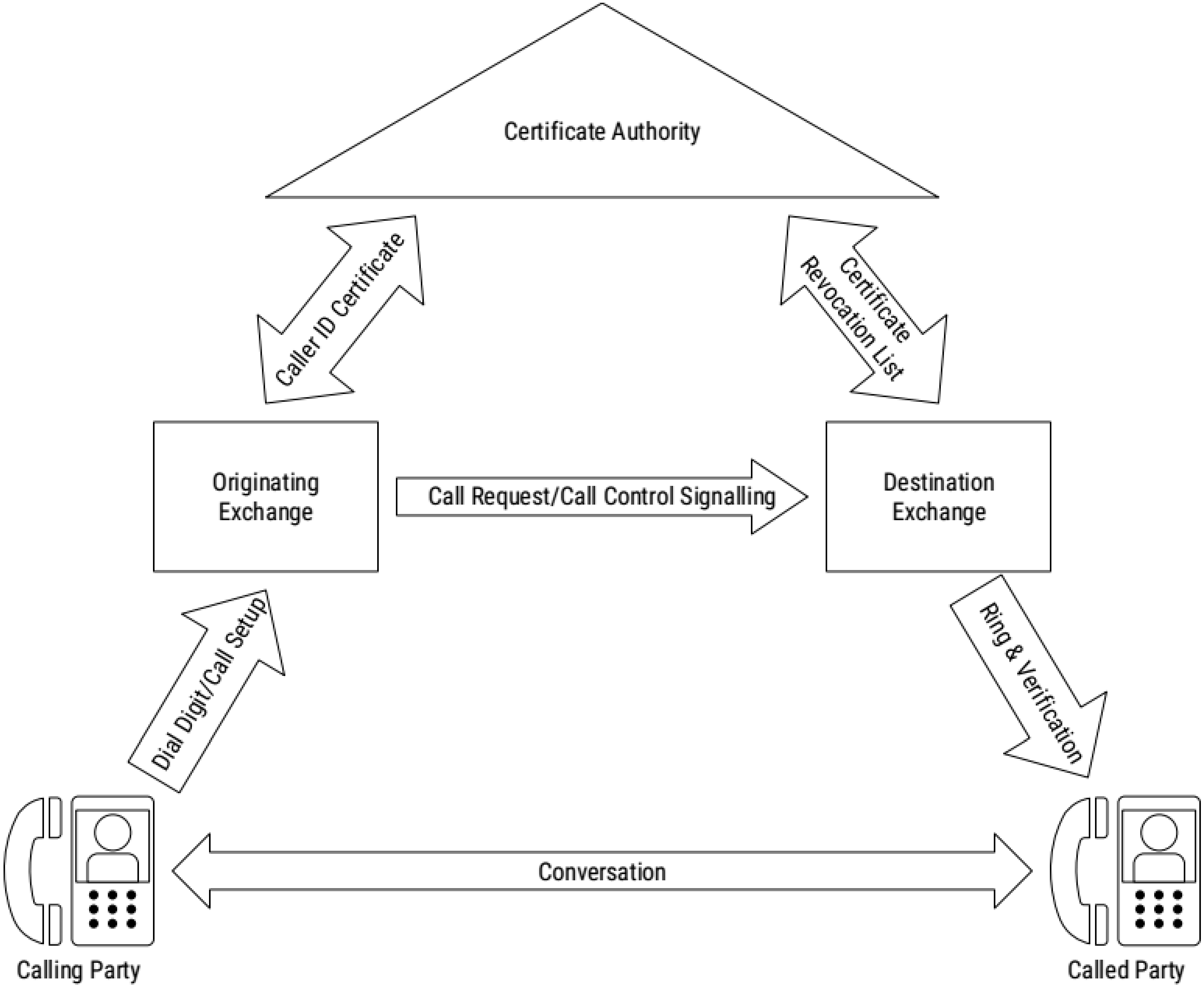
Your account information has been upda...

Designing the Verification Scheme


Calling Party
Originating Exchange
Destination Exchange
Called Party
Dial/Call Setup
Initial Address Message (IAM)
Ringing/Call Setup
Address Complete Message (ACM)
Ringback
Answer/Connect
Answer Message (ANM)
Connect
Conversation

Design Principles

- Authentication
- Integrity
- Deployability


Certificate Authority
Caller ID Certificate
Certificate Revocation List
Originating Exchange
Call Request/Call Control Signalling
Destination Exchange
Dial Digit/Call Setup
Ring & Verification
Conversation
Calling Party
Called Party

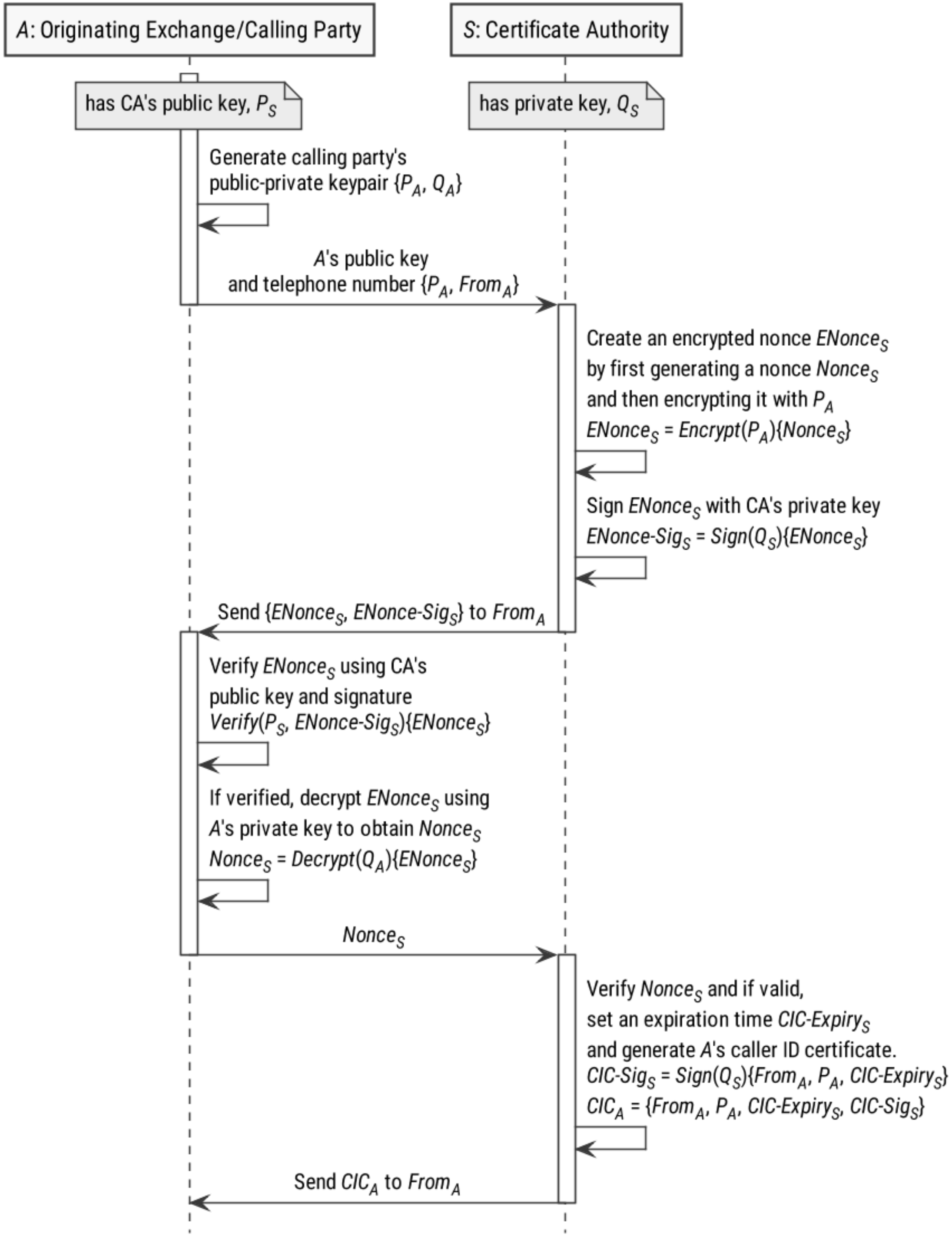
Scheme Overview

1. Caller ID Verification

2. Authenticated Call Request

Caller ID Verification

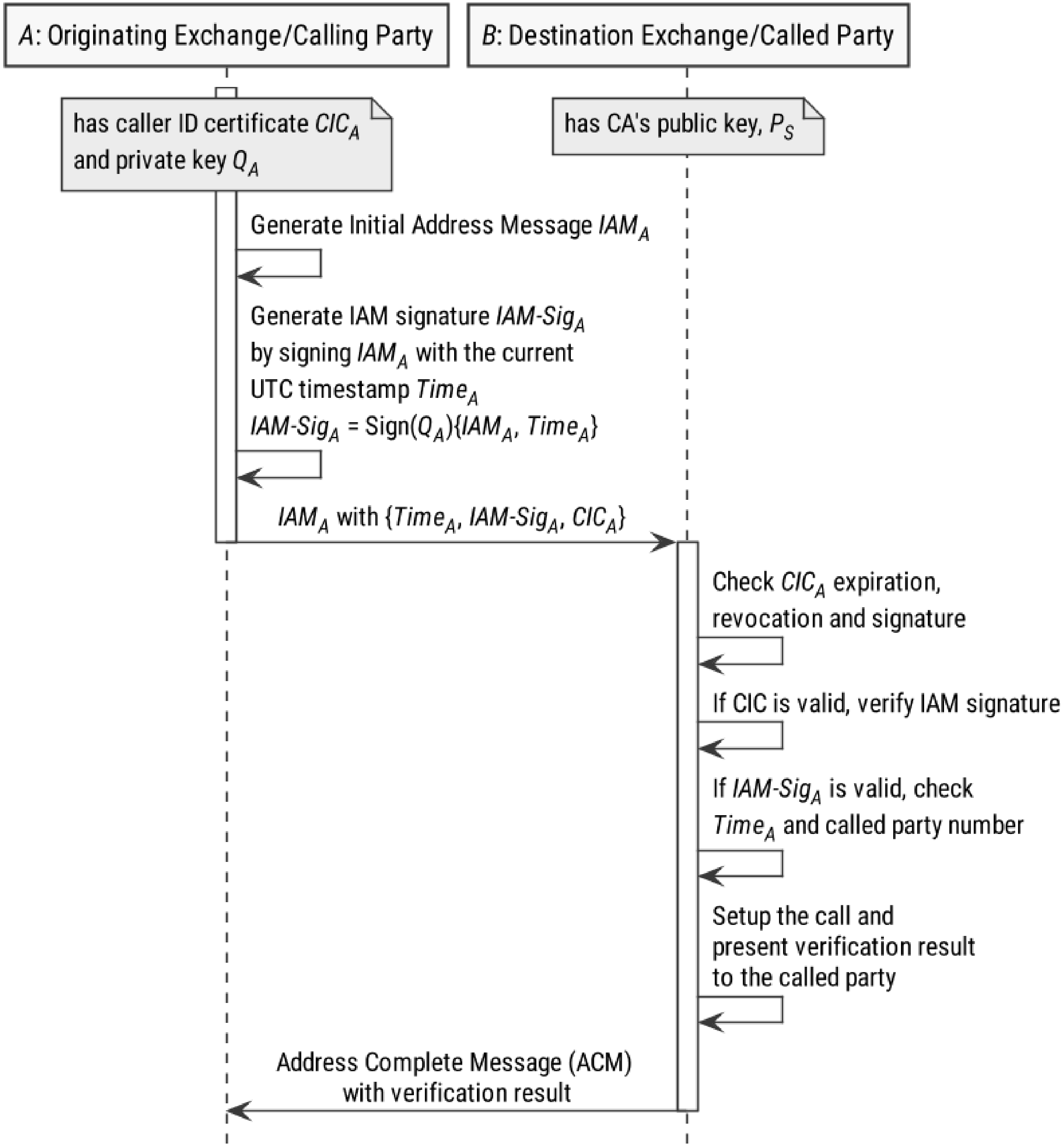
- Provide proof of E.164 ownership to a CA
- Obtain a short-term Caller ID Certificate
- Use caller ID to generate Authenticated Call Requests



A: Originating Exchange/Calling Party
S: Certificate Authority
has CA's public key, P_S
has private key, Q_S
Generate calling party's public-private keypair $\{P_A, Q_A\}$
A's public key and telephone number $\{P_A, From_A\}$
Create an encrypted nonce $ENonce_S$ by first generating a nonce $Nonce_S$ and then encrypting it with P_A
$ENonce_S = Encrypt(P_A)\{Nonce_S\}$
Sign $ENonce_S$ with CA's private key
$ENonce\text{-}Sig_S = Sign(Q_S)\{ENonce_S\}$
Send $\{ENonce_S, ENonce\text{-}Sig_S\}$ to $From_A$
Verify $ENonce_S$ using CA's public key and signature
$Verify(P_S, ENonce\text{-}Sig_S)\{ENonce_S\}$
If verified, decrypt $ENonce_S$ using *A*'s private key to obtain $Nonce_S$
$Nonce_S = Decrypt(Q_A)\{ENonce_S\}$
$Nonce_S$
Verify $Nonce_S$ and if valid, set an expiration time $CIC\text{-}Expiry_S$ and generate *A*'s caller ID certificate.
$CIC\text{-}Sig_S = Sign(Q_S)\{From_A, P_A, CIC\text{-}Expiry_S\}$
$CIC_A = \{From_A, P_A, CIC\text{-}Expiry_S, CIC\text{-}Sig_S\}$
Send CIC_A to $From_A$

Authenticated Call Request

- Assert the originating identity
- Generate an extended IAM with a digital signature using the Caller ID Certificate
- Validate both the IAM signature as well as the signer


A: Originating Exchange/Calling Party
B: Destination Exchange/Called Party
has caller ID certificate CIC_A and private key Q_A
has CA's public key, P_S
Generate Initial Address Message IAM_A
Generate IAM signature $IAM\text{-}Sig_A$ by signing IAM_A with the current UTC timestamp $Time_A$
$IAM\text{-}Sig_A$ = Sign(Q_A){IAM_A, $Time_A$}
IAM_A with {$Time_A$, $IAM\text{-}Sig_A$, CIC_A}
Check CIC_A expiration, revocation and signature
If CIC is valid, verify IAM signature
If $IAM\text{-}Sig_A$ is valid, check $Time_A$ and called party number
Setup the call and present verification result to the called party
Address Complete Message (ACM) with verification result

Other Details

- UTC Timestamp (UNIX time)
- X.509 certificate format
- International E.164 format
- Parameter Compatibility Information parameter (Q.764.2.9.5.3.2)

Parameter	**Type**	**Length (octets)**
UTC Timestamp	Optional Part	4-?
Signature Algorithm	Optional Part	1-?
Signature	Optional Part	16-?
Caller Identity Certificate	Optional Part	32-?

Security Considerations

- Certificate Revocation to guard against stolen identity
  - E.g. stolen certificate, cell phone theft, etc.

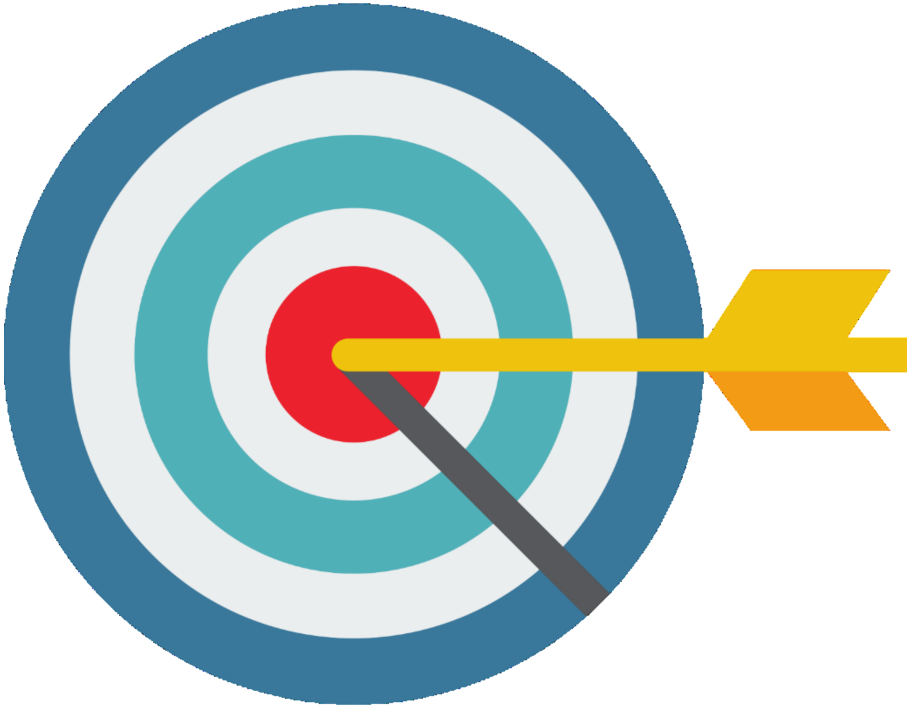
- Recommend using Certificate Revocation List (CRL) with short-term certificates
  - No stalling, OCSP can cause stalling
  - Risk containment
  - Reduce list size

Local Deployment Considerations

- Presenting the security indicator to the called party

- Use a flag indicator, only if
  - local exchange network connection is secured
  - identity of the local exchange carrier is authenticated
  - the call request header is integrity protected

- Otherwise recommend using full conversion of the extended IAM parameters to allow the called party's user equipment to perform verification



ITU

Acknowledgement

CENTER FOR
CYBERSECURITY &
DIGITAL FORENSICS

sefcom
security engineering for future computing

ITU Kaleidoscope 2016

ICTs for a Sustainable World

Thank You

Huahong Tu
Arizona State University
tu@asu.edu

Download paper:
http://huahongtu.me/publications/itu-callerid.pdf

Bangkok, Thailand
14-16 November 2016