DEFENSE INFORMATION SYSTEMS AGENCY
The IT Combat Support Agency

PK-Enabling Mobile Devices with DoD PKI Credentials

DoD PKE
20-22 April 2016

Overarching Goals

- Establish trust in device certificates used by the provisioning server to encrypt configuration data bound for a device
- Demonstrate possession and usage of existing smart card-based credentials
- Enable use of system APIs to exercise cryptographic keys without proliferation of certificates
- Decouple key management from device management

Solution Fundamentals

- Integrate into new DoD PKI enclave
- Source code available for review by the government
- Support centralized key generation
- Support distributed key generation
- Support use of recovered decryption keys
- Authenticate and authorize all parties involved in provisioning, i.e., devices, people, services
- Use NIST approved cryptographic algorithms and key sizes
- Support NIAP-validated or in-evaluation devices

Solution Fundamentals (continued)

- Demonstrate possession and control of CAC per NIST SP800-157
- Provision keys to work with system APIs
- Support system apps, e.g., mail, browser and VPN
- Support 3rd party and enterprise apps
- Avoid proliferation of certificates
- Facilitate automated revocation of software credentials for mobile devices when associated CAC is revoked, if necessary

Solution Fundamentals (continued)

- Provision keys independent of or in collaboration with MDM service
- Avoid manual side-loading of PKCS #12 files where possible
- Reduce touch labor
  - Avoid having user visit a provisioning facility
- Support modern certificate enrollment protocols (e.g., EST)
- Perform certificate validation per RFC 5280 using DoD trust anchors, revocation information providers, certificate policies, name constraints, etc.
  - RFC 5280 is the “Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile”
  - Defines certificate structure, CRL structure, certification path validation rules, etc.

What is Purebred?

- Key management server and set of apps for mobile devices
- Aims to facilitate separating key management from device management
  - Key management maintains affinity with PKI and is used across the enterprise
  - Device management can vary with operational scenario, e.g., service/agency
- Uses modified version of Apple's over-the-air profile delivery and configuration (OTA) protocol for all platforms
  - Modifications address device certificate vetting

Purebred Status

- Supports two phone platforms
  - iOS and Android
- Supports three table platforms
  - iOS, Android and Microsoft Universal Windows Platform (UWP)
- Supported versions
  - iOS 8, iOS 9
  - Android 5 and Android 6
  - Windows 10 (on Surface Pro 3 and Surface Pro 4)
- Common workflow across platforms
  - Relatively minor differences in user experience per platform

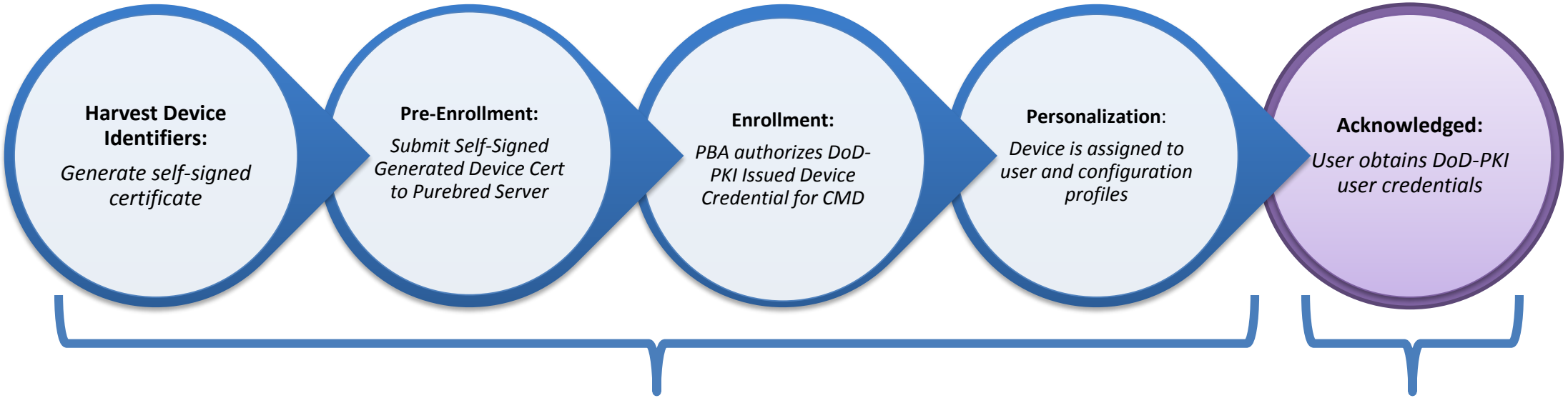
Purebred Status (continued)

- **Supports system apps, enterprise apps and third-party apps**
  - **iOS**
    - System key chain receives keys shared via configuration profile
    - Enterprise apps (DISA signed) may use a common key chain access group allowing access to keys
    - Third-party apps may receive keys as PKCS #12 files via a document provider interface
  - **Android**
    - System key chain receives keys generated and imported during enrollment
  - **Microsoft**
    - Keys generated on TPM and associated with issued certificate in CAPI
    - Have not yet built for ARM (hence no support for Windows phones yet)
  - **Blackberry**
    - Works on PRIV now (Android-based)
    - Waiting on API mods to facilitate enrollment on BB10 devices

Workflow Characteristics

- Purebred Agent provides EDIPI and two one-time password (OTP) values to enroll a device
  - First OTP associated the device with a fresh device-generated public key
  - Second OTP authorized device enrollment and provides attestation that the person performing the enrollment has visually vetted the device key
- Device provides one or two OTP values to provisions keys to a device
  - First OTP authorizes user enrollment (typically including one recovered key)
  - Second OTP authorizes recovery of additional decryption keys
- OTP values are obtained via mutually authenticated TLS sessions using PC-based browser and common access card (CAC)
  - OTP values generated per time-based OTP specification using an SP800-108 key derivation function (KDF) on a Thales hardware security module (HSM)

Purebred Workflow



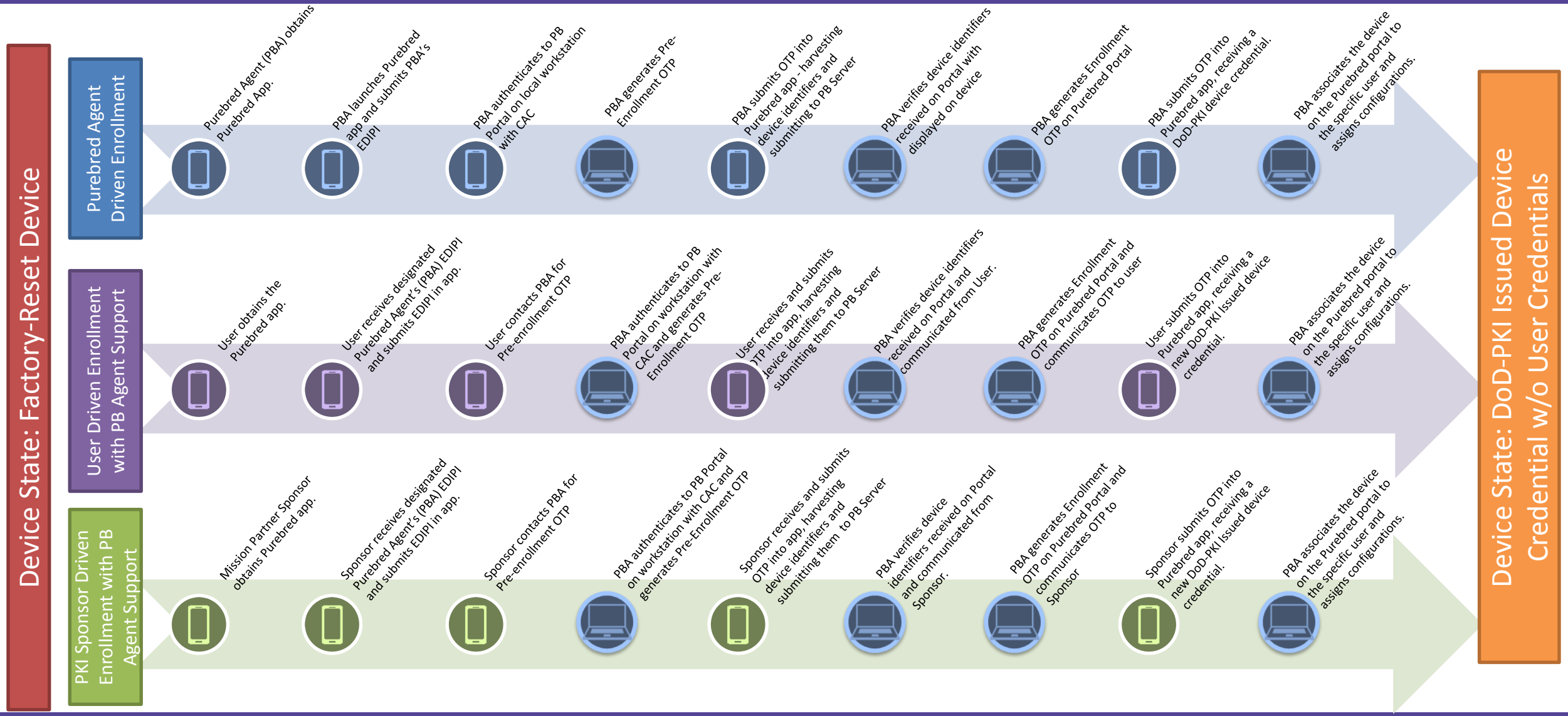
Stage 1: Obtaining a DoD-PKI Issued Device Credential
Role: Purebred Agent **OR** User or other PKI Sponsor* with remote Purebred Agent Support

Stage 2: Obtaining a DoD-PKI Issued User Credential
Role: User Only

*** An example of another PKI Sponsor filling this role could be a Telephone Control Officer (TCO)**

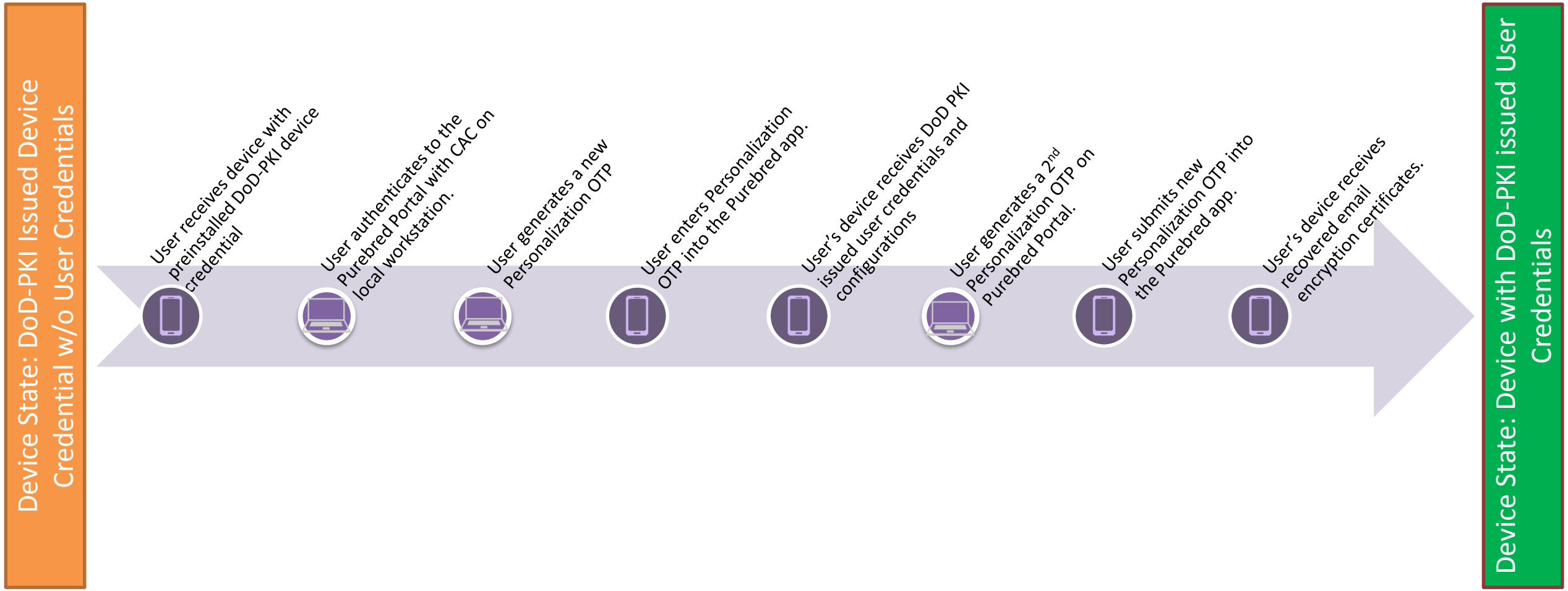
Purebred Workflow

Stage 1 - Device Enrollment



Purebred Workflow – User Enrollment

Stage 2 - Obtaining User Credentials



Using the Key Sharing Extension

- **Developers incorporate code similar to the following sample code into their application to allow users to view the Purebred Document Picker View to import keys:**

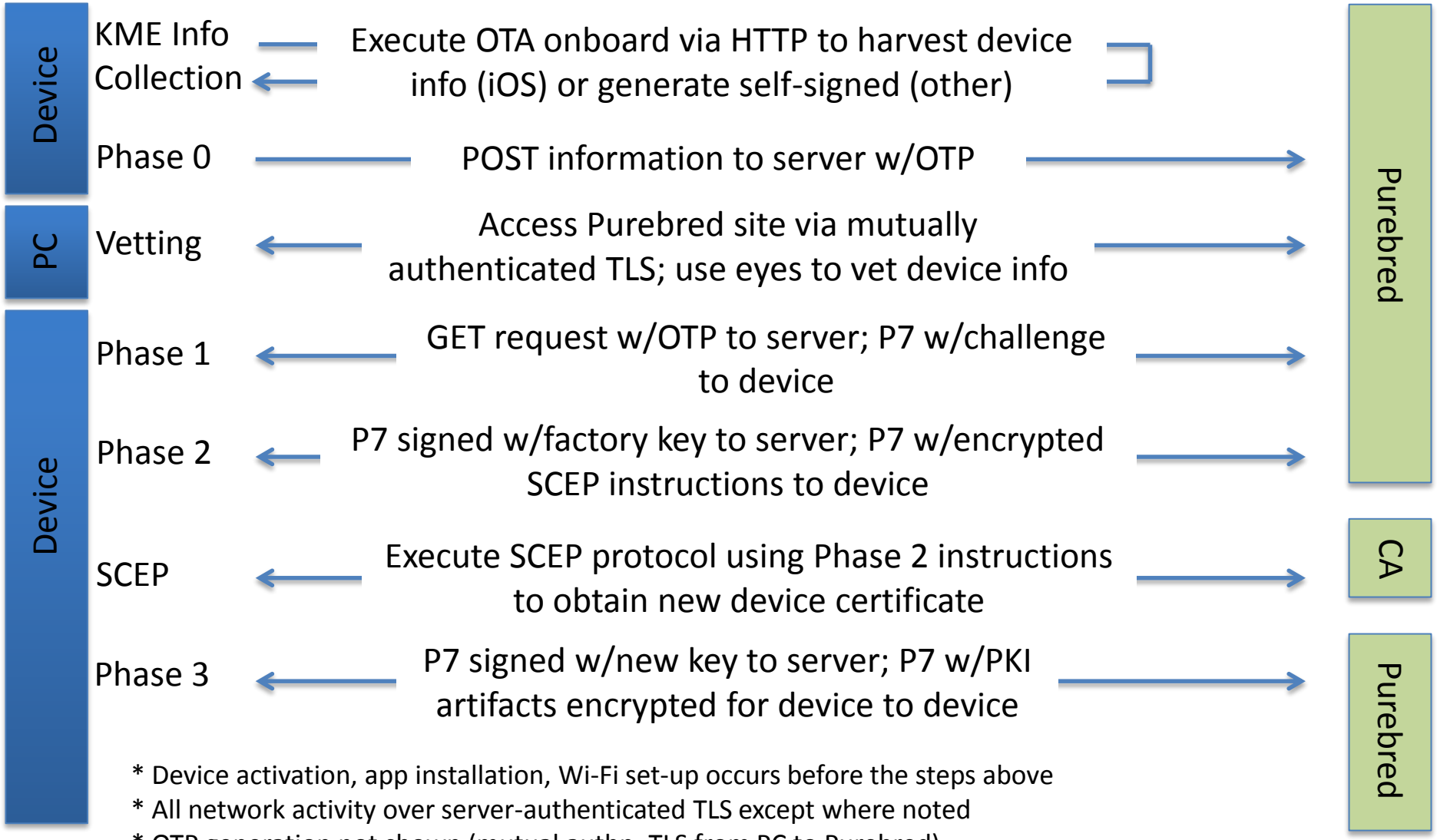
```
UIDocumentPickerViewController *documentPicker =
    [[UIDocumentPickerViewController alloc]
        initWithDocumentTypes:@[@"com.rsa.pkcs-12"]
    inMode:UIDocumentPickerModeOpen];

documentPicker.delegate = self;
documentPicker.modalPresentationStyle = UIModalPresentationFormSheet;
[self presentViewController:documentPicker
    animated:YES completion:nil];
```

- **Once imported and installed into the developer keychain, developers can build applications to enable use of these keys.**

OTA KME

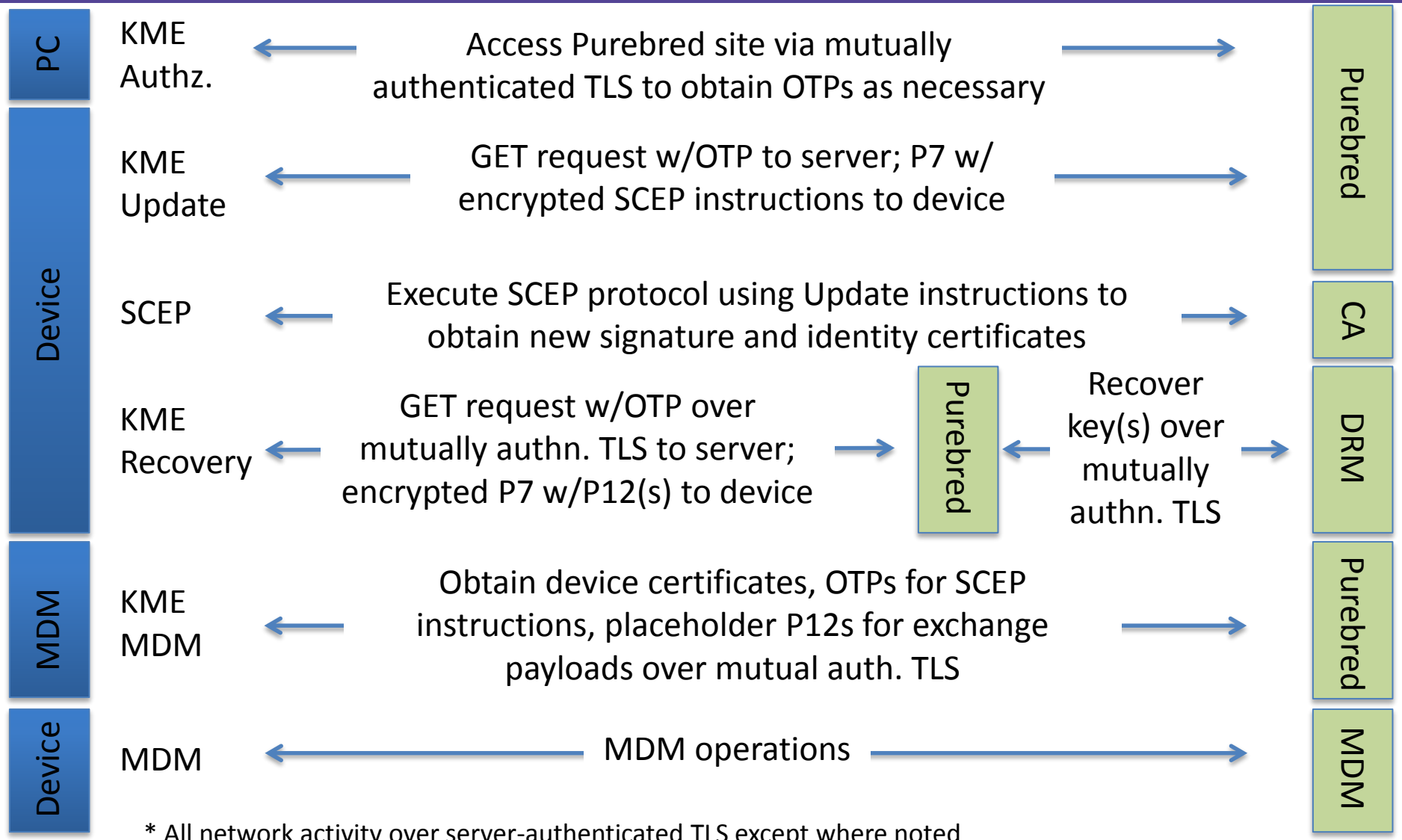
- Over-the-air Profile Delivery and Configuration Protocol w/ Key Management Extensions (OTA KME)
  - Collection of provisioning practices, device-facing web interfaces and MDM-facing web interfaces
- OTA KME aims to use the OTA protocol while establishing trust in device certificates and avoiding having users visit a provisioning facility
  - Purebred is the first implementation of OTA KME

OTA KME (Trusted Network)



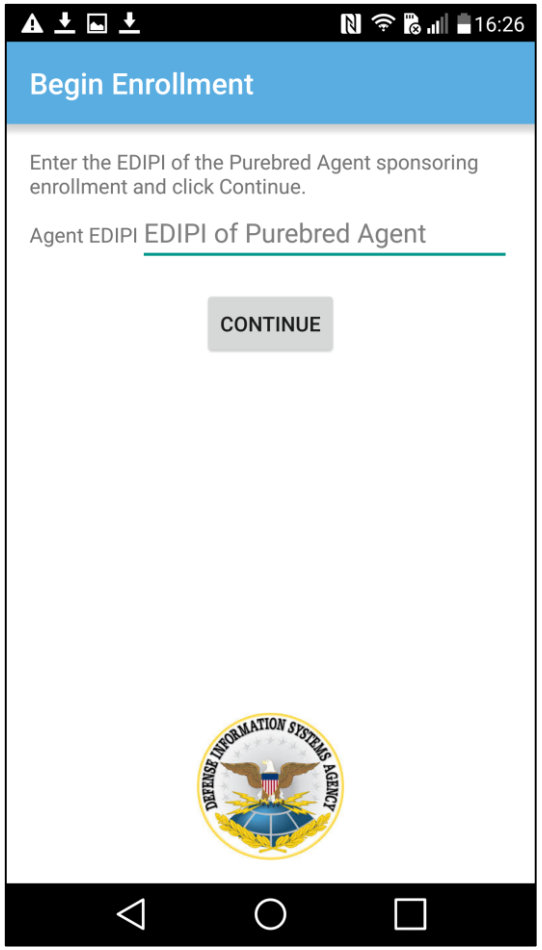
* Device activation, app installation, Wi-Fi set-up occurs before the steps above
* All network activity over server-authenticated TLS except where noted
* OTP generation not shown (mutual authn. TLS from PC to Purebred)

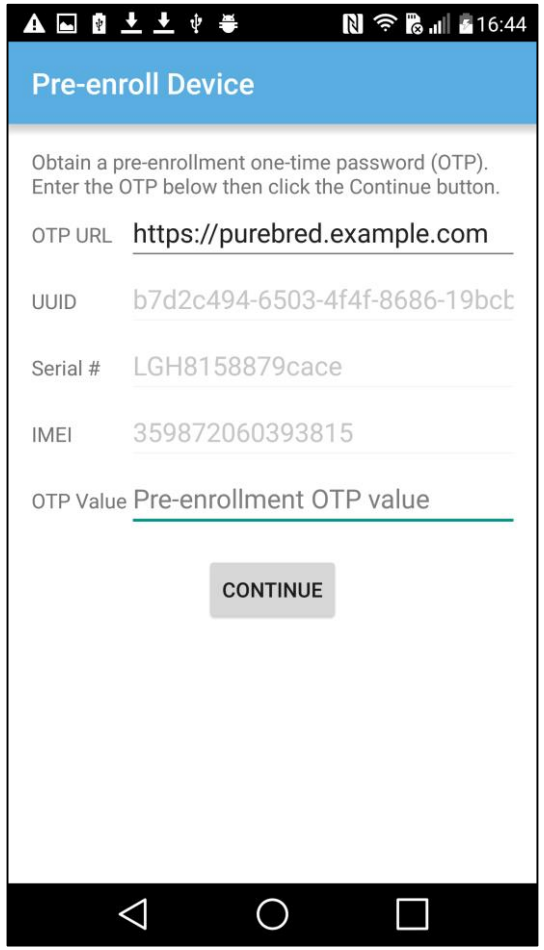
OTA KME (User Enrollment)

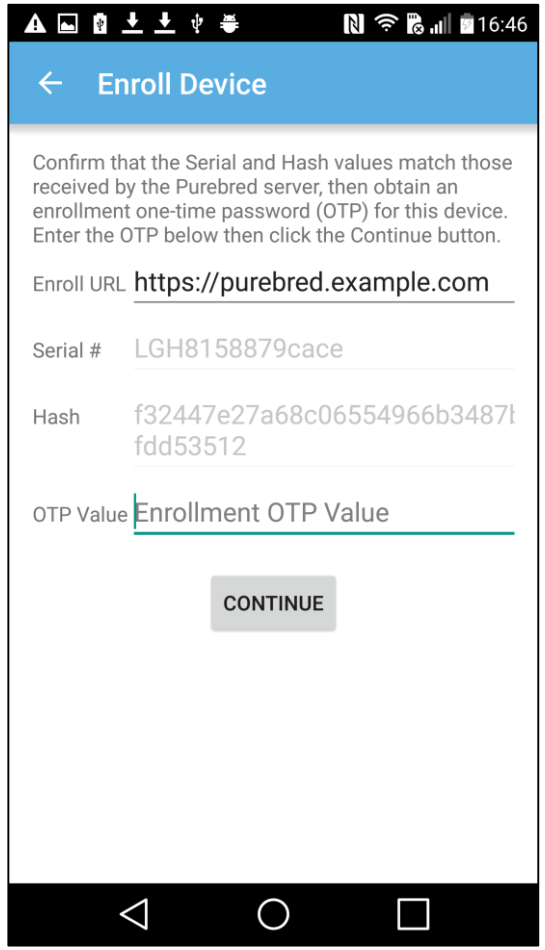


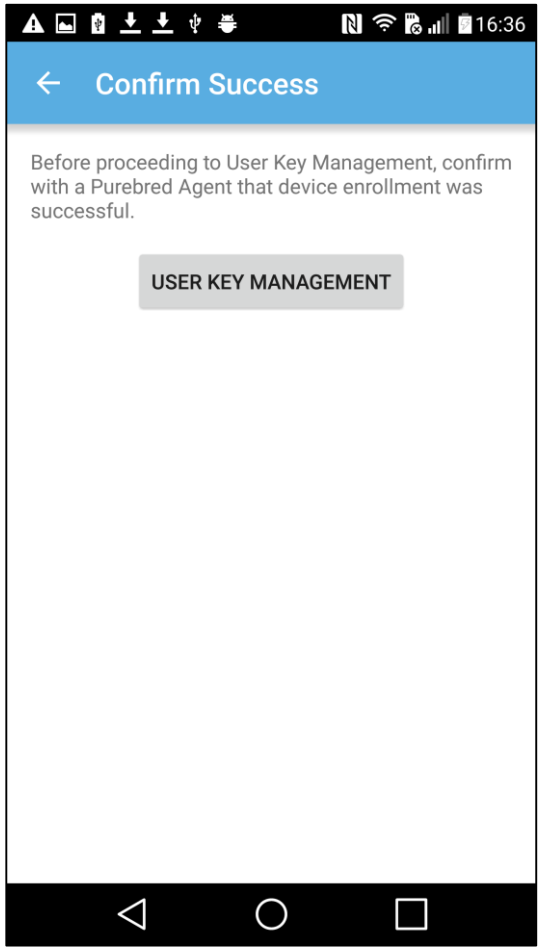
* All network activity over server-authenticated TLS except where noted

Purebred Agent Views

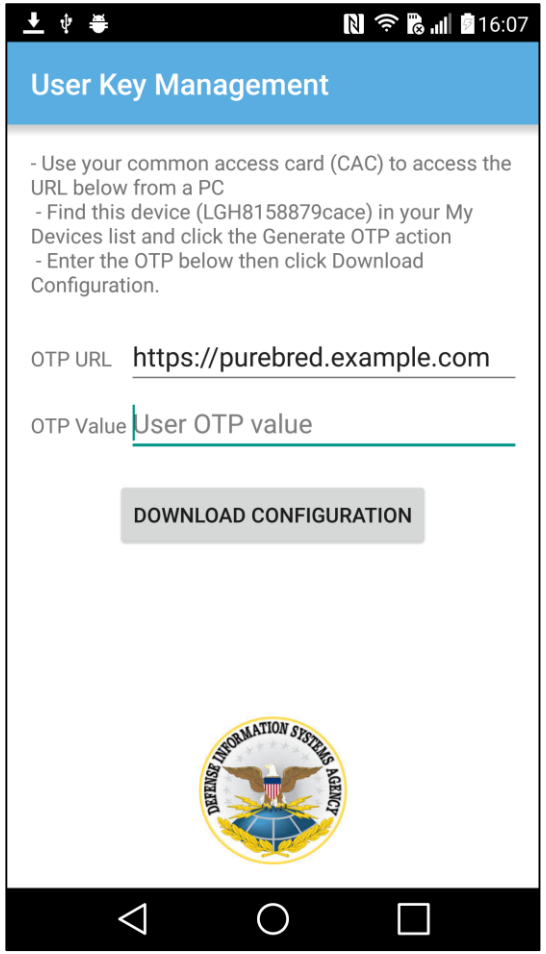


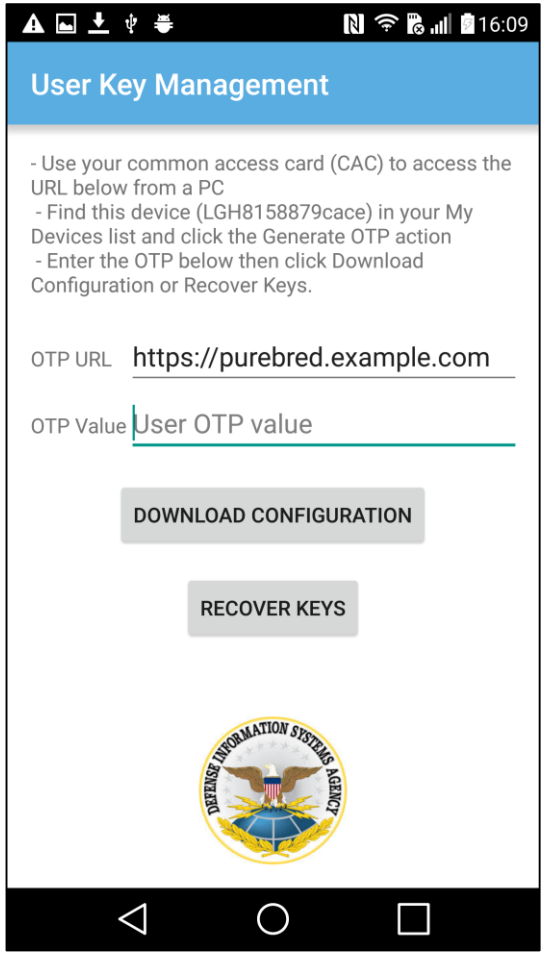






Purebred User Views





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