# Reducing Identity Theft with W3C Verifiable Credentials

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# Acknowledgements

*This work was performed in collaboration with*

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*And*

*Declan Barnes*
*University of Kent*

*And*

*Dr Manreet Nijjar*
*Truu ltd (previously Doctors Link Ltd)*

# The True Cost of Identity Theft

# *Will NEVER be known!!*

# But we have some estimates

- **173k people reported ID theft in the UK in 2016, total cost estimated at £5.4 billion**
- **16.7M victims in US in 2017 at cost of $16 billion**
- Over $107 billion in the U.S., in the past six years according to 2018 report by **Javelin Strategy & Research**

# What are Verifiable Credentials?

- Potentially long-lived electronic credentials that users store under their control and use to identify themselves whenever they wish to access electronic resources
- Contain cryptographically protected identity attributes (PII)
- Used as Authorisation tokens in Attribute Based Access Control (ABAC) systems

# Why are VCs needed?

- Because most web sites today are not able to verify a user's identity attributes
  - They either trust the user, or do not offer the online service
- Because today's federated identity management infrastructures have a number of limitations that VCs address
- Because Identity Theft is a serious problem

# Signing an Amnesty Petition – Are you under 18?

amnesty.org.uk/actions/protect-journalists-exposed-abuse-gay-men-chechnya-russia

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Amnesty International UK

## PROTECT JOURNALISTS WHO REVEALED ABUSE OF GAY MEN IN CHECHNYA

**We're demanding that Russian authorities:**

- Investigate the threats to Novaya Gazeta and Ekho Moskvy staff, in accordance with the Russian Criminal Code regarding 'obstruction of lawful activities of journalists'
- Publicly condemn all threats and violence towards journalists, and bring those responsible to account
- Guarantee freedom of expression and protect journalists, in accordance with the European Convention on Human Rights.

First Name *

Surname *

Email *

Mobile number (optional)

Enter your mobile number to receive actions like this by text. You can unsubscribe at anytime. We will also call you about other ways to support our work.

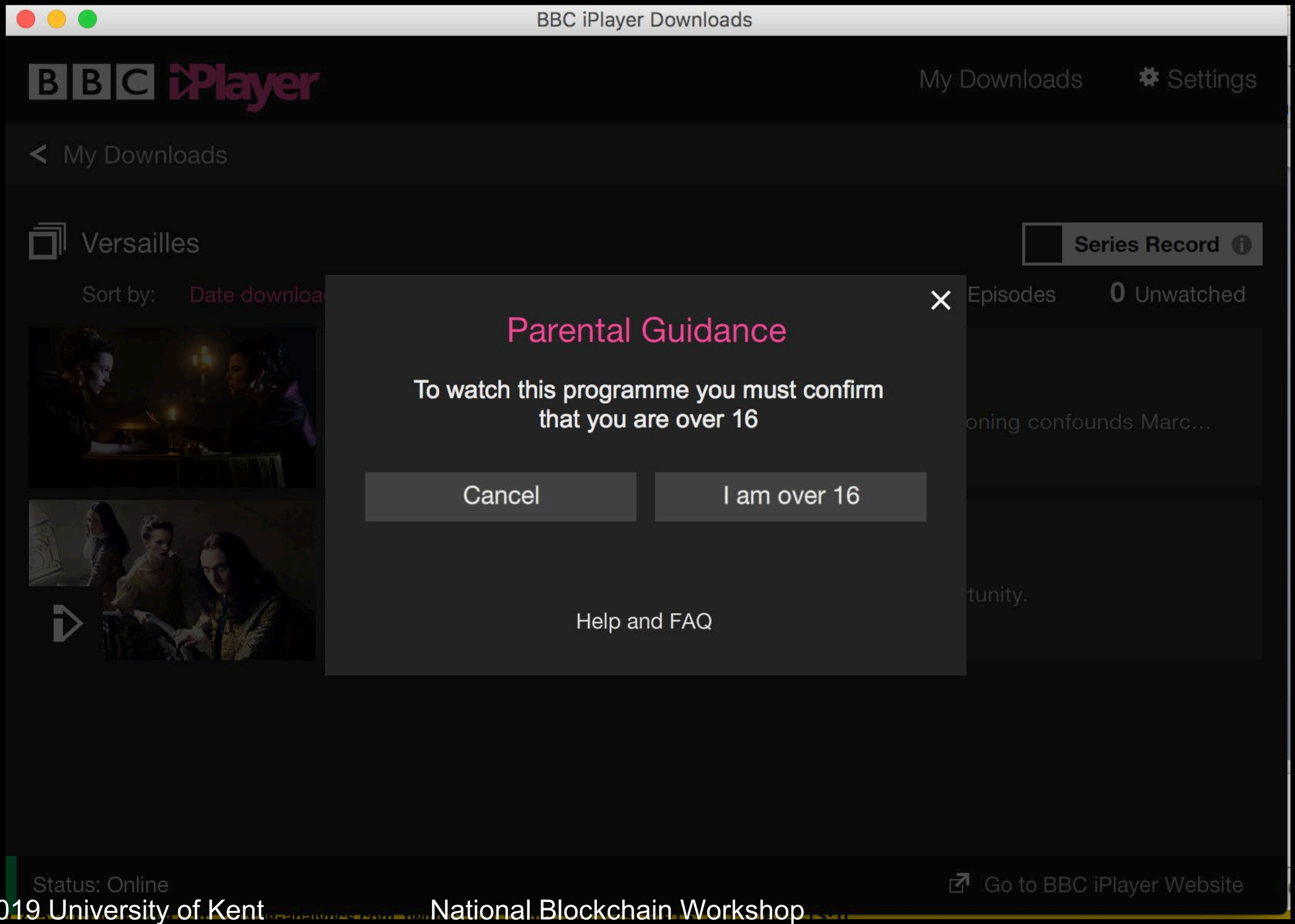
Are you under 18? * No Yes

Read email and SMS terms and conditions

I would like to receive email updates about Amnesty's work. Unticking will stop all existing and future communications.

SUBMIT

# BBC TV – Parental Guidance



# Purchase a reduced price train ticket with a Railcard

Firefox File Edit View History Bookmarks Tools Window Help 100% Sat 29 Apr 14:03 D.W.Chadwick

IBM and Se | File your Cc | pdac-w10- | Duolingo | ¡Hola, Barc | Greenpeace | C | Cybersecur | YHA Borth | UCU - Logi | Cheap T | FIDO - Kup

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Today Tomorrow Same day Next day

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Leaving at

Leaving at

14 15

1 adult
No railcards

Adults (16+) 1

Child (5-15) 0

Please select...

ANNUAL GOLD CARD
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DALES RAILCARD
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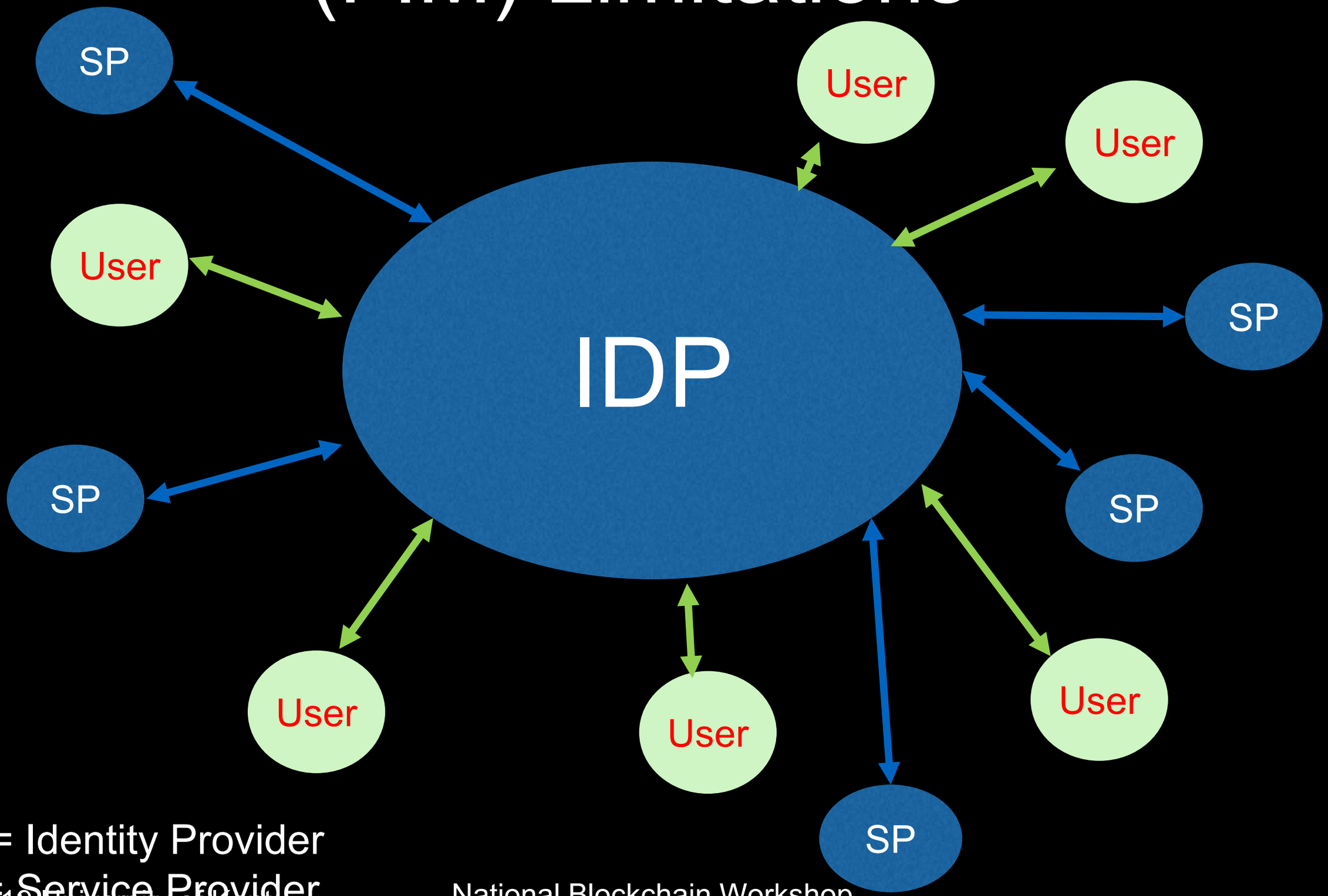
# Federated Identity Management (FIM) Limitations




IDP = Identity Provider
SP = Service Provider

# FIM Limitations

- “Insufficient attribute release by IdPs is considered by user communities as the major problem today in the eduGAIN space” [1].

[1] EU AARC Project Deliverable DNA2.4 “Training Material Targeted at Identity Providers” 27 July 2016. Available from https://aarc-project.eu/wp-content/uploads/2016/07/AARC-DNA2.4.pdf

# FIM Limitations

- Trust model is wrong: IdPs have to trust SPs to keep user's attributes private
  - IdPs are often unwilling to release some of the user's identity attributes to any SP
  - IdPs are not willing to release any of the user's attributes to most SPs (since they are not in the IdP's federation)

# FIM Limitations

- SPs may require attributes from multiple authorities (Attribute Aggregation)
  - Some do this by assigning a globally unique ID to the user, which provides a privacy invasive correlating handle
- IdP sends all user's attributes at login before service is chosen so does not provide Least Privileges
- Susceptible to phishing attacks by redirection to fraudulent IdP

# Compare FIM assertions to Plastic Cards, Passports etc.

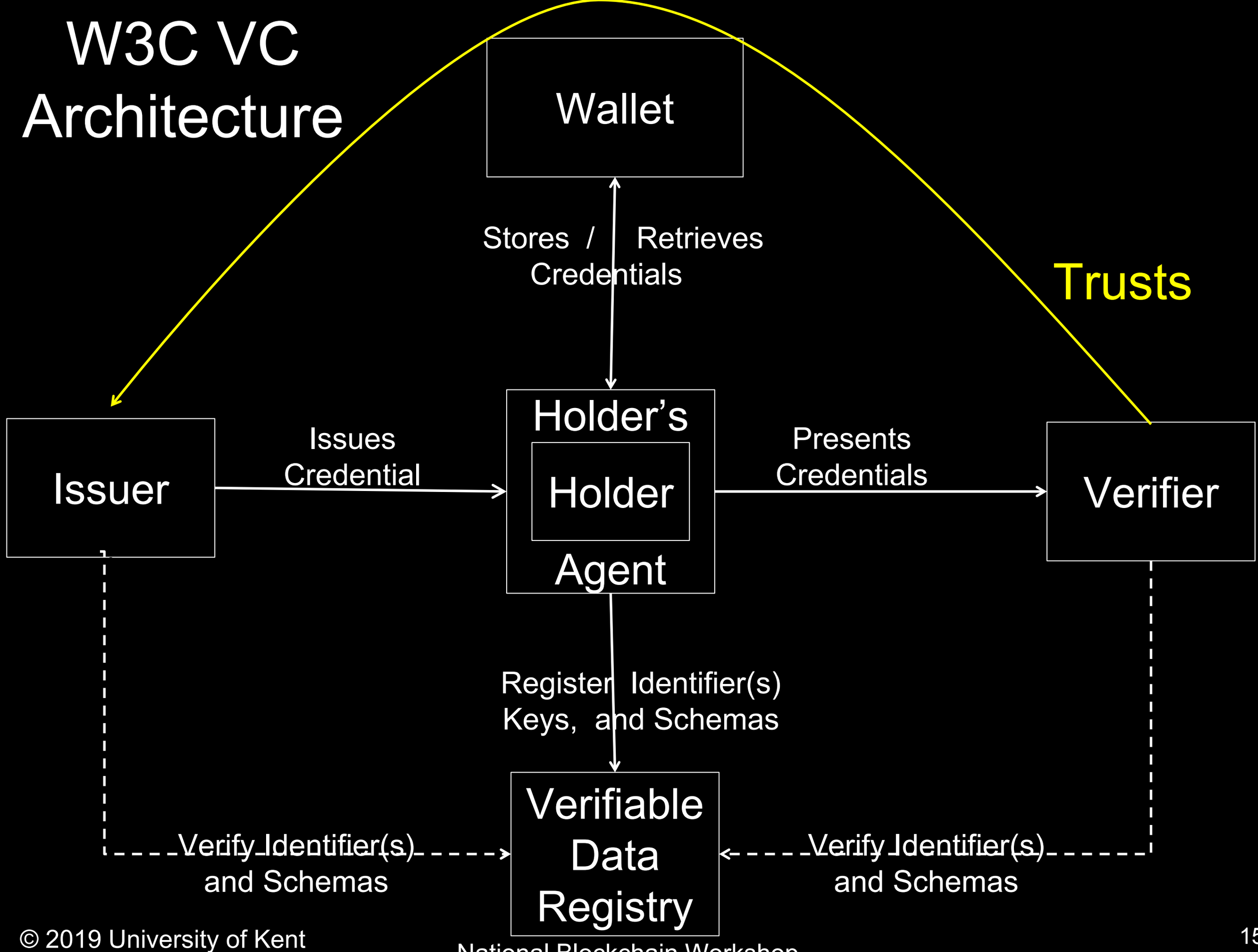
- Users can show their credentials to any SPs that ask for them, without the issuer being aware of this, or able to stop it
- Users can aggregate these credentials as required by the SPs
- Users can ask issuers to revoke their credentials on demand

- USERS ARE IN CONTROL

➢ Verifiable Credentials are the electronic equivalent of today's physical credentials, only better

  - More secure, more privacy protecting

# W3C VC Architecture



# Verifiable Credentials Standardisation

- W3C VC Working Group only tasked with standardizing a data model for VCs
- Has just finished work and Proposed Recommendation published in September 2019
- Protocols are out of scope, but Credentials Community Group may now incubate them

# Fast Identity Online - FIDO

- The FIDO Alliance originally developed the original FIDO specifications for strong authentication in 2014
- Then took them to W3C for standardization, which published the Web Authentication Recommendation in 2019 (FIDO2)
- Uses asymmetric encryption, with a unique key pair created for every web site the user visits
- Two original FIDO specifications merged into WebAuthn
  - UAF: Universal Authentication Framework for password-less authentication from FIDO enabled smart devices
  - U2F:Universal Second Factor protocol (U2F) for two factor authentication using a small hardware token to accompany a non-FIDO smart device having a FIDO compliant web browser

# FIDO UAF Architecture

TLS

User's Browser

UAF Protocol

Web Site

Service Provider

FIDO Client

FIDO Server

Public Key DB

Authenticator Specific Module API

FIDO Authenticator

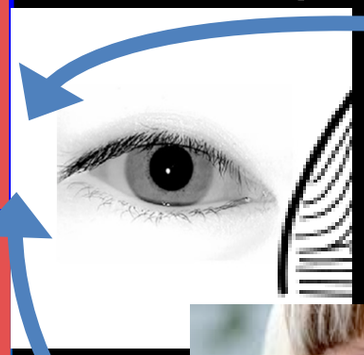
Authn Keys

Attestation Key

Certify Compliance

FIDO Metadata Service

Trusted Authenticators + Attestation Certs (out of band)



PIN

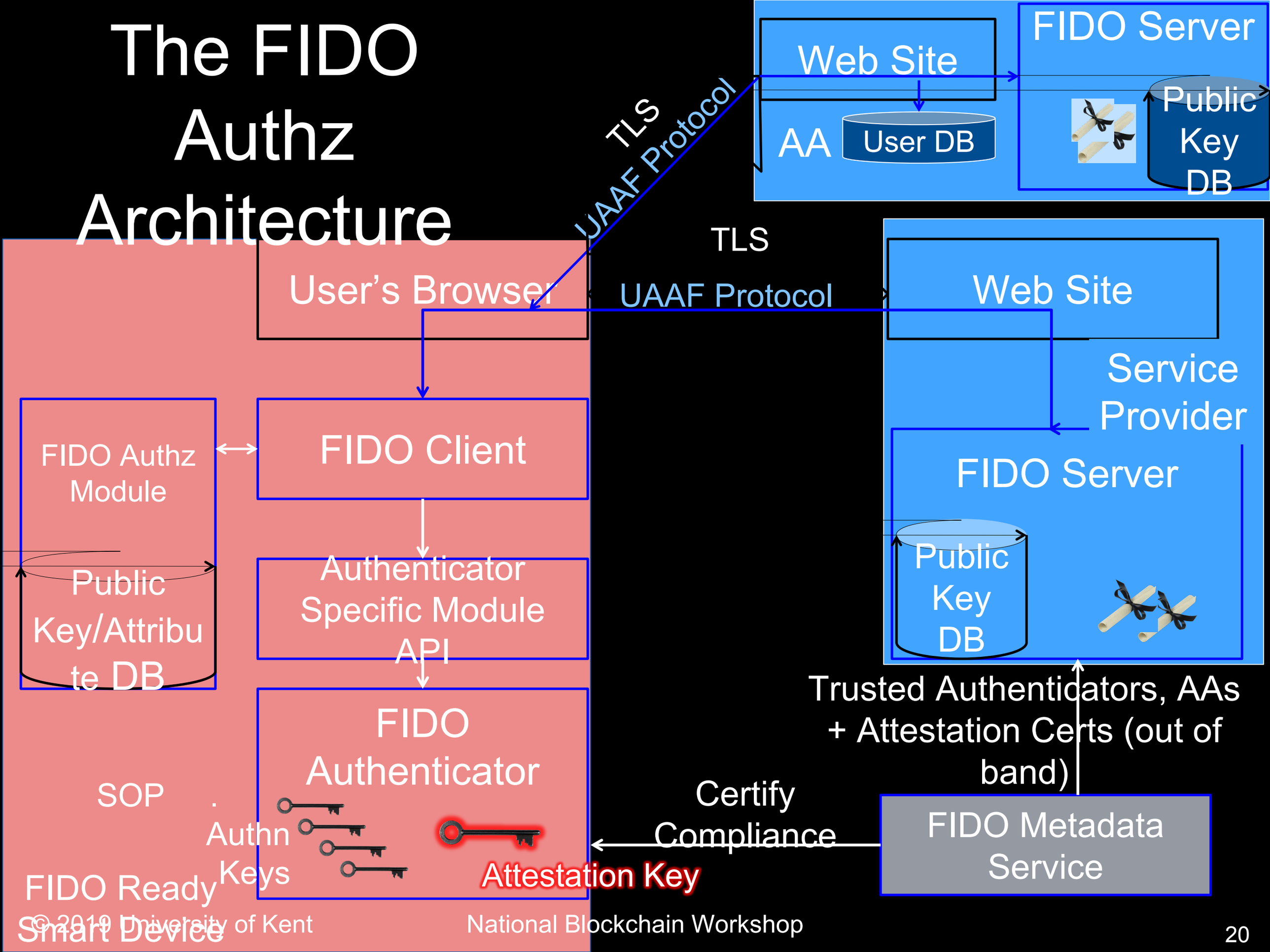
Device Authentication Mechanism

FIDO Ready Smart Device

# BUT…

- FIDO only provides strong authentication
- It does not identify the user
- It does not provide authorisation
  - which are the main goals of verifiable credentials
- So… we devised an authorisation enhancement for FIDO/FIDO2, that conforms to the W3C verifiable credentials model

# The FIDO Authz Architecture



# Universal Authentication and Authorisation Framework (UAAF) Protocol

1. User registers her FIDO keys at her IdPs and consents to her attributes being released as VCs

2. User accesses a Site (SP), asks to access a protected resource, and SP sends its identification policy (in DNF or CNF) to the device

3. Device checks if user has/can get VCs conforming to the ID policy, and user chooses which VCs to use

4. Device requests VCs from her AAs

5. Device stores VCs for subsequent use

6. Device sends VCs to SP

7. SP grants user access to resource

# Security and Privacy Benefits

- Not susceptible to phishing attacks
- Protects against Identity Theft with cryptographic credentials
- Does not need user passwords for login
- Provides 2 factor Authn (FIDO key and Biometric/PIN to access it)
- Provides Least Privileges by only releasing attributes that are needed for each transaction
- Provides Privacy Protection and aids compliance with GDPR
  - User authenticated by site specific public key only

# Compliance with GDPR

- Makes SP compliance easier
- 6(1)(a) – Data subject has given consent to both IdP and SP
- 7(1) – Demonstrate consent
- 6(1)(b) – Processing is necessary for the performance of a contract with the data subject
- 5(1)(c) – Adequate, relevant and limited to what is necessary in relation to the purposes for which they are processed ('data minimisation')
- 5(1)(d) – Accurate and up to date
- 5(1) (f) – Processed in a manner that ensures appropriate security of the personal data
- 11 – Do not require the identification of a data subject

# NHS Use Case

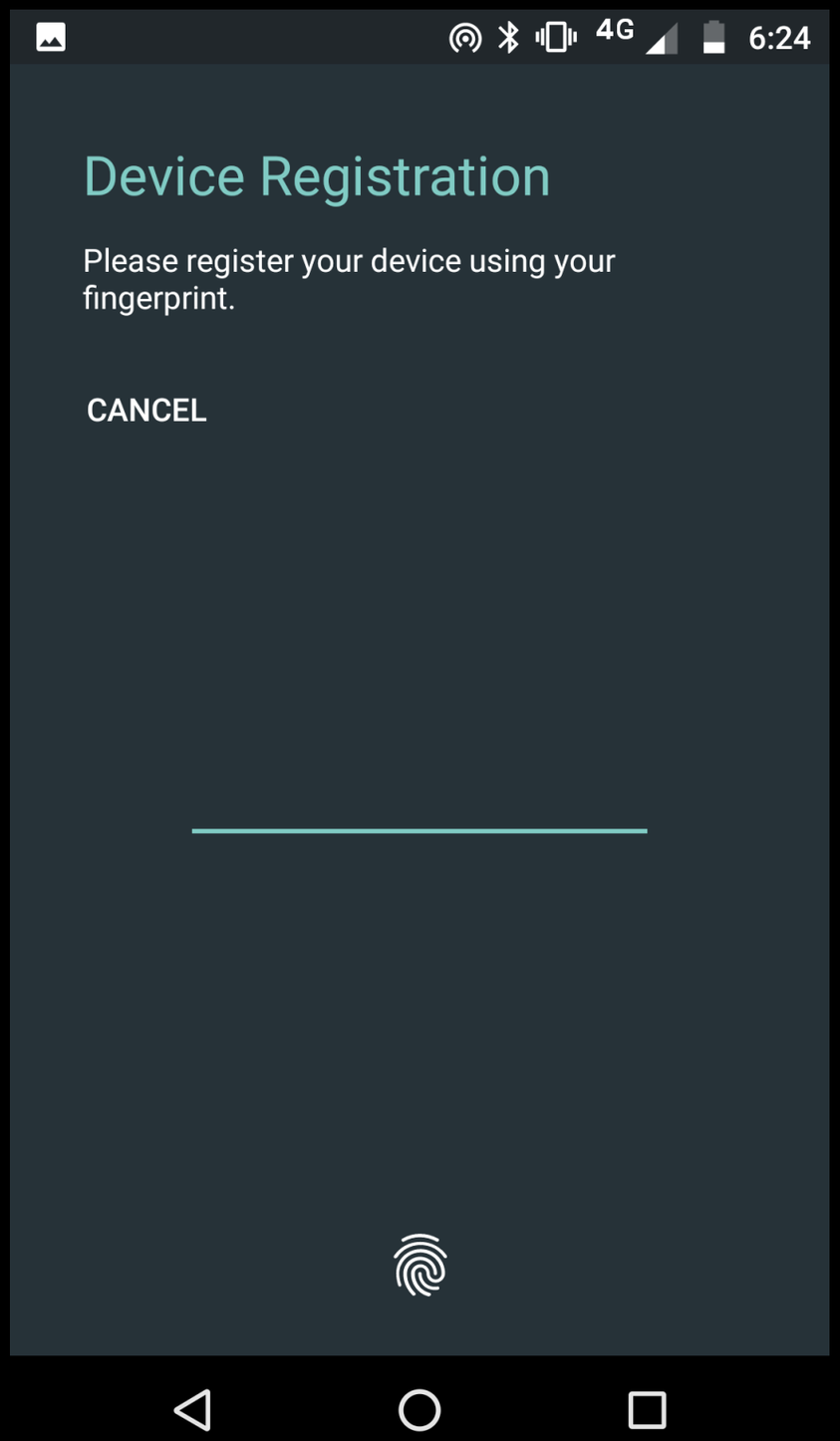
Missed GP and hospital appointments cost the English NHS nearly £1bn a year in 2015. Missed GP appointments alone cost £216M in 2018.

Repeat prescriptions can be time consuming requiring either two trips to the hospital or a long wait time

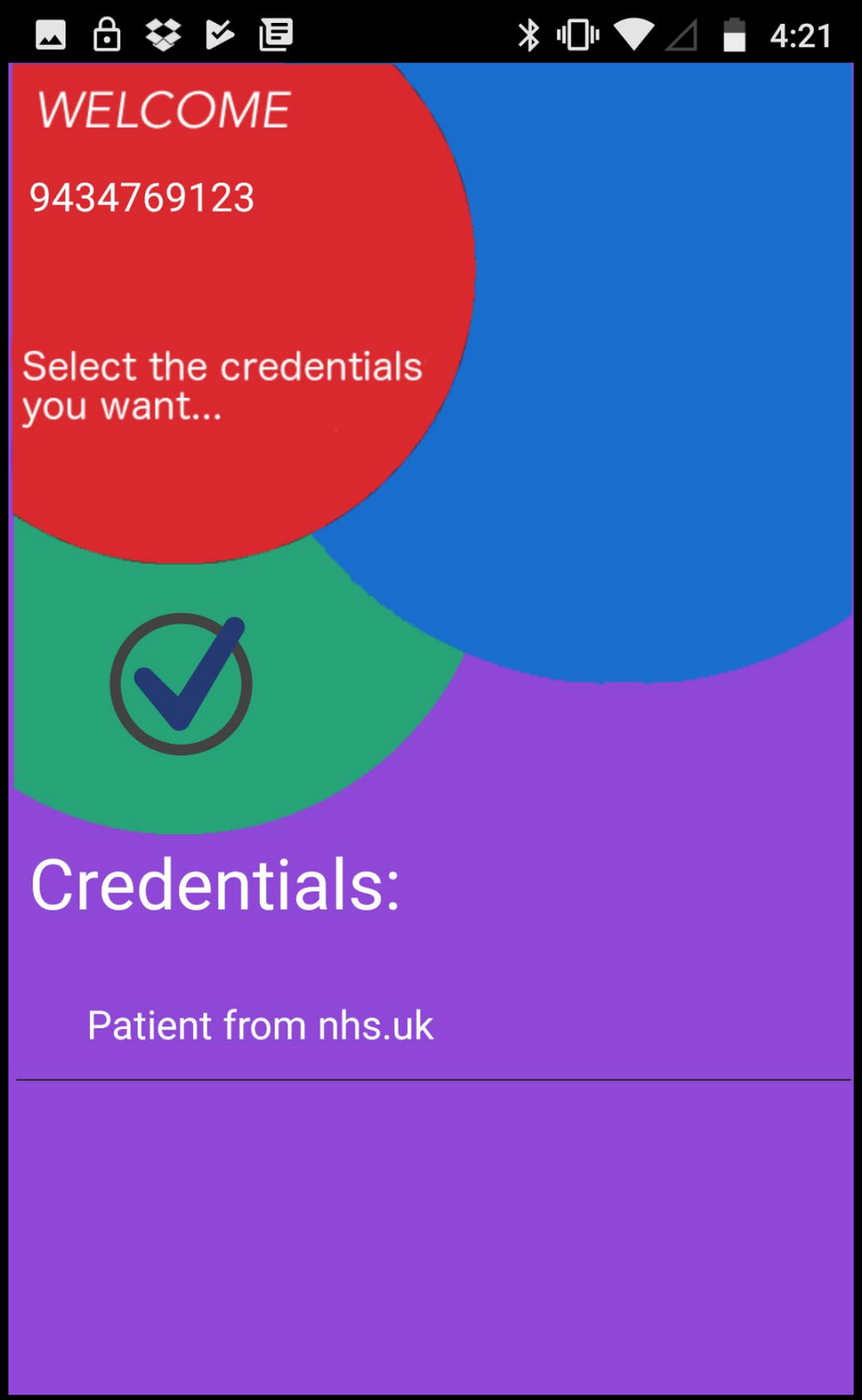
We developed an Android App to allow a patient to book and cancel a hospital appointment and to order repeat prescriptions

# Registration Step 1. User registers with NHS Attribute Authority (using OTP posted to user's home address)

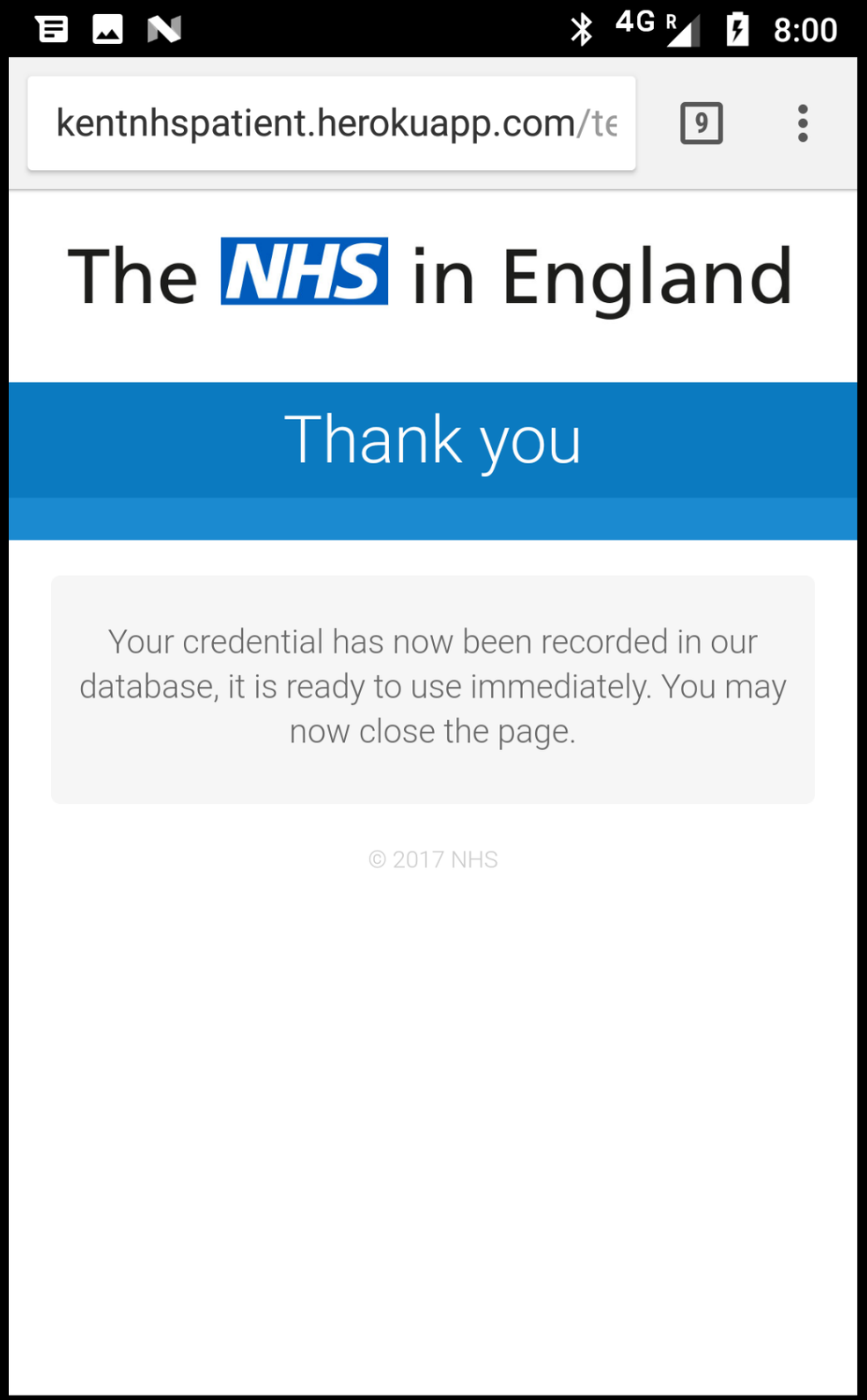
# Registration Step 2. User authenticates to phone by swiping finger, phone creates a new key pair and sends public key to the NHS AA



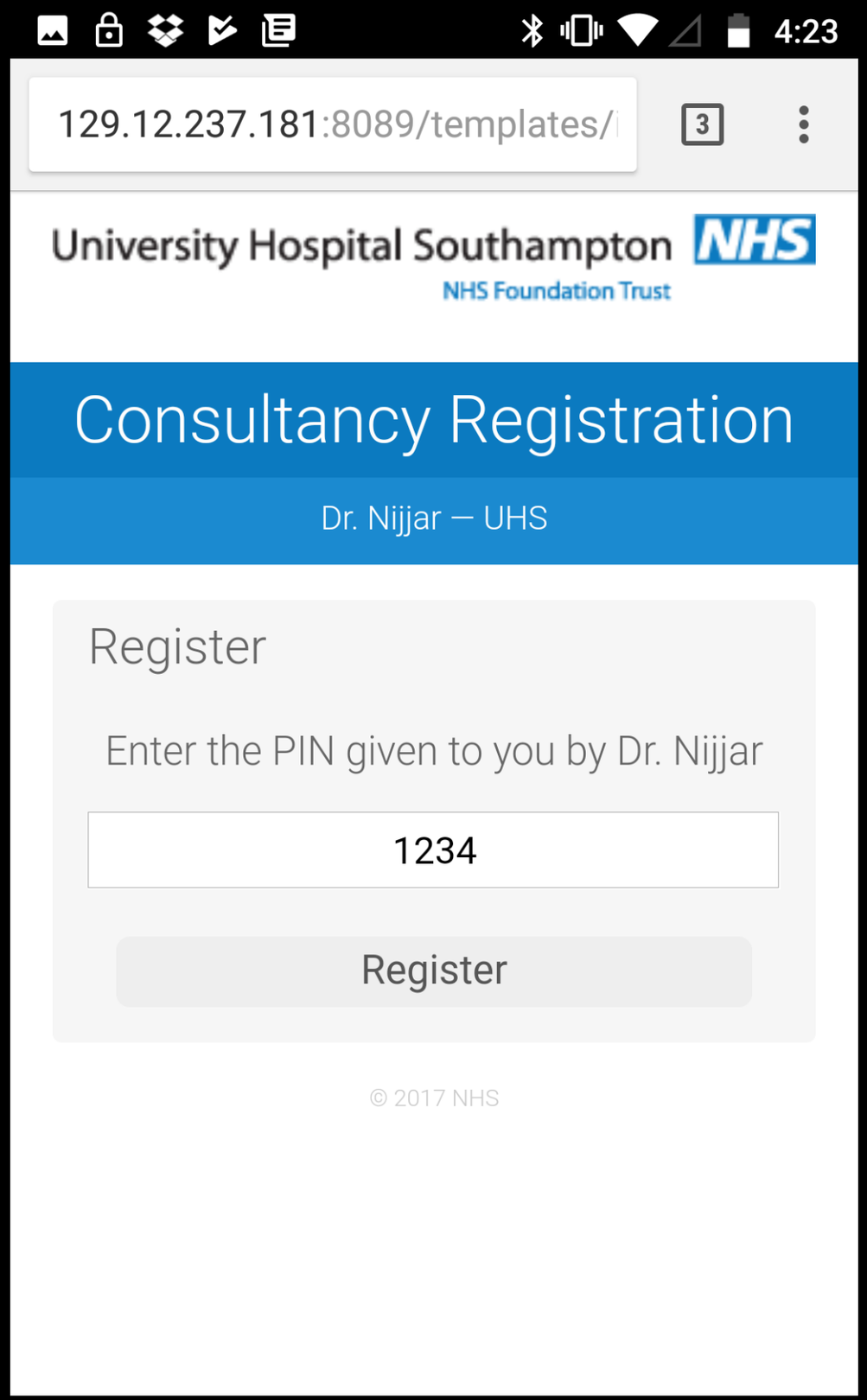
# Registration Step 3. NHS asks user which credentials he wants. User chooses and NHS remembers (in this case there is no choice)



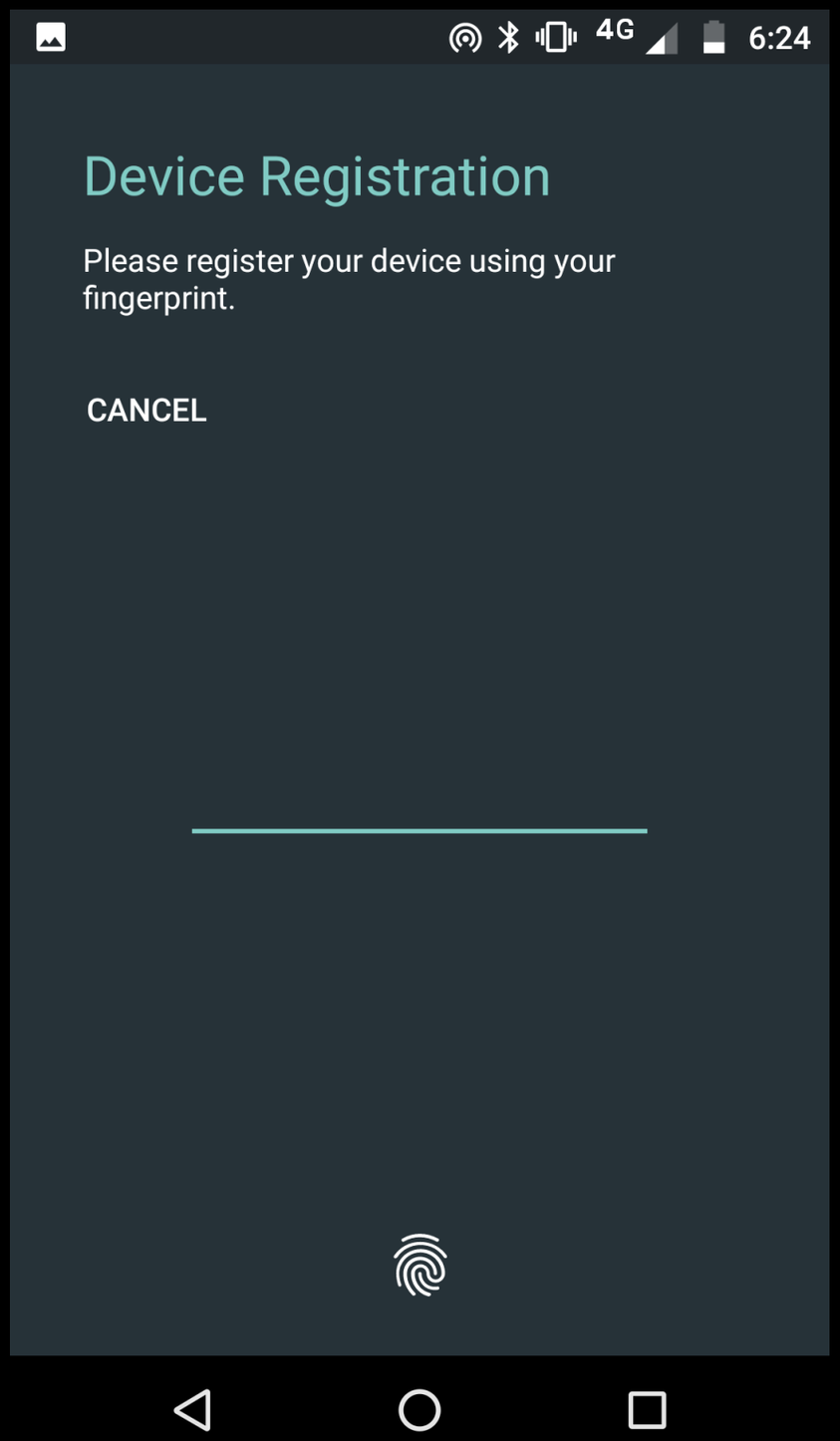
# Registration Step 4. NHS confirms recording of credential



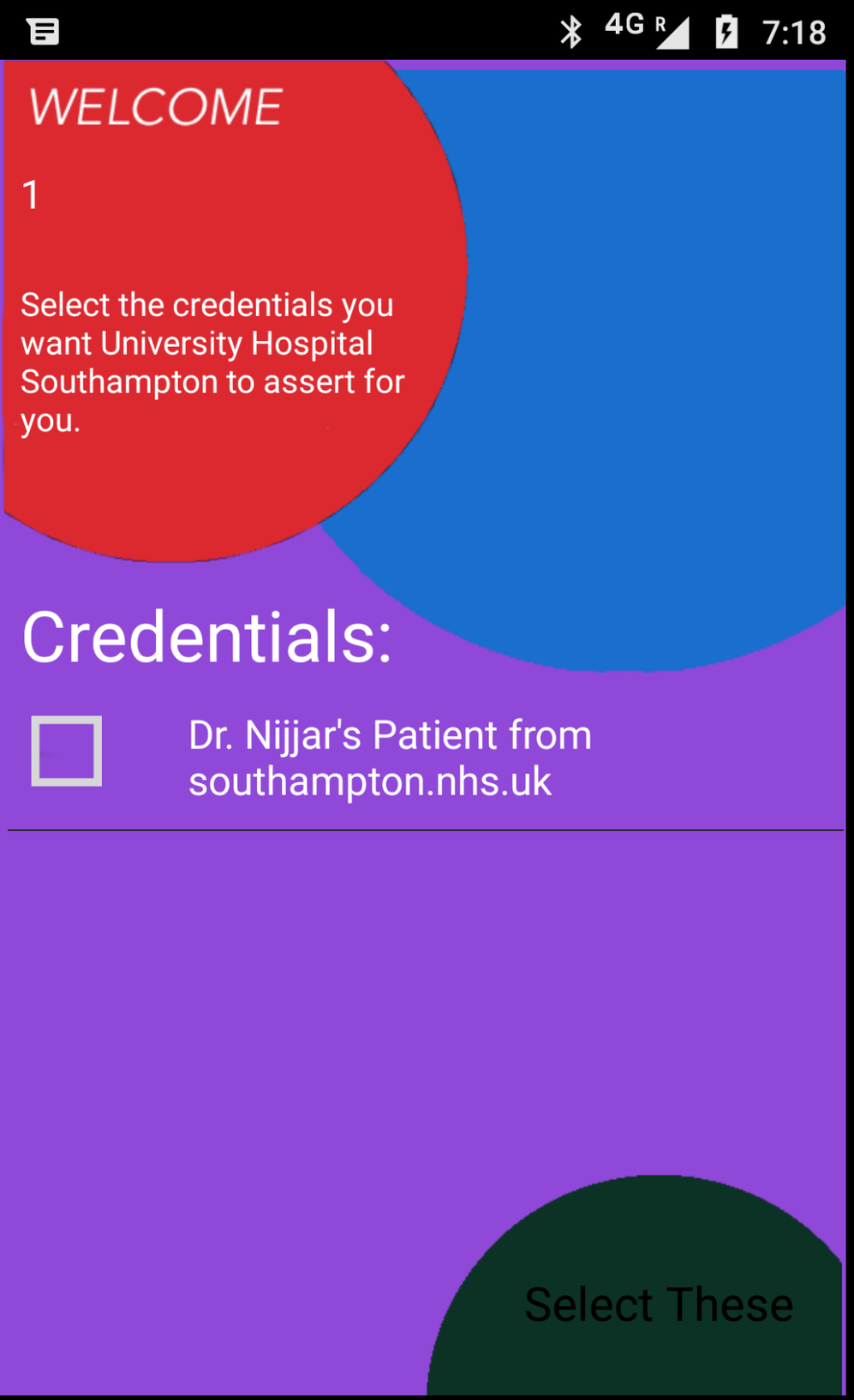
# Registration Step 5. The user goes to the hospital consultant and registers to use the consultant's service



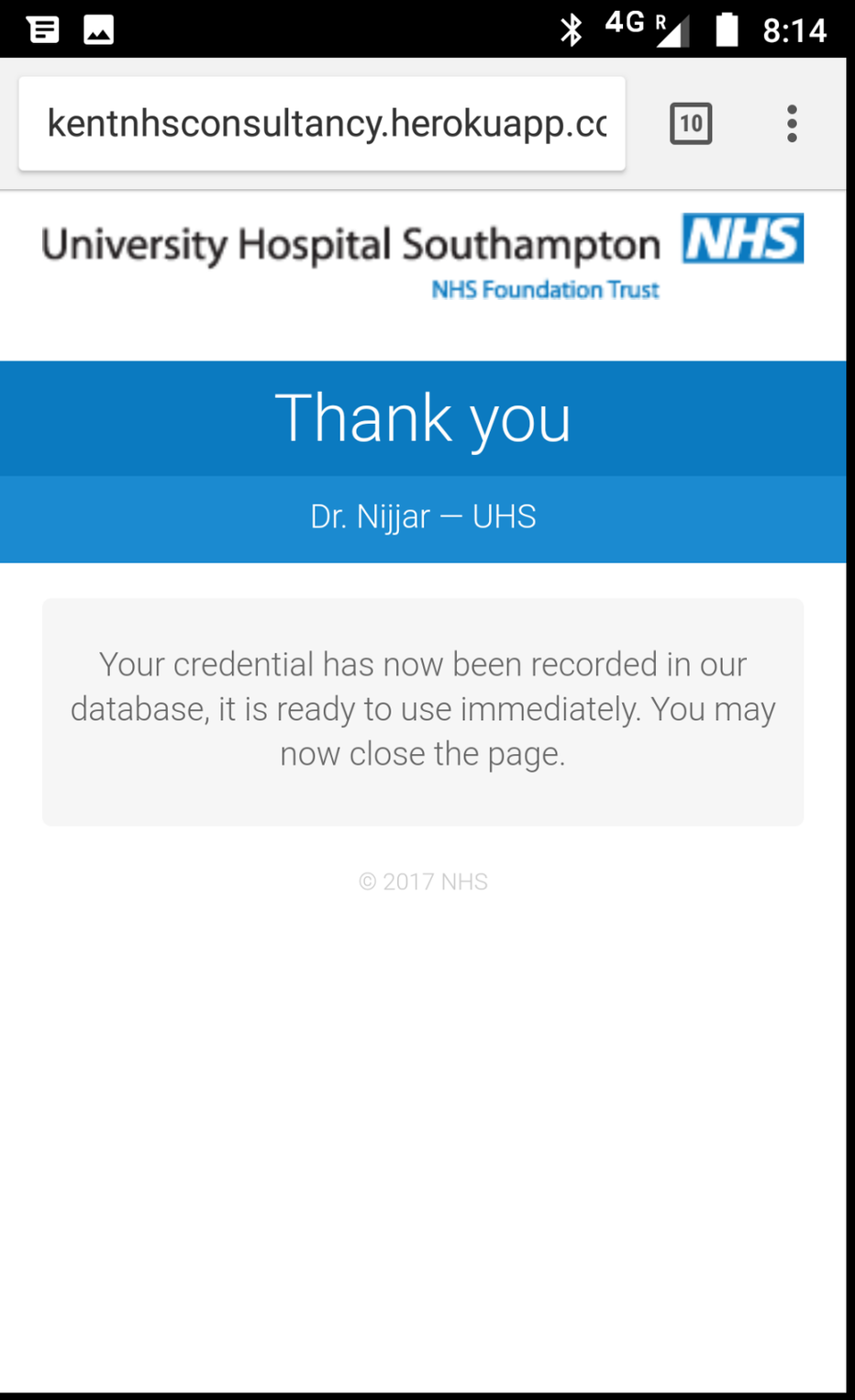
# Registration Step 6. User authenticates to phone by swiping finger, phone creates a new key pair and sends public key to the Consultant's AA




# Registration Step 7. Consultant's AA asks user to select credentials to be asserted. User chooses and AA remembers choice (in this case no choice)

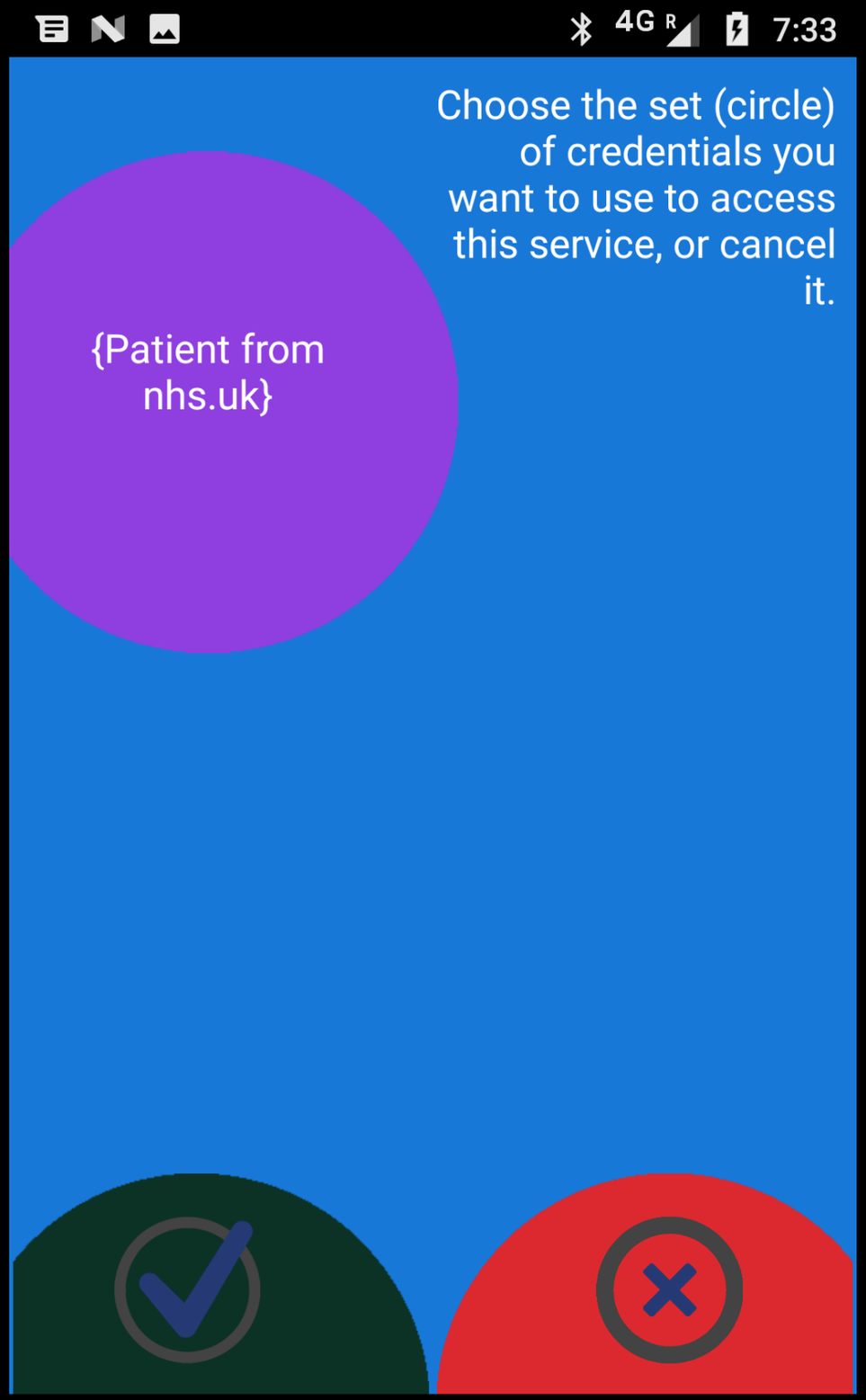


# Registration Step 8. Hospital confirms recording of credential

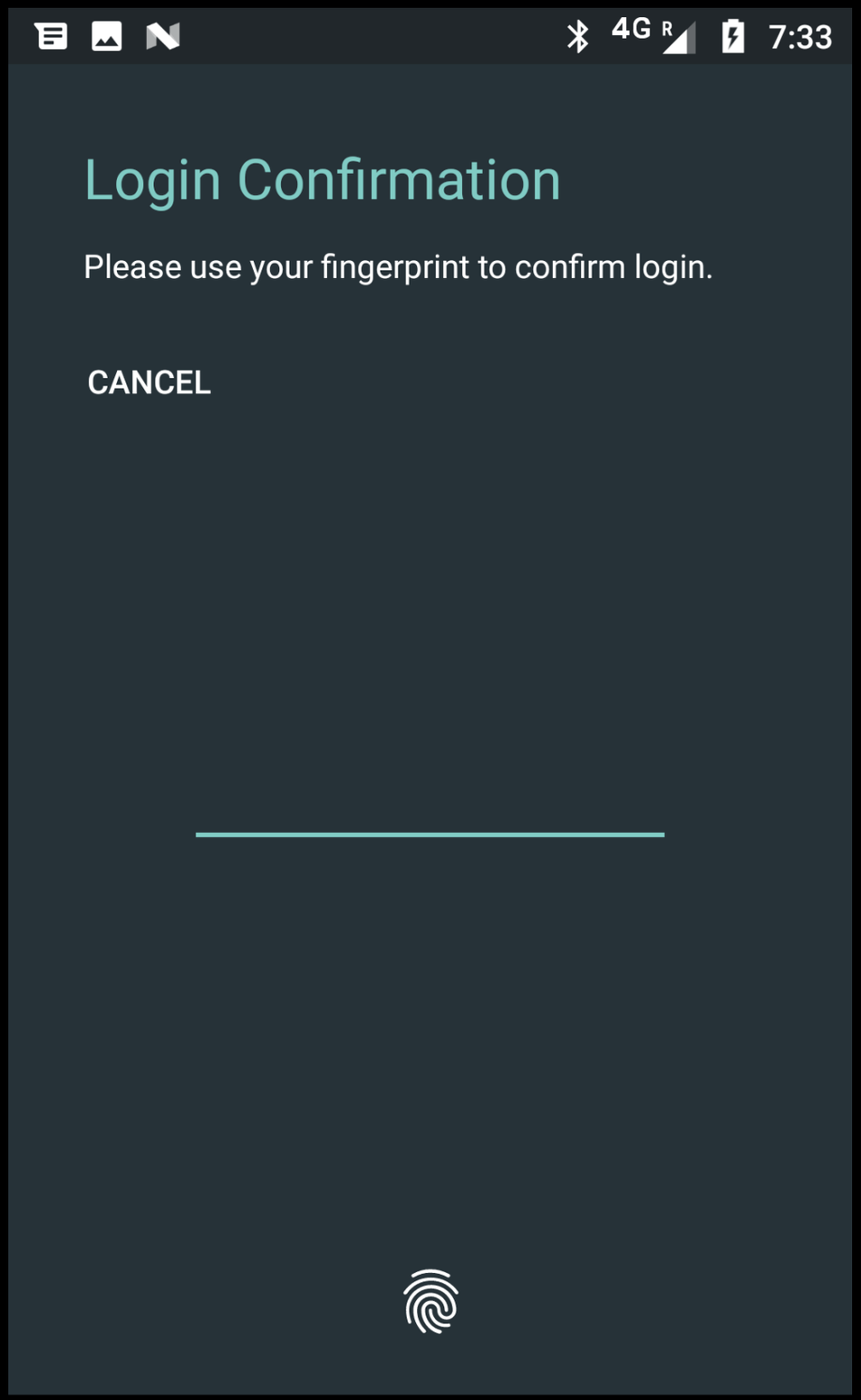


# Use Step 1. User visits the hospital web site and signs in as an NHS patient

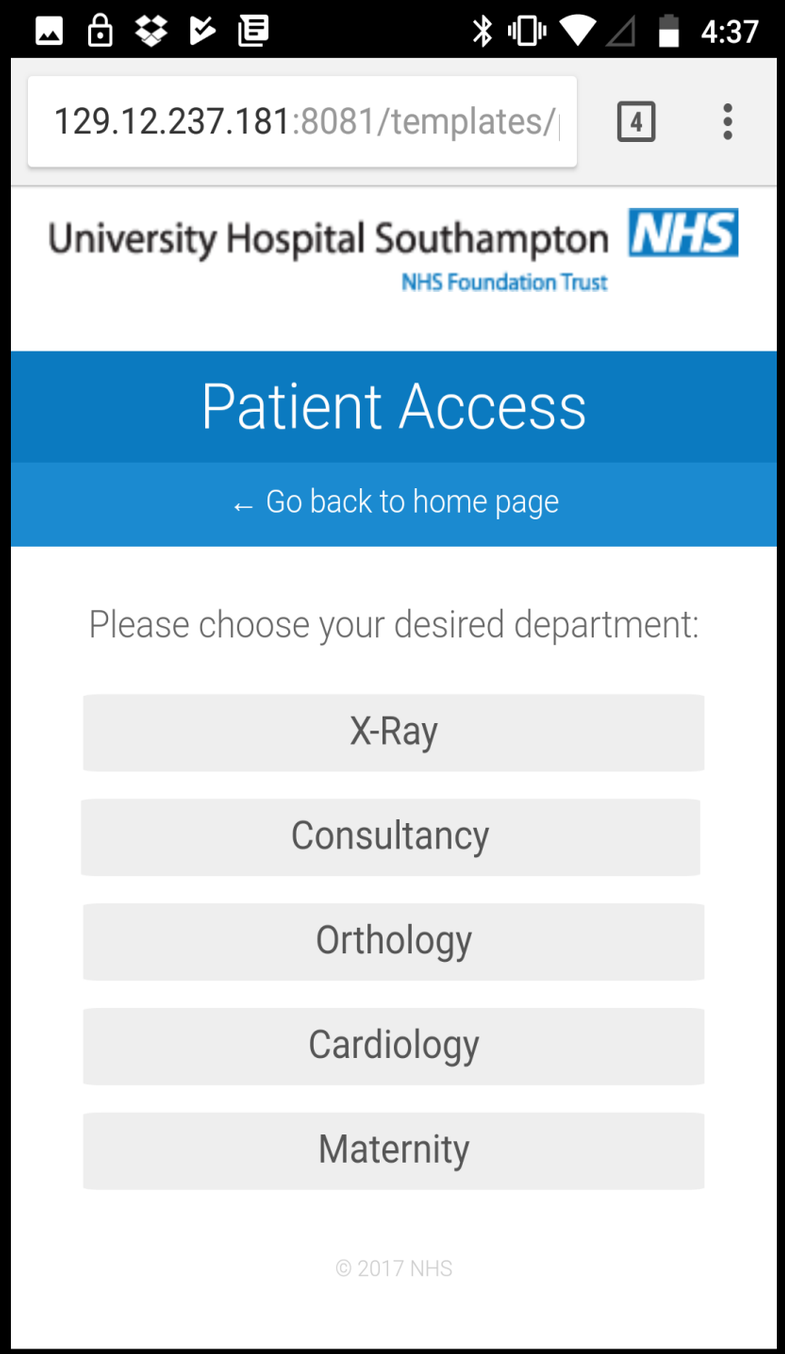
# Use Step 2. Hospital sends its authz policy to the phone. Device matches policy against user's VCs and asks user to choose (no choice in this case)



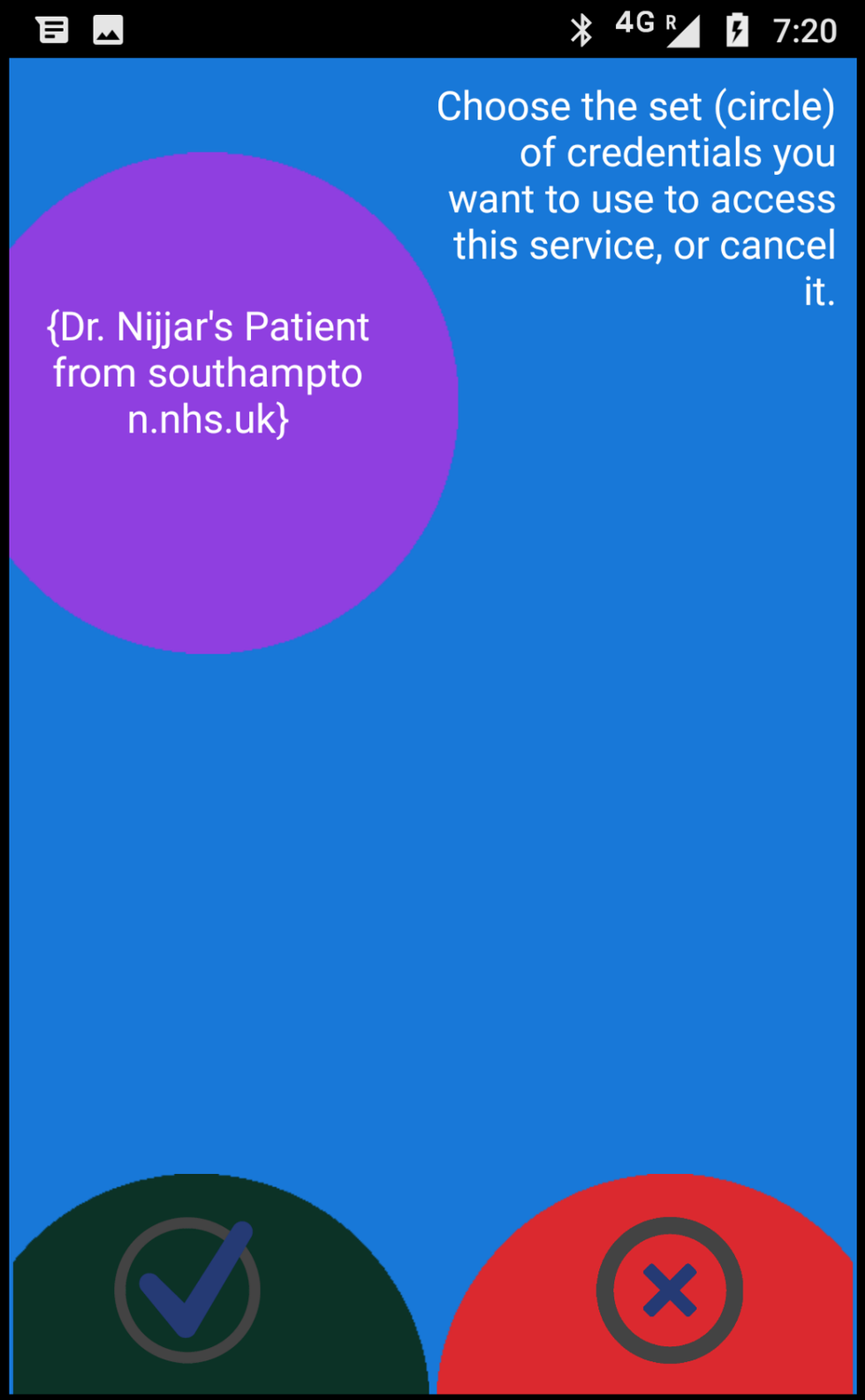
# Use Step 3. User confirms selection with fingerprint



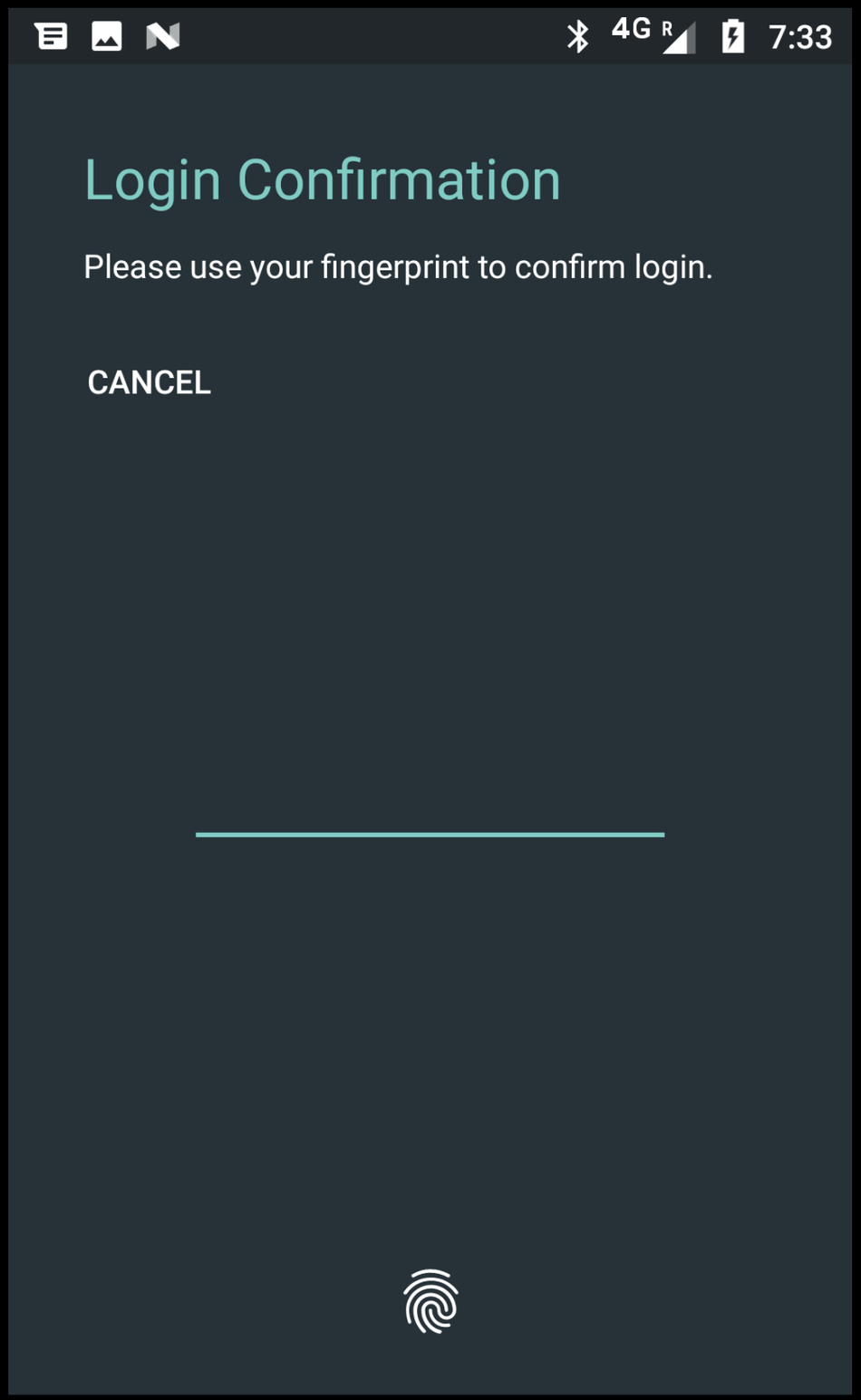

# Use Step 4. Hospital Patient Menu is displayed. User chooses Consultancy



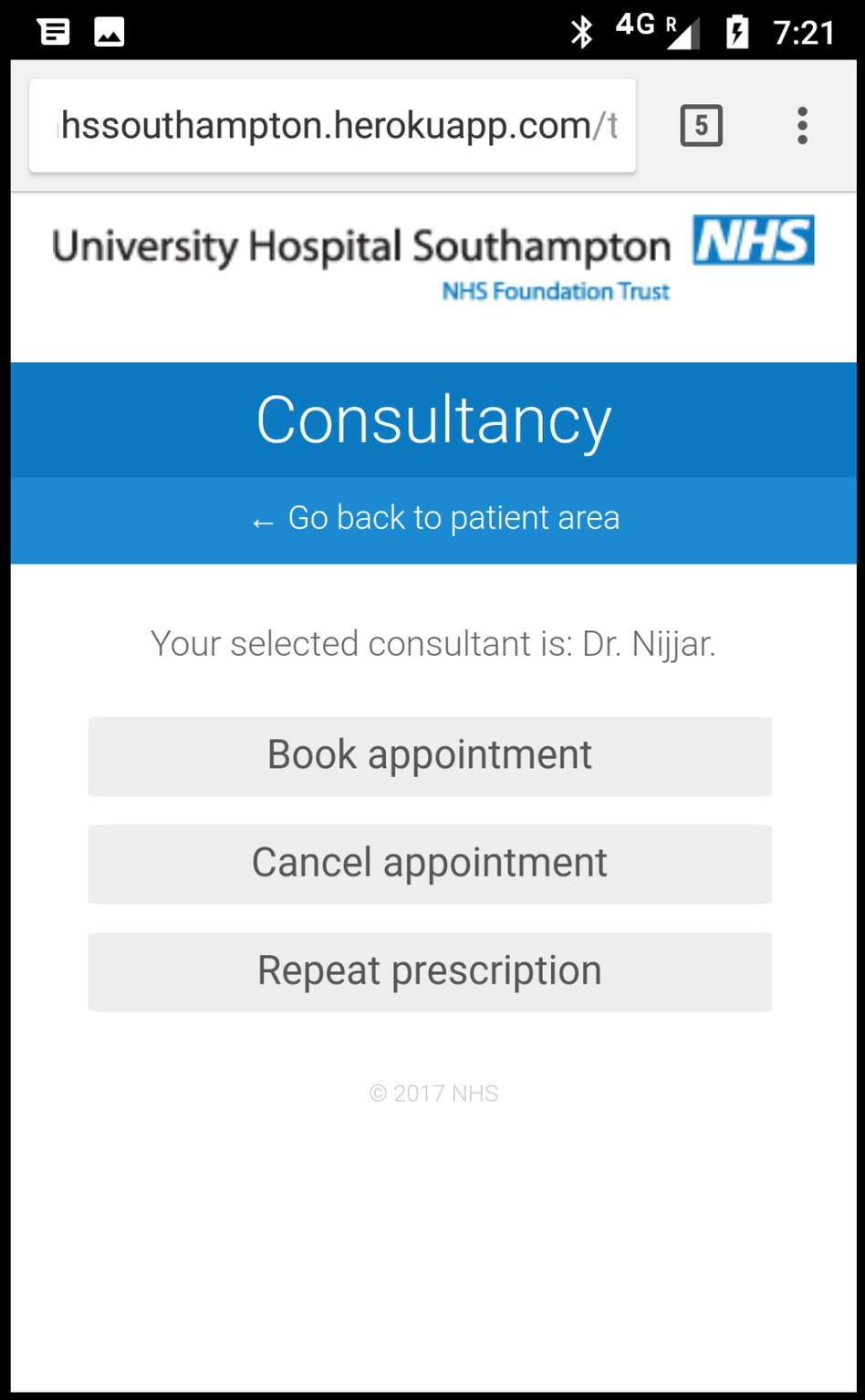
# Use Step 5. Consultant's Authz policy is sent to phone. Phone matches policy against VCs on phone and asks user to choose (no choice in this case)



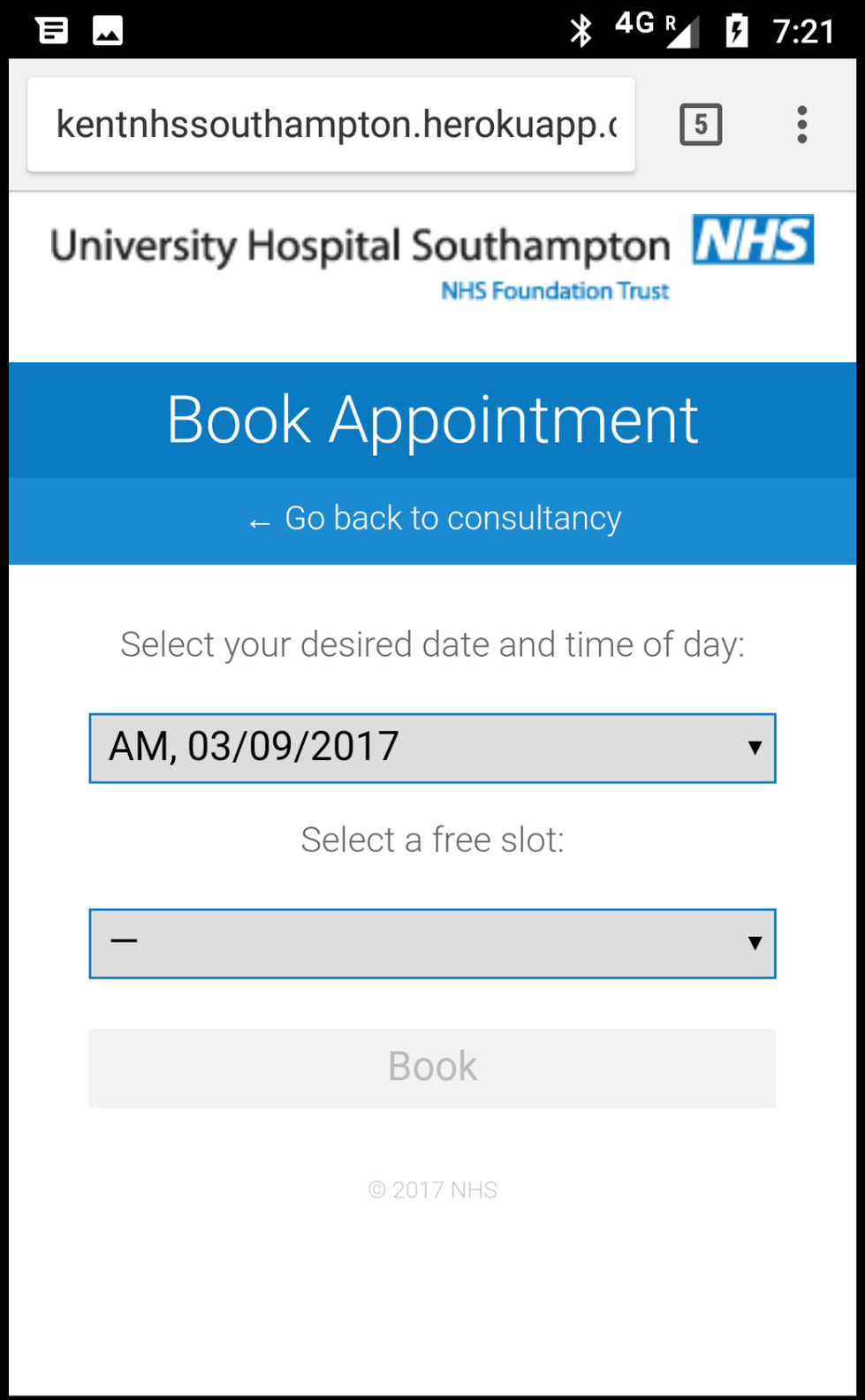
# Use Step 6. User confirms selection with fingerprint



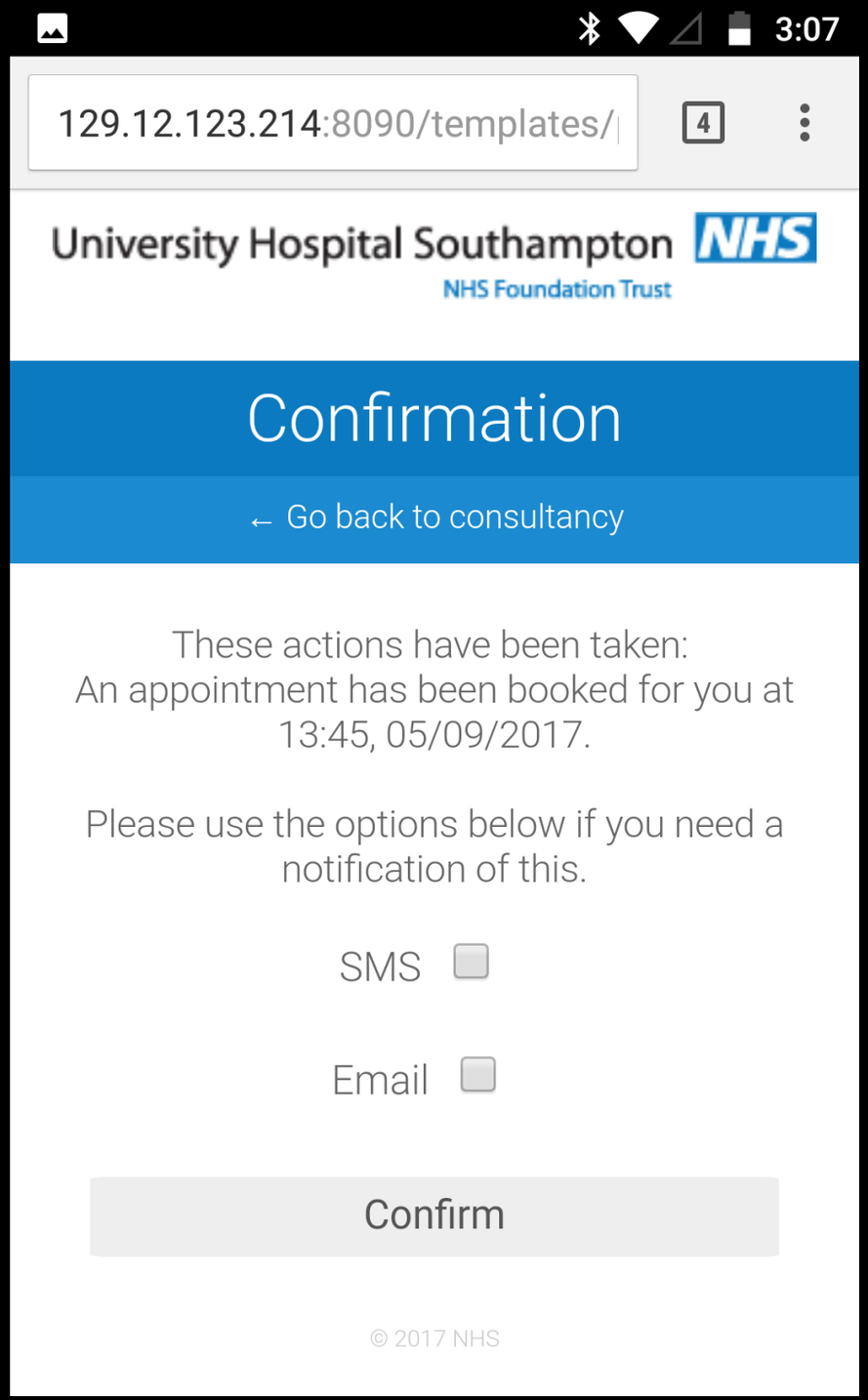

# Use Step 7. Consultancy Menu is Displayed



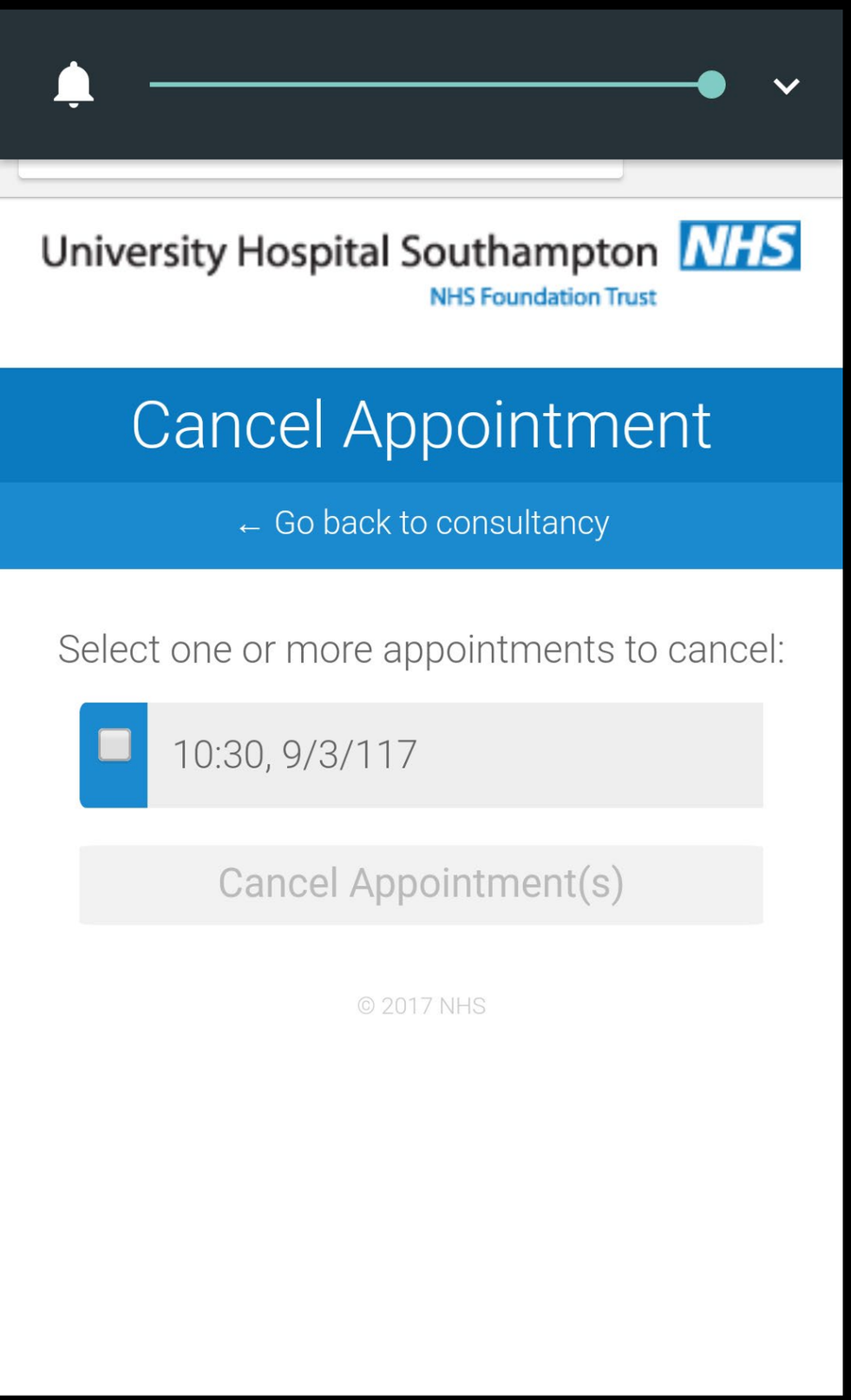
# Use Step 9. Book Appointment



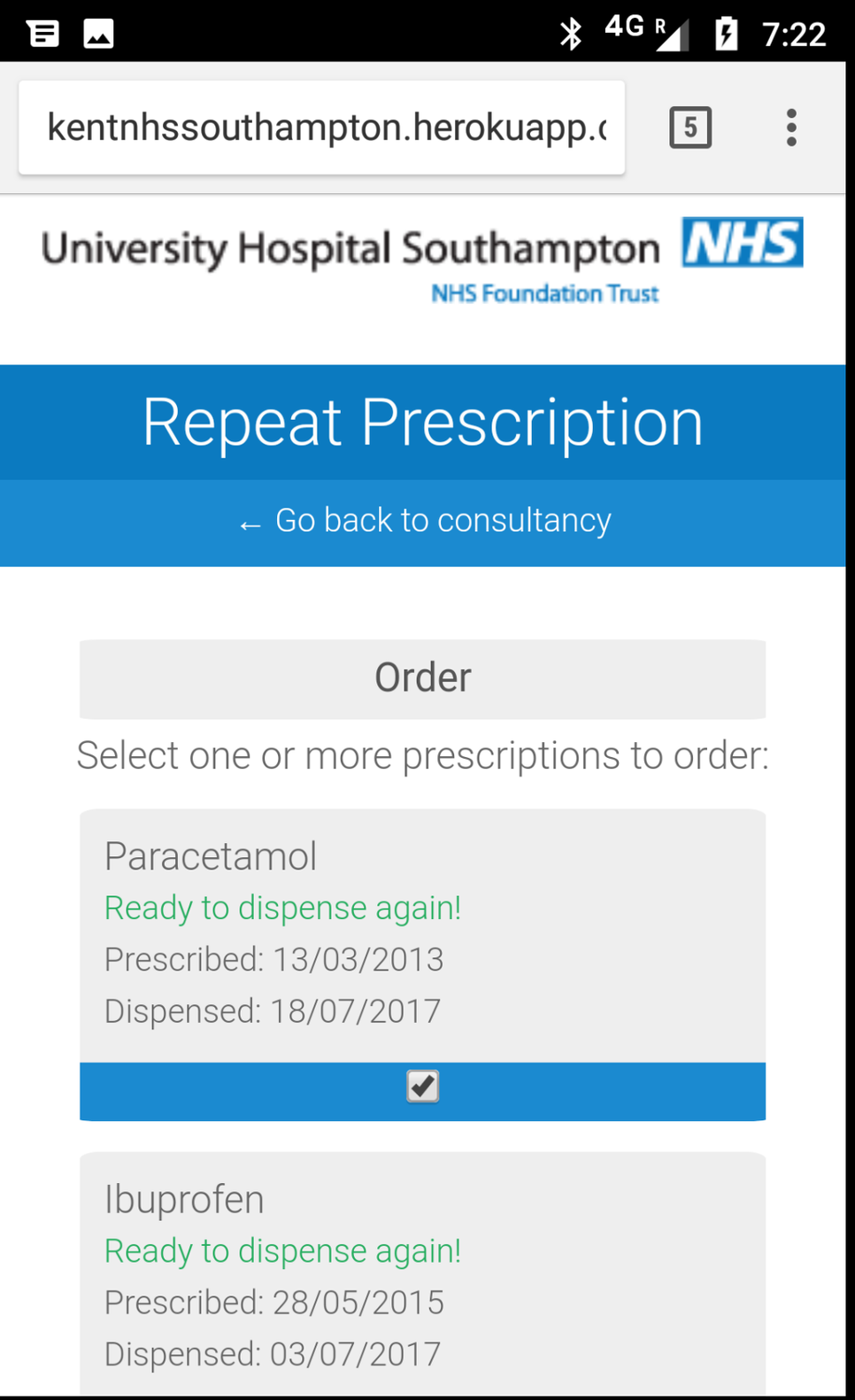
# Use Step 10. Confirmation Message



# Step 9. Cancel Appointment



# Step 9. Order Repeat Prescription



# User Trials

- 10 hospital outpatients age <20 to >80
- Unanimously found the app easy to use and liked the use of fingerprints rather than usernames and passwords
- 1 user would prefer voice or iris scanning to fingerprints

# Conclusion

- VCs are privacy protecting and have the potential to significantly reduce Identity Theft
  - Give the user full control of their identity
  - SP only obtains the attributes needed for identification and authorisation and that the user consents to reveal
  - No globally unique correlating handle
  - IdP does not know which SP the user is visiting
- VCs protect against phishing attacks and identity theft because
  - No SP login passwords. Cryptographically protected credentials instead.
  - You would need to trick every IdP at registration time, and register before the real owner, in order to get their VCs,  or Steal the user's phone and finger (or PIN) after he has registered
- VCs can be very easy to use and in our limited user trials were unanimously liked by patients

# Any questions?