

IDPro Body of Knowledge Table of Contents

Working DRAFT

September 12, 2019

Contents

1	Introduction	1
1.1	Ethics	1
1.2	Information security	1
1.2.1	Trust (say more - what is this?)	1
1.3	Privacy	1
1.4	Identification and authentication	1
1.4.1	Context and Identity	1
1.4.2	Levels of Assurance	1
1.5	The Business Case for IAM	1
1.5.1	Workforce IAM	1
1.5.2	Consumer/Citizen IAM	1
2	Digital Identity	2
2.1	Definition	2
2.1.1	Reputation	2
2.1.2	Laws of Identity (this sounds like jurisdictions and real laws - is that the intent?)	2
2.2	Identifiers	2
2.3	Digital Identity Lifecycle (?)	2
2.4	Mapping to human or device	2
2.5	Proofing, Binding or Registration (?)	2
2.5.1	Verification/Validation	2
2.6	Credentials	2
3	Access Control	3
3.1	Authentication	3
3.1.1	Dynamic Authentication (risk-based)	3
3.1.2	Multi-Factor Authentication	3
3.1.3	Single Sign-on Within a Domain	3
3.1.4	Centralised Authentication Service	3

3.1.5	Federated Authentication (between domains)	3
3.1.6	Device Identity for Corroboration	3
3.1.7	Fast Identity Online (FIDO) and its cousins	3
3.1.8	Session Management	3
3.2	Authorization	3
3.2.1	Resources to Protect	3
3.2.2	Authorisation	3
3.2.2.1	ACL's	3
3.2.2.2	RBAC	3
3.2.2.3	ABAC / Dynamic Access Management	3
	Policy Management solutions	3
3.2.3	Privileged Access Management	4
3.2.3.1	Alignment to Risk Management	4
3.2.3.2	System Accounts	4
4	Laws, Regulations, and Standards	5
4.1	Framework to Understand Legal Environment	5
4.2	Highlights of Selected Laws	5
4.2.1	Europe	6
4.2.1.1	GDPR	6
4.2.2	United States	6
4.2.2.1	Sarbanes-Oxley Section 404	6
4.2.2.2	Health Insurance Portability and Accountability Act (HIPAA)	6
4.2.2.3	Health Information Technology for Economic and Clinical Health Act (HITECH)	6
4.2.2.4	Family Educational Rights and Privacy Act of 1974 (FERPA)	6
4.2.2.5	Children's Online Privacy Protection Act (COPPA)	6
4.2.2.6	Fair and Accurate Credit Transaction Act (FACTA)	6
4.2.3	Canada	6
4.2.3.1	Personal Information Protection and Electronic Documents Act (PIPED Act, or PIPEDA)	6
4.3	Regulations	6
4.4	Standards	7
4.4.1	Architecture	7
4.4.1.1	ISO/IEC 24760-2:2015 Information technology -- Security techniques -- A framework for identity management -- Part 2: Reference architecture and requirements	7
4.4.2	Assurance	7
4.4.2.1	<i>Standard on Identity and Credential Assurance</i>	7
4.4.2.2	<i>Digital Identity Guidelines</i>	7

4.4.2.3	<i>Guide for Applying the Risk Management Framework to Federal Information Systems: A Security Life Cycle Approach . .</i>	7
4.4.3	Authentication	8
4.4.3.1	<i>Digital Identity Guidelines: Authentication and Lifecycle Management</i>	8
4.4.3.2	<i>Introduction to Public Key Technology and the Federal PKI Infrastructure</i>	8
4.4.3.3	<i>Lightweight Directory Access Protocol (LDAP): Technical Specification Road Map</i>	8
4.4.3.4	<i>OpenID Connect Core 1.0 incorporating errata set 1</i>	8
4.4.3.5	<i>Personal Identity Verification (PIV) of Federal Employees and Contractors</i>	8
4.4.3.6	<i>Biometric Data Specification for Personal Identity Verification</i>	8
4.4.4	Authorization	8
4.4.4.1	<i>The OAuth 2.0 Authorization Framework</i>	9
4.4.4.2	<i>User-Managed Access (UMA) Profile of OAuth 2.0</i>	9
4.4.5	Federation	9
4.4.5.1	<i>OpenID Connect Core 1.0 incorporating errata set 1</i>	9
4.4.5.2	<i>Assertions and Protocols for the OASIS Security Assertion Markup Language (SAML) V2.0</i>	9
4.4.5.3	<i>Digital Identity Guidelines: Federation and Assertions</i>	9
4.4.6	Lifecycle	9
4.4.6.1	<i>Standard on Identity and Credential Assurance</i>	10
4.4.6.2	<i>Digital Identity Guidelines: Enrollment and Identity Proofing Requirements</i>	10
4.4.6.3	<i>Digital Identity Guidelines: Authentication and Lifecycle Management</i>	10
4.4.7	Operations	10
4.4.7.1	<i>Information technology -- Security techniques -- A framework for identity management -- Part 3: Practice</i>	10
4.4.8	Terminology	10
4.4.8.1	<i>Digital Identity Guidelines</i>	10
4.4.8.2	<i>An Ontology of Identity Credentials Part I: Background and Formulation</i>	10
4.4.8.3	<i>Security and Privacy -- A Framework For Identity Management -- Part 1: Terminology And Concepts</i>	11
4.4.8.4	<i>ISO/IEC 24760-1:2019 IT Security and Privacy -- A Framework For Identity Management -- Part 1: Terminology And Concepts</i>	11

5	Workforce IAM / Internal IAM	12
5.1	IAM Processes	12
5.1.1	Joiner-Mover-Leaver	12
5.1.2	HR Ownership	12
5.1.3	Provisioning (On-boarding and Off-boarding)	12
5.1.4	Role Management	12
5.1.5	Re-certification	12
5.2	Compliance	12
5.3	Analytics and Intelligence	12
5.4	Handling Business Partners' People	12
6	Consumer/Citizen IAM	13
6.1	Consumer Journey (identification to loyal customer)	13
6.1.1	Registration of Consumers	13
6.1.2	Authentication Assurance (meeting LoA requirements)	13
6.2	Industry Considerations	13
6.2.1	Public Sector vs. Private Sector	13
6.2.2	Financial Services	13
6.2.3	Healthcare	13
6.3	Social Sign-up and Sign-on	13
7	Non-Human Entity	14
7.1	Operational Technology (OT)	14
7.2	IoT Devices	14
7.2.1	IoT Sectors	14
7.2.1.1	Home Automation	14
7.2.1.2	Personal (wearables)	14
7.2.1.3	Implants	14
7.2.1.4	Plant Automation	14
7.2.1.5	Vehicle	14
7.2.1.6	Smart Cities	14
7.2.1.7	Agriculture	14
7.2.1.8	Building/Industrial	14
7.2.1.9	Utilities	14
7.3	RPA / robotics	14
7.4	Security requirements	14
8	IAM Architecture and Solutions	15
8.1	Business System	15
8.1.1	Business Processes	15
8.1.1.1	Recertification of accounts	15

8.2	Information/Data Architecture	15
8.3	Application Portfolio	15
8.3.1	APIs	15
8.3.1.1	HTTP	15
8.3.1.2	S/LDAP	15
8.3.1.3	RACF	15
8.3.1.4	XACML	15
8.4	Technical	15
8.4.1	Repositories	15
8.4.1.1	Relational Database	15
	Query optimization	15
	Replication limitations	15
8.4.1.2	Directories	16
	Historical note - X.500	16
	SLAPD and its descendants	16
8.4.1.3	NoSQL databases	16
	Graph Databases	16
8.4.1.4	Identity Provider (IdP) Trends	16
	Distributed Ledger (Blockchain)	16
8.4.2	Identity Provider Services	16
8.4.3	Protocols	16
8.4.3.1	Kerberos	16
8.4.3.2	Lightweight Directory Access Protocol (LDAP)	16
8.4.3.3	SCIM	16
8.4.3.4	SAML	16
	SP Initiated vs IDP Initiated	16
	Bindings	16
8.4.3.5	OIDC	16
	Authentications Flows	16
8.4.3.6	OAuth	17
8.4.3.7	WS-Fed	17
8.4.3.8	FIDO U2F and UAF	17
8.4.4	Enterprise control of "Cloud"	17
8.4.4.1	Public Cloud vs Private Cloud	17
8.4.4.2	Local Connectors and Gateways	17
8.4.4.3	IPSec VPN	17
8.5	Recommended Practices	17
8.5.1	Design for security	17
8.6	Governance and Administration	17
8.6.1	Audit	17
8.6.2	Monitoring	17

9 Operational Considerations	18
9.1 Account recovery	18
9.2 Call centers	18
9.3 Engagement of user for their own security	18
9.4 Security events and operations	18
10 Project Management	19
10.1 Project Management Institute Framework	19
10.2 New Implementation Projects	19
10.3 Migration Projects	19
10.4 Project Management Office Issues	19
11 IAM Knowledge Sharing	20
11.1 Independent Organizations	20
11.2 Standards Bodies	20
11.3 Analyst Organizations	20
11.4 Conferences	20
12 Advanced Topics – Parking Lot	21
12.1 Digital Legacy - handling deceased persons' digital ID (Advanced Topic)	21
12.2 Self-Sovereign Identity	21
12.2.1 Blockchain ID	21

Chapter 1

Introduction

1.1 Ethics

1.2 Information security

1.2.1 Trust (say more - what is this?)

1.3 Privacy

1.4 Identification and authentication

1.4.1 Context and Identity

1.4.2 Levels of Assurance

1.5 The Business Case for IAM

1.5.1 Workforce IAM

1.5.2 Consumer/Citizen IAM

Chapter 2

Digital Identity

2.1 Definition

2.1.1 Reputation

2.1.2 Laws of Identity (this sounds like jurisdictions and real laws - is that the intent?)

2.2 Identifiers

2.3 Digital Identity Lifecycle (?)

2.4 Mapping to human or device

2.5 Proofing, Binding or Registration (?)

2.5.1 Verification/Validation

2.6 Credentials

Chapter 3

Access Control

3.1 Authentication

- 3.1.1 Dynamic Authentication (risk-based)**
- 3.1.2 Multi-Factor Authentication**
- 3.1.3 Single Sign-on Within a Domain**
- 3.1.4 Centralised Authentication Service**
- 3.1.5 Federated Authentication (between domains)**
- 3.1.6 Device Identity for Corroboration**
- 3.1.7 Fast Identity Online (FIDO) and its cousins**
- 3.1.8 Session Management**

3.2 Authorization

- 3.2.1 Resources to Protect**
- 3.2.2 Authorisation**
 - 3.2.2.1 ACL's**
 - 3.2.2.2 RBAC**
 - 3.2.2.3 ABAC / Dynamic Access Management**

Policy Management solutions

3.2.3 Privileged Access Management

3.2.3.1 Alignment to Risk Management

3.2.3.2 System Accounts

Chapter 4

Laws, Regulations, and Standards

Abstract: This chapter provides information about the externally defined environment in which Identity and Access management professionals operate. The laws are documents that define duties and consequences in legal jurisdictions, such as countries. Regulations are more specific and detailed requirements. Standards may also be mandatory; government entities often require compliance with standards produced by certain standards bodies. We also include *de facto* standards and recommended practices here.

4.1 Framework to Understand Legal Environment

Abstract: Identity systems and its participants are governed by a myriad and complex set of laws, regulations, and contractual requirements, and the obligations they impose are not always clear. This article focuses on the legal environment that governs identity systems. The emphasis is on United States, but references are made to other countries' laws and efforts to coordinate rules underway in the UN Commission on International Trade Law (UNCITRAL) regarding identity management legislation.

4.2 Highlights of Selected Laws

Abstract: This section is organized by jurisdiction. It is intended to provide at a minimum a reference to known laws and regulations in jurisdictions likely to be encountered by our membership. At present this includes Europe, United States, and Canada will likely also include Australia in the short term.

4.2.1 Europe

4.2.1.1 GDPR

Abstract: This article provides a basic understanding of how the *General Data Protection Regulation (GDPR)* applies when processing ‘any information relating to an identified or identifiable natural person’.

4.2.2 United States

Abstract: This article explains how identity and access management supports the requirements of prominent U.S. laws.

4.2.2.1 Sarbanes-Oxley Section 404

4.2.2.2 Health Insurance Portability and Accountability Act (HIPAA)

4.2.2.3 Health Information Technology for Economic and Clinical Health Act (HITECH)

4.2.2.4 Family Educational Rights and Privacy Act of 1974 (FERPA)

4.2.2.5 Children’s Online Privacy Protection Act (COPPA)

4.2.2.6 Fair and Accurate Credit Transaction Act (FACTA)

4.2.3 Canada

Abstract: This article explains how identity and access management support the requirements of prominent Canadian laws.

4.2.3.1 Personal Information Protection and Electronic Documents Act (PIPED Act, or PIPEDA)

4.3 Regulations

Abstract: This article explains how identity and access management supports the requirements of prominent regulations.

4.4 Standards

Abstract: There are many standards. Standards may be mandatory such as when government entities require compliance with standards produced by certain standards bodies. We also include *de facto* standards and recommended practices here. This is a curated set of standards that have been deemed to be useful to identity professionals. They are organized topically, not by their source. Standards that span more than one topic are possible. In this case cross references may be used.

4.4.1 Architecture

Abstract: This article surveys the known standards concerning architecture for identity systems.

4.4.1.1 ISO/IEC 24760-2:2015 Information technology -- Security techniques -- A framework for identity management -- Part 2: Reference architecture and requirements

4.4.2 Assurance

Abstract: This article surveys the known standards concerning risk and assurance for identity systems.

4.4.2.1 *Standard on Identity and Credential Assurance*

[Canada] Government of Canada February 2013 <https://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=26776>. Archived - Need successors

4.4.2.2 *Digital Identity Guidelines*

[SP 800-63-3] NIST Special Publication 800-63-3 June 2017 <https://doi.org/10.6028/NIST.SP.800-63-3>

4.4.2.3 *Guide for Applying the Risk Management Framework to Federal Information Systems: A Security Life Cycle Approach*

[SP-800-37] NIST Special Publication 800-37r1 June 2014 <https://doi.org/10.6028/NIST.SP.800-37r1>

4.4.3 Authentication

Abstract: This article surveys the known standards concerning methods of authenticating principals.

4.4.3.1 *Digital Identity Guidelines: Authentication and Lifecycle Management*

[SP 800-63B] NIST Special Publication 800-63C December 2017 <https://doi.org/10.6028/NIST.SP.800-63b>

4.4.3.2 *Introduction to Public Key Technology and the Federal PKI Infrastructure*

[SP 800-32] NIST Special Publication 800-32 February 2001. https://tsapps.nist.gov/publication/get_p

4.4.3.3 *Lightweight Directory Access Protocol (LDAP): Technical Specification Road Map*

[IETF RFC 4510] RFC 4510 June 2006 <https://tools.ietf.org/html/rfc4510>

4.4.3.4 *OpenID Connect Core 1.0 incorporating errata set 1*

[OIDC] Sakimura, N., Bradley, B., Jones, M., de Medeiros, B., and C. Mortimore November 2014 https://openid.net/specs/openid-connect-core-1_0.html.

4.4.3.5 *Personal Identity Verification (PIV) of Federal Employees and Contractors*

[FIPS 201-2] NIST FIPS Publication 201-2 September 2013 <https://doi.org/10.6028/NIST.FIPS.201-2>

4.4.3.6 *Biometric Data Specification for Personal Identity Verification*

[SP 800-76-2] NIST Special Publication 800-76-2 July 2013 <https://doi.org/10.6028/NIST.SP.800-76-2>

4.4.4 Authorization

Abstract: This article surveys the known standards concerning methods of access control. These standards involve protecting resources. This is sometimes called authorization.

4.4.4.1 *The OAuth 2.0 Authorization Framework*

[IETF RFC 6749] RFC 6749 October 2012 <https://tools.ietf.org/html/rfc6749>

4.4.4.2 *User-Managed Access (UMA) Profile of OAuth 2.0*

Abstract: The weaknesses of many notice-and-consent paradigms of data privacy are clear. This article notes the social, legal and regulatory drivers and examines some approaches to satisfy them.

[KI UMA] Kantara Initiative UMA Recommendation December 2015 <https://docs.kantarainitiative.org/uma-core.html>

4.4.5 Federation

Abstract: This article surveys the known standards concerning methods of allowing authentication from one domain to be honored in another.

4.4.5.1 *OpenID Connect Core 1.0 incorporating errata set 1*

[OIDC] Sakimura, N., Bradley, B., Jones, M., de Medeiros, B., and C. Mortimore November 2014 https://openid.net/specs/openid-connect-core-1_0.html.

4.4.5.2 *Assertions and Protocols for the OASIS Security Assertion Markup Language (SAML) V2.0*

[OASIS SAML 2] SAML 2.0 March 2005 <http://docs.oasis-open.org/security/saml/v2.0/saml-core-2.0-os.pdf>

4.4.5.3 *Digital Identity Guidelines: Federation and Assertions*

[SP 800-63C] NIST Special Publication 800-63C December 2017 <https://doi.org/10.6028/NIST.SP.800-63c>

4.4.6 Lifecycle

Abstract: This article surveys the known standards concerning the creation and registration of identities and subsequent changes to the characteristics of those identities and the eventual removal of the same.

4.4.6.1 *Standard on Identity and Credential Assurance*

[Canada] Government of Canada February 2013 <https://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=26776>. Archived - Need successors

4.4.6.2 *Digital Identity Guidelines: Enrollment and Identity Proofing Requirements*

[SP 800-63A] NIST Special Publication 800-63A December 2017 <https://doi.org/10.6028/NIST.SP.800-63a>

4.4.6.3 *Digital Identity Guidelines: Authentication and Lifecycle Management*

[SP 800-63B] NIST Special Publication 800-63C December 2017 <https://doi.org/10.6028/NIST.SP.800-63b>

4.4.7 Operations

Abstract: This article surveys the known standards concerning the operation of identity systems.

4.4.7.1 *Information technology -- Security techniques -- A framework for identity management -- Part 3: Practice*

[ISO 24760-3] ISO/IEC 24760-3:2016 2016 <https://webstore.ansi.org/Standards/ISO/ISOIEC247602016>

4.4.8 Terminology

Abstract: This article surveys the known standards for the purpose of collating and contrasting terminology defined.

4.4.8.1 *Digital Identity Guidelines*

[SP 800-63-3] NIST Special Publication 800-63-3 June 2017 <https://doi.org/10.6028/NIST.SP.800-63-3>

4.4.8.2 *An Ontology of Identity Credentials Part I: Background and Formulation*

[SP 800-103] NIST Special Publication 800-103 (Draft) October 2006. <https://tsapps.nist.gov/publication>

4.4.8.3 *Security and Privacy -- A Framework For Identity Management -- Part 1: Terminology And Concepts*

[ISO 24760-1] ISO/IEC 24760-1:2019 IT 2019 <https://webstore.ansi.org/Standards/ISO/ISOIEC247602>

4.4.8.4 ISO/IEC 24760-1:2019 IT Security and Privacy -- A Framework For Identity Management -- Part 1: Terminology And Concepts

Chapter 5

Workforce IAM / Internal IAM

5.1 IAM Processes

5.1.1 Joiner-Mover-Leaver

5.1.2 HR Ownership

5.1.3 Provisioning (On-boarding and Off-boarding)

5.1.4 Role Management

5.1.5 Re-certification

5.2 Compliance

5.3 Analytics and Intelligence

5.4 Handling Business Partners' People

Chapter 6

Consumer/Citizen IAM

6.1 Consumer Journey (identification to loyal customer)

6.1.1 Registration of Consumers

6.1.2 Authentication Assurance (meeting LoA requirements)

6.2 Industry Considerations

6.2.1 Public Sector vs. Private Sector

6.2.2 Financial Services

6.2.3 Healthcare

6.3 Social Sign-up and Sign-on

Chapter 7

Non-Human Entity

7.1 Operational Technology (OT)

7.2 IoT Devices

7.2.1 IoT Sectors

7.2.1.1 Home Automation

7.2.1.2 Personal (wearables)

7.2.1.3 Implants

7.2.1.4 Plant Automation

7.2.1.5 Vehicle

7.2.1.6 Smart Cities

7.2.1.7 Agriculture

7.2.1.8 Building/Industrial

7.2.1.9 Utilities

7.3 RPA / robotics

7.4 Security requirements

Chapter 8

IAM Architecture and Solutions

8.1 Business System

8.1.1 Business Processes

8.1.1.1 Recertification of accounts

8.2 Information/Data Architecture

8.3 Application Portfolio

8.3.1 APIs

8.3.1.1 HTTP

8.3.1.2 S/LDAP

8.3.1.3 RACF

8.3.1.4 XACML

8.4 Technical

8.4.1 Repositories

8.4.1.1 Relational Database

Query optimization

Replication limitations

8.4.1.2 Directories

Historical note - X.500

SLAPD and its descendants

8.4.1.3 NoSQL databases

Graph Databases

8.4.1.4 Identity Provider (IdP) Trends

Distributed Ledger (Blockchain)

8.4.2 Identity Provider Services

8.4.3 Protocols

8.4.3.1 Kerberos

8.4.3.2 Lightweight Directory Access Protocol (LDAP)

8.4.3.3 SCIM

8.4.3.4 SAML

SP Initiated vs IDP Initiated

Bindings

8.4.3.5 OIDC

Authentications Flows

8.4.3.6 OAuth

8.4.3.7 WS-Fed

8.4.3.8 FIDO U2F and UAF

8.4.4 Enterprise control of “Cloud”

8.4.4.1 Public Cloud vs Private Cloud

8.4.4.2 Local Connectors and Gateways

8.4.4.3 IPSec VPN

8.5 Recommended Practices

8.5.1 Design for security

8.6 Governance and Administration

8.6.1 Audit

8.6.2 Monitoring

Chapter 9

Operational Considerations

9.1 Account recovery

9.2 Call centers

9.3 Engagement of user for their own security

9.4 Security events and operations

Chapter 10

Project Management

Many Identity and Access Management (IAM) projects proceed without a project manager. In these cases the IT group in charge of identity management are left to deploy the required solution in the absence of any overarching management. While this is sometimes seen as the most expedient way to get a system installed or updated, it is short-sighted and likely to cost the organisation more money in the longer term. An IAM solution touches so many systems within an organisation and is dependent on the current and planned condition of so many applications that to deploy a solution without properly considering the impact, managing the required resources and keeping management advised of progress, will result in a substandard deployment.

Here we look at two ways to manage a project – “Classic”, sometimes called Waterfall, and “Agile, a way to manage projects that accommodates changes that inevitably arise during the course of a project.

Reference is made to the Project Management Institute (PMI) Framework. This document in no way seeks to replicate the PMI’s methodology or replace the project management training that the PMI provides. The reader is referred to the PMI Body of Knowledge for further information.

10.1 Project Management Institute Framework

10.2 New Implementation Projects

10.3 Migration Projects

10.4 Project Management Office Issues

Chapter 11

IAM Knowledge Sharing

11.1 Independent Organizations

11.2 Standards Bodies

11.3 Analyst Organizations

11.4 Conferences

Chapter 12

Advanced Topics – Parking Lot

**12.1 Digital Legacy - handling deceased persons' digital ID
(Advanced Topic)**

12.2 Self-Sovereign Identity

12.2.1 Blockchain ID