EXAMINING THE INTERPLAY BETWEEN PRIVACY BY DESIGN (PBD) SCHEMES AND PRIVACY PATTERNS

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ABSTRACT

Privacy is a vague concept. This vagueness makes it difficult to understand what it means. Software engineering is an area such ambiguity creates a significant problem. For example, if the software developers do not understand privacy properly, they are not going to develop the software in a privacy-protected manner. To address this issue, as a community, over the last two decades, many researchers have proposed a few different Privacy by Design (PbD) schemes. Typically, PbD schemes comprise a set of instructions. These instructions are also referred to as guidelines, principles, strategies. Another way to address this problem of ambiguity is privacy patterns. Inspired by design patterns in software engineering domain, researchers and privacy experts have developed privacy patterns. Each Privacy pattern is designed to improve privacy in particular application design by eliminating certain privacy risks in a certain way. For our analysis, we identified ten (10) different PhD schemes. We analyse them against 74 different privacy patterns (privacypatterns.eu, privacypatterns.org). In this report, we examine the interplay between Privacy by Design (PbD) schemes and privacy patterns. This document contains the raw outcome of our analysis. Please refer to our research paper to read about insights we generated through this analysis.

Table 1: Privacy	Schemes use in t	the Analysis
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Citation	Туре	Number
(1) Perera et al. [1]	Guidelines	30
(2) Hoepman [2]	Strategies	8
(3) Cavoukian [3]	Principles	7
(4) Cavoukian and Jonas [4]	Principles	7
(5) ISO 29100 Privacy framework [5]	Principles	11
(6) Wright and Raab [6]	Principles	9
(7) Fair Information Practice Principles (FIPPs) [7]	Principles	5
(8) Economic Cooperation and Development (OECD) [8]	Guidelines	8
(9) Rost and Bock [9]	Goals	6
(10) Fisk et al. [10]	Principles	3

Keywords Privacy, Privacy by Design, Internet of Things, Privacy Knowledge Engineering

1 PbD Guidelines by Perera et al. [1]

Perera et al. [1] have proposed 30 privacy guidelines: (1) Minimise data acquisition, (2) Minimise number of data sources, (3) Minimise raw data intake, (4) Minimise knowledge discovery, (5) Minimise data storage, (6) Minimise data retention period, (7) Hidden data routing, (8) Data anonymisation, (9) Encrypted data communication, (10) Encrypted data processing, (11) Encrypted data storage, (12) Reduce data granularity, (13) . Query answering, (14) Repeated query blocking, (15) Distributed data storage, (16) Distributed data storage, (17) Knowledge discovery based aggregation, (18) Geography based aggregation, (19) Chain aggregation, (20) Time-Period based aggregation, (21) Category based aggregation, (22) Information Disclosure, (23) Control, (24) Logging, (25) Auditing, (26) Open Source, (27) Data Flow, (28) Certification, (29) Standardisation, (30) Compliance. More details can be found in [1].

Table 2: Privacy Patterns Examined Against Privacy Strategies [1]

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	1. Minimise data acquisition	2. Minimise number of data sources	3. Minimise raw data intake	4. Minimise knowledge discovery	5. Minimise data storage	6. Minimise data retention period	7. Hidden data routing	8. Data anonymisation	9. Encrypted data communication	10. Encrypted data processing	11. Encrypted data storage	12. Reduce data granularity	13. Query answering	14. Repeated query	15. Distributed data processing
Privacy Pattern List															
1. Protection against Tracking 2. Location Granularity	•				•	•		•							
3. Minimal Information Asymmetry		•										•			
4. Informed Secure Passwords															
5. Awareness Feed.															
6. Encryption with user-managed keys 7. Federated Privacy Impact Assessment	٠										•				
8. Use of dummies				٠											
9. Who's Listening															
10. Privacy Policy Display															
 Layered Policy Design Discouraging Blanket Strategies 												•			
13. Reciprocity															
14. Asynchronous notice															
15. Abridged Terms and Condition															
 Policy Matching Display Incentivized Participation 															
18. Outsourcing [with consent]															
19. Ambient Notice															
20. Dynamic Privacy Policy Display															
21. Privacy Labels 22. Data Breach Notification Pattern															
23. Pseudonymous Messaging				•			•	•							
24. Onion Routing									٠	٠					
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33. Single Point of Contact															
34. Informed Implicit Consent															
35. Enable/Disable Function 36. Privacy Color Coding															
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39. Icons for Privacy Policies															
40. Obtaining Explicit Consent 41. Privacy Mirrors															
42. Appropriate Privacy Feedback															
43. Impactful Information and Feedback															
44. Decoupling [content] and															
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45. Platform for Privacy Preferences 46. Selective Access control															
47. Pay Back															
48. Privacy Dashboard															
49. Preventing Mistakes or Reducing their Impact															
50. Obligation Management															
51. Informed Credential Selection															
52. Anonymous Reputation-based															
Blacklisting 52 Negatistics of Drivery Deliny															
53. Negotiation of Privacy Policy															
54. Reasonable Level of Control															

56. Buddy List					
57. Privacy Awareness Panel					
58. Lawful Consent					
59. Privacy Aware Wording					
60. Sticky Policies					
61. Personal Data Table					
62. Informed Consent for Web-based Transactions					
63. Added-noise measurement obfuscation		•			
64. Increasing Awareness of Information Aggregation					
65. Attribute Based Credentials	•	•			
66. Trustworthy Privacy Plug-in	• •	•		•	•
67. [Support] Selective Disclosure					
68. Private Link					
69. Anonymity Set		•	•	•	
70. Active Broadcast of Presence					
71. Unusual Activities					
72. Strip Metadata	•	• • •			
73. Identity Federation					
Do Not Track Pattern					
74. Dynamic Location Granularity	•				

Table 3: Privacy Patterns Examined Against Privacy Guidelines (continue) [1]

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2. Location Granularity		٠	٠			٠									
3. Minimal Information Asymmetry							•				•	•			
4. Informed Secure Passwords							٠								
5. Awareness Feed.							٠				•	•			
Encryption with user-managed keys								•							
7. Federated Privacy Impact Assessment															•
8. Use of dummies		•													
9. Who's Listening							•		•		•	•			
10. Privacy Policy Display							٠		•		•	•		٠	
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12. Discouraging Blanket Strategies								•							
13. Reciprocity								•							
14. Asynchronous notice							•								•
15. Abridged Terms and Condition							٠				•	•		٠	
16. Policy Matching Display							•				•	•		•	
17. Incentivized Participation								•							
18. Outsourcing [with consent]															•
19. Ambient Notice							•								•
20. Dynamic Privacy Policy Display							•					-		•	
21. Privacy Labels							•				•	•		•	
22. Data Breach Notification Pattern 23. Pseudonymous Messaging							•		•	•					•
24. Onion Routing															
25. Strip Invisible Metadata															
26. Pseudonymous Identity															
27. Personal Data Store								•							
28. Trust Evaluation of Services Slides							•	•							
29. Aggregation Gateway													•		
30. Privacy icons		•									•				
31. Privacy-Aware Network Client														•	
32. Sign an Agreement							•				-				
33. Single Point of Contact								•							
34. Informed Implicit Consent								•							
35. Enable/Disable Function															
36. Privacy Color Coding							•								
37. Appropriate Privacy Icons															
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39. Icons for Privacy Policies							٠				•	•		٠	
40. Obtaining Explicit Consent							•								
41. Privacy Mirrors							•				•	•			
42. Appropriate Privacy Feedback							•				•	•			
43. Impactful Information and Feedback							•				•	•			
44. Decoupling [content] and															
Location Information Visibility								•							
45. Platform for Privacy Preferences							٠								
46. Selective Access control								•							
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49. Preventing Mistakes or						•							
Reducing their Impact						•							
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51. Informed Credential Selection						٠	٠		•				
52. Anonymous Reputation-based													
Blacklisting													
53. Negotiation of Privacy Policy						٠	٠						
54. Reasonable Level of Control							•						
55. Masquerade							٠						
56. Buddy List							٠						
57. Privacy Awareness Panel						٠							
58. Lawful Consent						٠	٠					•	٠
59. Privacy Aware Wording						٠							
60. Sticky Policies												•	٠
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62. Informed Consent for Web-based Transactions						٠	٠						
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64. Increasing Awareness of Information Aggregation	•	•	•	•	•	٠							
65. Attribute Based Credentials	•	•			•								
66. Trustworthy Privacy Plug-in	•												
67. [Support] Selective Disclosure							•						
68. Private Link							٠						
69. Anonymity Set	•	•											
70. Active Broadcast of Presence							٠						
71. Unusual Activities						•							
72. Strip Metadata													
73. Identity Federation													
Do Not Track Pattern													
74. Dynamic Location Granularity	•	•			•								

2 PbD Strategies by Hoepman et al. [2]

Hoepman et al. [2] have proposed eight privacy strategies: (1) Minimise, (2) Hide, (3) Separate, (4) Aggregate, (5) Inform, (6) Control, (7) Enforce, (8) Demonstrate. More details can be found in [2].

Table 4: Privacy Patterns Examined Against Privacy Strategies [2]

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72. Strip Metadata		•	•			-			

73. Identity Federation Do Not Track Pattern 74. Dynamic Location Granularity

3 PbD Principles by Cavoukian et al. [3]

Cavoukian [3] has proposed seven Privacy by Design foundation principles: (1) Proactive not Reactive; Preventative not Remedial, (2) Privacy as the Default Setting, (3) Privacy Embedded into Design, (4) Full Functionality-Positive - Sum, not Zero-Sum, (5) End-to-End Security - Full Lifecycle Protection, (6) Visibility and Transparency - Keep it Open, (7) Respect for User Privacy - Keep it User-Centric. Detailed are presented in [3].

Table 5: Privacy Patterns Examined Against Privacy Strategies [2]

Privacy Pattern List	1. Proactive not Reactive; Preventative not Remedial	2. Privacy as the Default Setting	3. Privacy Embedded into Design	4. Full Functionality-Positive-Sum, not Zero-Sum	5. End-to-End Security-Full Lifecycle Protection	6. Visibility and Transparency-Keep it Open	7. Respect for User Privacy-Keep it User-Centric
1. Protection against Tracking	•	•	•				•
2. Location Granularity	•	•	•				
3. Minimal Information Asymmetry	•	•	•			•	•
4. Informed Secure Passwords	•		٠		•		•
5. Awareness Feed.	•		•			٠	•
 Encryption with user-managed keys Federated Privacy Impact Assessment 	•	•	•		•		
8. Use of dummies	•	•	•				
9. Who's Listening	•					٠	•
10. Privacy Policy Display						٠	
11. Layered Policy Design						٠	
12. Discouraging Blanket Strategies 13. Reciprocity	•		•				
14. Asynchronous notice						•	•
15. Abridged Terms and Condition						•	
16. Policy Matching Display						٠	•
17. Incentivized Participation			•				•
 18. Outsourcing [with consent] 19. Ambient Notice 			•			•	
20. Dynamic Privacy Policy Display	•		•			•	•
21. Privacy Labels						•	
22. Data Breach Notification Pattern						٠	•
23. Pseudonymous Messaging 24. Onion Routing	•	•	•		•		
25. Strip Invisible Metadata			•				
26. Pseudonymous Identity	•	•	•	٠			
27. Personal Data Store	•		•			•	•
 Trust Evaluation of Services Slides Aggregation Gateway 	•					•	
30. Privacy icons	•		•			•	
31. Privacy-Aware Network Client						•	
32. Sign an Agreement	٠					٠	•
33. Single Point of Contact	•		٠		•		•
34. Informed Implicit Consent 35. Enable/Disable Function						•	
36. Privacy Color Coding						٠	
37. Appropriate Privacy Icons						•	
38. User Data Confinement Pattern	٠	٠	٠				
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57. Privacy Awareness Panel			•	•	
58. Lawful Consent	•			•	•
59. Privacy Aware Wording				٠	
60. Sticky Policies	•	٠	•		
61. Personal Data Table			•	•	
62. Informed Consent for Web-based Transactions		•		٠	•
63. Added-noise measurement obfuscation	•	•	•		
64. Increasing Awareness of Information Aggregation				٠	•
65. Attribute Based Credentials	٠	•			
66. Trustworthy Privacy Plug-in	•	•	•		
67. [Support] Selective Disclosure					•
68. Private Link			•		•
69. Anonymity Set	٠	•			
70. Active Broadcast of Presence			•		٠
71. Unusual Activities			•		•
72. Strip Metadata	•				
73. Identity Federation					
Do Not Track Pattern					
74. Dynamic Location Granularity					
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4 PbD Principles by Cavoukian and Jonas [4]

Cavoukian and Jonas [4] has proposed seven privacy principles by extending the Cavoukian's privacy principle [] as follows: (1) Full Attribution, (2) Data Tethering, (3) Analytics on Anonymised Data, (4) Tamper-Resistant Audit Logs, (5) False Negative Favouring Methods, (6) Self-Correcting False Positives, (7) Information Transfer Accounting. More details can be found in [].

Table 6: Privacy Patterns Examined Against Privacy Strategies [2]

Privacy Pattern List 1. Protection against Tracking 2. Location Granularity 3. Minimal Information Asymmetry 4. Informed Secure Passworks 5. Awareness Feed. 5. Awareness Feed. 6. Encryption with user-managed keys 7. Federated Privacy Impact Assessment 6. Encryption with user-managed keys 7. Federated Privacy Impact Assessment 7. Federated Privacy Impact Assessment 7. Prederated Privacy Impact Assessment 7. Prevacy Index Participation 7. Prevacy In		1. Full Attribution	2. Data Tethering	3. Analytics on Anonymised Data	4. Tamper-Resistant Audit Logs	5. False Negative Favouring Methods	6. Self-Correcting False Positives	7. Information Transfer Accounting
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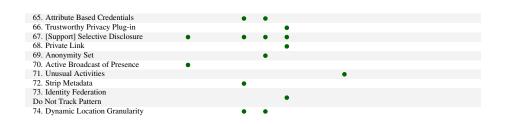
62. Informed Consent for Web-based Transactions	•	•
63. Added-noise measurement obfuscation	•	
64. Increasing Awareness of Information Aggregation		•
65. Attribute Based Credentials		
66. Trustworthy Privacy Plug-in		•
67. [Support] Selective Disclosure	•	•
68. Private Link		
69. Anonymity Set	•	
70. Active Broadcast of Presence		
71. Unusual Activities		
72. Strip Metadata		
73. Identity Federation		
Do Not Track Pattern		
74. Dynamic Location Granularity		

5 PbD Principles by ISO 29100 Privacy framework [5]

ISO 29100 [5] has proposed 11 privacy principles: (1) Consent and choice, (2)Purpose legitimacy and specification, (3) Collection limitation, (4). Data minimisation, (5) Use, retention and disclosure limitation, (6) Accuracy and quality, (7). Openness, transparency and notice, (8) Individual participation and access, (9) Accountability, (10) Information security, (11) Privacy compliance. Detailed can be found in [5]

Table 7: Privacy Patterns Examined Against Privacy Principles [5]

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63. Added-noise measurement obfuscation				•	•						
64. Increasing Awareness of Information Aggregation											



6 PbD Principles by Wright and Raab [6]

Wright and Raab [6] Privacy Principles have proposed nine privacy principles (1) Right to dignity, (2) Right to be let alone, (3) Right to anonymity, (4) Right to autonomy, (5). Right to individuality and uniqueness of identity, (6) Right to assemble or associate with others without being surveilled, (7) Right to confidentiality and secrecy of communications, (8) Right to travel (in physical or cyber space) without being tracked, (9) People should not have to pay in order to exercise their rights of privacy (subject to any justifiable exceptions), nor be denied goods or services or offered them on a less preferential basis. Detailed are presented in [6].

 Table 8: Privacy Patterns Examined Against Privacy Strategies [2]

	1. Right to dignity	2. Right to be let alone	3. Right to anonymity	4. Right to autonomy	5. Right to individuality	6. Right to assemble	7. Right to confidentiality	8. Right to travel without being tracked	9. People should not have to pay
Privacy Pattern List									
I. Protection against Tracking Location Granularity S. Minimal Information Asymmetry Informed Secure Passwords		•				٠	•	•	
5. Awareness Feed. 6. Encryption with user-managed keys	•					•	•	•	
7. Federated Privacy Impact Assessment							•		
8. Use of dummies		٠	٠					•	
9. Who's Listening 10. Privacy Policy Display	•								
11. Layered Policy Design									
12. Discouraging Blanket Strategies	•	٠					٠		
13. Reciprocity									
 Asynchronous notice Abridged Terms and Condition 	•	•				•	•	•	
16. Policy Matching Display									
17. Incentivized Participation	•								
18. Outsourcing [with consent] 19. Ambient Notice	•	•				•	•		
20. Dynamic Privacy Policy Display	•	•				•	•	•	
21. Privacy Labels									
22. Data Breach Notification Pattern							•		
23. Pseudonymous Messaging 24. Onion Routing		•					•	•	
25. Strip Invisible Metadata		•						•	
26. Pseudonymous Identity		٠	٠						
27. Personal Data Store 28. Trust Evaluation of Services Slides	•								
29. Aggregation Gateway		٠							
30. Privacy icons									
 Privacy-Aware Network Client Sign an Agreement 									
33. Single Point of Contact									
34. Informed Implicit Consent	•					٠		٠	
35. Enable/Disable Function		•					•	•	
 Privacy Color Coding Appropriate Privacy Icons 									
38. User Data Confinement Pattern	•	٠						٠	
39. Icons for Privacy Policies									
40. Obtaining Explicit Consent 41. Privacy Mirrors							•	•	
42. Appropriate Privacy Feedback	•	•				•		•	
43. Impactful Information and Feedback									
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Reducing their Impact	•				•				
50. Obligation Management									
51. Informed Credential Selection 52. Anonymous Reputation-based									
Blacklisting	•		•						
53. Negotiation of Privacy Policy									
54. Reasonable Level of Control		•	٠	•		٠	•	٠	
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58. Lawful Consent			•				•
59. Privacy Aware Wording							
60. Sticky Policies							
61. Personal Data Table							
62. Informed Consent for Web-based Transactions							
63. Added-noise measurement obfuscation		•					
64. Increasing Awareness of Information Aggregation							
65. Attribute Based Credentials		•					
66. Trustworthy Privacy Plug-in	•					٠	
67. [Support] Selective Disclosure	•	•		•	•		
68. Private Link				•	•		
69. Anonymity Set	•	•		•	•	•	
70. Active Broadcast of Presence							
71. Unusual Activities							
72. Strip Metadata	•	٠					
73. Identity Federation		•					
Do Not Track Pattern	•	•			•		
74. Dynamic Location Granularity	•			•		•	

7 PbD Principles by Fair Information Practice Principles (FIPPs) [7]

Fair Information Practice Principles (FIPPs) [7] comprises of five privacy principles: (1) Notice / Awareness, (2) Choice / Consent Choice, (3) Access / Participation, (4) Integrity / Security, (5) Enforcement / Redress. Detailed are presented in [7].

Table 9: Privacy Patterns Examined Against Privacy Strategies [2]

	1. Notice / Awareness	2. Choice / Consent Choice	3. Access / Participation	4. Integrity / Security	5. Enforcement / Redress
Privacy Pattern List					
Protection against Tracking Location Granularity		•			
3. Minimal Information Asymmetry	•				
4. Informed Secure Passwords	٠			٠	
5. Awareness Feed. 6. Encryption with user-managed keys	•			•	
7. Federated Privacy Impact Assessment					•
8. Use of dummies 9. Who's Listening				•	
10. Privacy Policy Display	•				
11. Layered Policy Design	٠				
12. Discouraging Blanket Strategies 13. Reciprocity		•			
14. Asynchronous notice	•				
15. Abridged Terms and Condition	•				
16. Policy Matching Display 17. Incentivized Participation	•				
18. Outsourcing [with consent]	٠				
19. Ambient Notice	•				
20. Dynamic Privacy Policy Display 21. Privacy Labels	•				
22. Data Breach Notification Pattern	•			•	
23. Pseudonymous Messaging				•	
24. Onion Routing 25. Strip Invisible Metadata				•	
26. Pseudonymous Identity		٠			
27. Personal Data Store 28. Trust Evaluation of Services Slides			•		
29. Aggregation Gateway				•	
30. Privacy icons	•				
31. Privacy-Aware Network Client 32. Sign an Agreement	•				
33. Single Point of Contact	•	•		٠	
34. Informed Implicit Consent	٠	٠			
35. Enable/Disable Function36. Privacy Color Coding		•			
37. Appropriate Privacy Icons	•				
38. User Data Confinement Pattern				٠	
39. Icons for Privacy Policies40. Obtaining Explicit Consent	•	•			
41. Privacy Mirrors	•		•		
42. Appropriate Privacy Feedback	•				
43. Impactful Information and Feedback 44. Decoupling [content] and	•				
Location Information Visibility				•	
45. Platform for Privacy Preferences 46. Selective Access control	•				
47. Pay Back					
48. Privacy Dashboard	٠	٠	٠		
49. Preventing Mistakes or Reducing their Impact	•				
50. Obligation Management					
51. Informed Credential Selection	•				
52. Anonymous Reputation-based Blacklisting					
53. Negotiation of Privacy Policy	•				
54. Reasonable Level of Control 55. Masquerade		•			
56. Buddy List		•			
57. Privacy Awareness Panel	•				
58. Lawful Consent 59. Privacy Aware Wording	•	•			
60. Sticky Policies	-				
61. Personal Data Table	•		•		
62. Informed Consent for Web-based Transactions63. Added-noise measurement obfuscation	•	•			
64. Increasing Awareness of Information Aggregation	٠				
65. Attribute Based Credentials					

67. [Support] Selective Disclosure		•	
68. Private Link		•	•
69. Anonymity Set			•
Active Broadcast of Presence		•	
71. Unusual Activities	•		•
72. Strip Metadata			
73. Identity Federation			_
Do Not Track Pattern			•
74. Dynamic Location Granularity			•

8 PbD Guidelines by (OECD) Oleary 1995 [8]

There are eight OECD Personal Privacy Guidelines, namely, (1) Collection limitation, (2) Data quality, (3) Purpose specification, (4) Use limitation, (5) Security safeguards, (6) Openness, (7) Individual participation, (8) Accountability. More details can be found in [8].

Table 10: Privacy Patterns Examined Against Privacy Strategies [2]

	ation		ation		urds		ipation	
	ion limit	ality	e specific	itation	y safegua	ss	ual partic	tability
	1. Collection limitation	2. Data quality	3. Purpose specification	4. Use limitation	5. Security safeguards	6. Openness	7. Individual participation	8. Accountability
Privacy Pattern List								
1. Protection against Tracking	•							
2. Location Granularity	•		٠					
3. Minimal Information Asymmetry						•		
 Informed Secure Passwords Awareness Feed. 					•			
6. Encryption with user-managed keys					•	•	•	
7. Federated Privacy Impact Assessment								•
8. Use of dummies 9. Who's Listening					•	•		
10. Privacy Policy Display								
11. Layered Policy Design						•		
12. Discouraging Blanket Strategies							•	
13. Reciprocity 14. Asynchronous notice							•	
15. Abridged Terms and Condition						•		
16. Policy Matching Display						٠		
17. Incentivized Participation							•	
18. Outsourcing [with consent]19. Ambient Notice				•		•	•	•
20. Dynamic Privacy Policy Display						•		
21. Privacy Labels						٠		
22. Data Breach Notification Pattern 23. Pseudonymous Messaging	•				•	•		
24. Onion Routing	•			•	-			
25. Strip Invisible Metadata	٠							
26. Pseudonymous Identity	٠						٠	
27. Personal Data Store28. Trust Evaluation of Services Slides		•					•	
29. Aggregation Gateway				•	•			
30. Privacy icons						٠		
31. Privacy-Aware Network Client						•		
32. Sign an Agreement33. Single Point of Contact						•		
34. Informed Implicit Consent						٠		
35. Enable/Disable Function							•	
36. Privacy Color Coding						•		
 Appropriate Privacy Icons User Data Confinement Pattern 	•			•		•		
39. Icons for Privacy Policies						•		
40. Obtaining Explicit Consent						٠	٠	
41. Privacy Mirrors 42. Appropriate Privacy Feedback								
43. Impactful Information and Feedback						•		
44. Decoupling [content] and								
Location Information Visibility 45. Platform for Privacy Preferences	•							
46. Selective Access control						•		
47. Pay Back							•	
48. Privacy Dashboard		٠				٠	٠	
49. Preventing Mistakes or Reducing their Impact						•		•
50. Obligation Management								•
51. Informed Credential Selection						•		
52. Anonymous Reputation-based					•			
Blacklisting 53. Negotiation of Privacy Policy							•	
54. Reasonable Level of Control							•	
55. Masquerade	•						•	
56. Buddy List 57. Privacy Awareness Panel						•	•	
58. Lawful Consent							•	
59. Privacy Aware Wording						•		
60. Sticky Policies								•
61. Personal Data Table 62. Informed Consent for Web-based Transactions								
					•	•	-	
63. Added-noise measurement obfuscation								
					•	٠		

67. [Support] Selective Disclosure			•
68. Private Link			•
69. Anonymity Set		•	
Active Broadcast of Presence			•
71. Unusual Activities		•	•
72. Strip Metadata	•		
73. Identity Federation			
Do Not Track Pattern		•	
74. Dynamic Location Granularity	•		

9 PbD Goals by Rost and Bock [9]

Rost and Bock [9] have proposed six privacy goals: (1) Availability, (2) Integrity, (3) Confidentiality, (4) Transparency, (5) Unlinkability, (6) Ability to intervene. More details can be found in [9].

Table 11: Privacy Patterns Examined Against Privacy Strategies [2]

	-			•	-		-
							6. Ability to intervene
			2. Integrity	lity	Ś.	×.	ter
		lity		ntia	enc	ilit	.E.
		abij	rity	der	par	kat	ž
		vail	teg	guo	ans	nlin	bili
		1. Availability	- E	Ŭ.	4. Transparency	5. Unlinkability	Υ.
		-	0	ŝ	4	ŝ	9
Privacy Pattern List							
1. Protection against Tracking							
2. Location Granularity							
3. Minimal Information Asymmetry		٠	•			•	
4. Informed Secure Passwords							
5. Awareness Feed.			•		•		
6. Encryption with user-managed keys 7. Federated Privacy Impact Assessment			•	•			•
8. Use of dummies			•			•	
9. Who's Listening					٠		
10. Privacy Policy Display					٠		
11. Layered Policy Design					•		
12. Discouraging Blanket Strategies							•
13. Reciprocity 14. Asynchronous notice							•
15. Abridged Terms and Condition							
16. Policy Matching Display					•		
17. Incentivized Participation							٠
18. Outsourcing [with consent]					•		٠
19. Ambient Notice 20. Dynamic Privacy Policy Display					•		
20. Dynamic Privacy Policy Display 21. Privacy Labels							
22. Data Breach Notification Pattern			•		•		
23. Pseudonymous Messaging				•		•	
24. Onion Routing				•			
25. Strip Invisible Metadata							
26. Pseudonymous Identity 27. Personal Data Store		•				•	
28. Trust Evaluation of Services Slides		•			•		
29. Aggregation Gateway				•		•	
30. Privacy icons					٠		
31. Privacy-Aware Network Client					٠		
32. Sign an Agreement							•
33. Single Point of Contact34. Informed Implicit Consent							•
35. Enable/Disable Function							•
36. Privacy Color Coding					٠		
 Appropriate Privacy Icons 					•		
38. User Data Confinement Pattern						•	
 Icons for Privacy Policies Obtaining Explicit Consent 							
41. Privacy Mirrors		•			•		
42. Appropriate Privacy Feedback		•			•		
 Impactful Information and Feedback 					•		
44. Decoupling [content] and							•
Location Information Visibility 45. Platform for Privacy Preferences							
46. Selective Access control					•		
47. Pay Back							•
48. Privacy Dashboard		٠			٠		٠
49. Preventing Mistakes or							
Reducing their Impact							
50. Obligation Management 51. Informed Credential Selection			•				
52. Anonymous Reputation-based					•		
Blacklisting							
53. Negotiation of Privacy Policy					•		٠
54. Reasonable Level of Control							•
55. Masquerade							•
56. Buddy List 57. Privacy Awareness Panel		•					•
58. Lawful Consent		-			•		•
59. Privacy Aware Wording					•		
60. Sticky Policies			•				
61. Personal Data Table		•			•		
					•		•
62. Informed Consent for Web-based Transactions							
63. Added-noise measurement obfuscation							
						•	
63. Added-noise measurement obfuscation 64. Increasing Awareness of Information Aggregation 65. Attribute Based Credentials 66. Trustworthy Privacy Plug-in			•	•		•	
63. Added-noise measurement obfuscation 64. Increasing Awareness of Information Aggregation 65. Attribute Based Credentials			•	٠		•	•

70. Active Broadcast of Presence			•
71. Unusual Activities	•		
72. Strip Metadata		•	
73. Identity Federation			
Do Not Track Pattern			
74. Dynamic Location Granularity		•	

10 PbD Principle by Fisk et al. [10]

Fisk et al. [10] have proposed three privacy principles: (1) Principle of Least Disclosure, (2) Principle of Qualitative Evaluation, (3) Principle of Forward Progress. More details can be found in [10].

Table 12: Privacy Patterns Examined Against Privacy Strategies [2]

	losure	Evaluation	rogress
	L. Principle of Least Disclosure	2. Principle of Qualitative Evaluation	3. Principle of Forward Progress
	1. Pı	2. Pı	3. Pı
Privacy Pattern List			
1. Protection against Tracking	•	•	•
2. Location Granularity 3. Minimal Information Asymmetry	•	•	•
4. Informed Secure Passwords			
5. Awareness Feed. 6. Encryption with user-managed keys			
7. Federated Privacy Impact Assessment	•	٠	•
8. Use of dummies	•		•
9. Who's Listening 10. Privacy Policy Display	•	•	•
11. Layered Policy Design			
12. Discouraging Blanket Strategies	•	•	•
13. Reciprocity 14. Asynchronous notice	•	•	•
15. Abridged Terms and Condition			
16. Policy Matching Display			
17. Incentivized Participation 18. Outsourcing [with consent]			
19. Ambient Notice	•		
20. Dynamic Privacy Policy Display			
21. Privacy Labels22. Data Breach Notification Pattern			
23. Pseudonymous Messaging	٠		•
24. Onion Routing	•		•
25. Strip Invisible Metadata 26. Pseudonymous Identity		•	•
27. Personal Data Store		•	•
28. Trust Evaluation of Services Slides	٠	٠	٠
29. Aggregation Gateway 30. Privacy icons	•	•	•
31. Privacy-Aware Network Client			
32. Sign an Agreement			
33. Single Point of Contact34. Informed Implicit Consent			
35. Enable/Disable Function	•	•	٠
36. Privacy Color Coding			
37. Appropriate Privacy Icons38. User Data Confinement Pattern	•		
39. Icons for Privacy Policies	•		
40. Obtaining Explicit Consent			
 41. Privacy Mirrors 42. Appropriate Privacy Feedback 			
43. Impactful Information and Feedback			
44. Decoupling [content] and	•	•	•
45. Platform for Privacy Preferences		•	
46. Selective Access control	•	•	•
47. Pay Back	•	•	•
48. Privacy Dashboard 49. Preventing Mistakes or			
Reducing their Impact	•	•	•
50. Obligation Management			
51. Informed Credential Selection 52. Anonymous Reputation-based	•	•	•
Blacklisting			
53. Negotiation of Privacy Policy			_
54. Reasonable Level of Control 55. Masquerade			
56. Buddy List	•	•	•
57. Privacy Awareness Panel			
58. Lawful Consent 59. Privacy Aware Wording			
60. Sticky Policies			
61. Personal Data Table			
62. Informed Consent for Web-based Transactions63. Added-noise measurement obfuscation	•		•
64. Increasing Awareness of Information Aggregation	•	•	

65. Attribute Based Credentials	٠	•	٠
66. Trustworthy Privacy Plug-in			
67. [Support] Selective Disclosure	•	•	٠
68. Private Link	٠	٠	٠
69. Anonymity Set	•	•	٠
70. Active Broadcast of Presence	٠		٠
71. Unusual Activities			
72. Strip Metadata	٠	٠	٠
73. Identity Federation			
Do Not Track Pattern	•		
74. Dynamic Location Granularity	٠	٠	٠

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