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Chapter 1

Chapter Heading

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$$a \times b = c, \quad (1.1)$$

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$$\begin{array}{l} a \times b = c \\ \mathbf{a} \cdot \mathbf{b} = \mathbf{c} \end{array} \quad (1.2)$$

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 - a. Livelihood and survival mobility are oftentimes coutcomes of uneven socioeconomic development.
 - b. Livelihood and survival mobility are oftentimes coutcomes of uneven socioeconomic development.
2. Livelihood and survival mobility are oftentimes coutcomes of uneven socioeconomic development.

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Fig. 1.1 If the width of the figure is less than 7.8 cm use the `sidecaption` command to flush the caption on the left side of the page. If the figure is positioned at the top of the page, align the sidecaption with the top of the figure – to achieve this you simply need to use the optional argument `[t]` with the `sidecaption` command

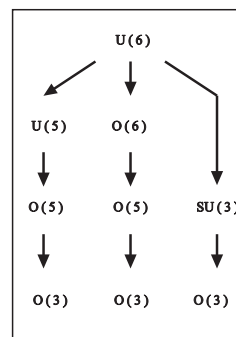
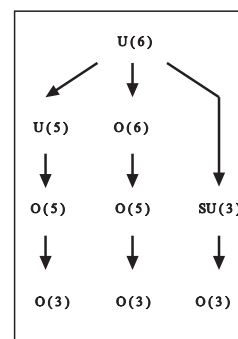


Fig. 1.2 Please write your figure caption here



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Table 1.1 Please write your table caption here

Classes	Subclass	Length	Action Mechanism
Translation	mRNA ^a	22 (19–25)	Translation repression, mRNA cleavage
Translation	mRNA cleavage	21	mRNA cleavage
Translation	mRNA	21–22	mRNA cleavage
Translation	mRNA	24–26	Histone and DNA Modification

^a Table foot note (with superscript)

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Type 1 That addresses central themes pertaining to migration, health, and disease. In Sect. 1.1, Wilson discusses the role of human migration in infectious disease distributions and patterns.

Type 2 That addresses central themes pertaining to migration, health, and disease. In Sect. 1.2.1, Wilson discusses the role of human migration in infectious disease distributions and patterns.

1.3.1 Subsection Heading

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Theorem 1.1. *Theorem text goes here.*

Definition 1.1. Definition text goes here.

Proof. Proof text goes here. \square

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Definition 1.2. Definition text goes here.

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$$a \times b = c \tag{1.3}$$

Problems

1.1. A given problem or Exercise is described here. The problem is described here. The problem is described here.

1.2. Problem Heading

- (a) The first part of the problem is described here.
- (b) The second part of the problem is described here.

References

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⁴ Always use the standard abbreviation of a journal's name according to the *ISSN List of Title Word Abbreviations*, see <http://www.issn.org/en/node/344>

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Chapter 2

Contiki OS

Assuming this is the structure...

2.1 Security in Contiki OS

Implementing security protocols poses great difficulty in IoT devices due to the constrained resources and variant applications. In this section, we will cover two security components that have so far been implemented in Contiki OS, namely LLSEC and DTLS respectively.

2.1.1 LLSEC: *noncoresec*

Link Layer Security, or LLSEC, is to provide security mechanism at Link Layer level. In Contiki OS, *noncoresec* is the 802.15.4 security instantiation that has been implemented. Its design goal is to provide:

- Data confidentiality over MAC layer payload.
- Authenticity and integrity over MAC header and MAC payload.

noncoresec is disabled by default. When enabled, different security level can be configured from no security, to encryption / authentication only, then to full encryption and authentication.

To be more specifically, *noncoresec* has the following implemented:

Block Cipher

As specified by 802.15.4 specification, AES-128 is chosen as the underlying block cipher. Contiki OS implements a software AES, but on those platforms with an AES coprocessor, such as CC2538, it can be switched to use the hardware implementation instead. The benefit for doing so is to have a better time

and energy efficiency as well as to gain potential protections against side channel analysis attacks.

Mode of Operation

Also specified by 802.15.4 specification, the AES block cipher is used in CCM* mode, i.e. CTR mode with CBC-MAC. The asterisk symbol implies the additional support of security levels and additional requirement to encode the security level into the nonce.

Key Management

A hard coded 128 bit AES key is shared among the whole network in LLSEC. This effectively means that the same key will be used for all incoming and outgoing data frames on every node.

Replay Protection

noncoresec has implemented the replay protection by comparing the received frame counter with the last frame counter from the same source.

Therefore in general, noncoresec has the following benefits:

- It prevents an eavesdropper from seeing the plaintext of MAC Layer payload.
- It prevents illegal nodes from joining the network, as nodes without knowledge of the network shared key cannot forge a message.
- It can be implemented efficiently on most platforms, especially with hardware support.

However, the following factors should also be taken into concern when adopting noncoresec as the security measures:

- Lack of flexibility. This is mostly due to the fact that the key is hard coded.
- Fixed key. As there is yet no key updating scheme implemented.
- Reused nonce. Since in CCM mode, the difference of two ciphertext is exactly the same of their according plaintext and knowing that can lead to breach of data confidentiality in many cases. The reuse may occur when the 4 bytes frame counter rounds up, or when the devices reboots which resets the frame counter back to 0.
- More discussion of 802.15.4 security can be found in [1].

2.1.2 DTLS

References

1. Sastry N, Wagner D (2004) Security Considerations for IEEE 802.15.4 Networks. Proceedings of the 3rd ACM Workshop on Wireless Security 32–42

Appendix A

Chapter Heading

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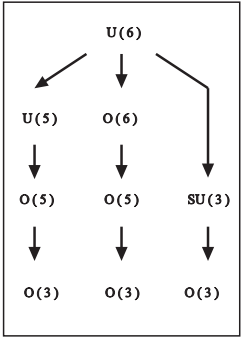
For multiline equations we recommend to use the `eqnarray` environment.

$$\begin{array}{l} \mathbf{a} \times \mathbf{b} = \mathbf{c} \\ \mathbf{a} \times \mathbf{b} = \mathbf{c} \end{array} \quad (\text{A.1})$$

A.1.1.1 Subsubsection Heading

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Fig. A.1 Please write your figure caption here



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Table A.1 Please write your table caption here

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Translation	mRNA ^a	22 (19–25)	Translation repression, mRNA cleavage
Translation	mRNA cleavage	21	mRNA cleavage
Translation	mRNA	21–22	mRNA cleavage
Translation	mRNA	24–26	Histone and DNA Modification

^a Table foot note (with superscript)

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Solutions

Problems of Chapter 1

1.1 The solution is revealed here.

1.2 Problem Heading

(a) The solution of first part is revealed here.

(b) The solution of second part is revealed here.