

Guidelines to write a report or a thesis

- Report
 - A report is a technical document, describing an engineering problem, and the work performed to solve it.
 - A report should formulate the problem under study, describe the methods used to solve it, analyse the performance of the used methods, and present the conclusion of the work.
 - The report should be organised in a way that allows an easy understanding of the work done, assuming that the reader has basic knowledge of the area, but that does not know the problem under study.
 - The report should give the reader, in a gradual way, the necessary information for the understanding of the problem, of the methods used, and of the results obtained. Hence, one should not use concepts that have not been previously introduced (except if they are of common knowledge).
- General format
 - The paper format should be A4 size.
 - The margins should be 2.5 cm, vertical and horizontal.
 - Arial 10 pt font, with a spacing of 1.5 lines should be used for normal text. A larger font should be used for headings, with additional spacing after it.
 - Arab numbering (1, 2, 3, ...) should start only at the first page of *Introduction*. Before that, small Roman numbering (i, ii, iii, ...) should be used.
 - Page numbering should start at the page following the cover page.
- Structure
 - The structure of the report should be (starting in separate pages, odd numbered, except for the *Lists*, which should not have blank pages in between them):
 - cover page, containing institution, title of the work, authors, place and date, name of supervisor, his department and institution
 - Acknowledgements
 - Abstract and Keywords (one single page for both, and the latter at the end of the page)
 - Table of Contents
 - List of Figures
 - List of Tables
 - List of Acronyms
 - List of Symbols
 - List of Software
 - 1. Introduction
 - 2. Chapter
 - 3. Chapter...
 - ...
 - ?. Conclusions
 - A. Annex ...
 - B. Annex ...
 - ...
 - References

- Contents and structure of chapters
 - The *Abstract* should state the problem under study, the methods used, and the main conclusions. It should not contain any general statements, or introductory ones, but only very short sentences. The text should be in a single paragraph, without line breaks. One should avoid including acronyms that are not of common knowledge, as well as defining them. It should contain, when it is the case, the main numerical results.
 - *Keywords* should be 5 or 6, representing the main areas of the work, and listed in a decreasing order of generality.
 - The *Table of Contents* should contain the whole structure of the report, i.e., both the parts numbered by i and the ones numbered by 1.
 - The style of the titles of chapters, sections, etc., must be uniform, namely concerning the use of capital letter for the beginning of the words.
 - *Lists* of figures and tables should contain all those existing in the report, annexes included. *Lists* of figures, tables, symbols, and others, should be sorted. *Lists of Figures* and *Tables* should contain the pages where they are located. The *List of Acronyms* should contain only acronyms in the singular. In the case of the *List of Symbols*, these should be group into three classes (Greek letters, Roman letters, and others) before being sorted; this list should contain just the meaning of the symbols, and neither their mathematical definition (equations) nor their units; do not define acronyms in this list.
 - The *Introduction* should start by giving very general information on the system/model, and as it progresses, more specific information should be given, until the topic dealt with in the report is referred. It should describe, in a concise way, the problem under study, and the main methods used in the work. It should also contain the State of the Art, with references to previous work, referring other alternatives for the solution of the problem (it is possible to present here just a superficial sate of the art, and then leave a detailed one for a following chapter). After that, a clear identification of the innovative aspects of the work should be given, and it should finish with the description of the contents and structure of the report.
 - The State of the Art should reference works by other authors, directly related to the report, briefly describing them, and addressing their differences to the work being described in the report.
 - A possible structure for the report can be: Chapter 2 – Basic concepts and state of the art of the problem under study; Chapter 3 – Theoretical development of the problem under study, and computer algorithms implementation and assessment; Chapter 4 – Analysis of results.
 - Before you start writing, establish a structure for the report, identifying chapters, sections, subsections, and topics to be addressed in each of them.
 - Do not include basic concepts, detailed descriptions, or any type of information that is not directly relevant to the problem under study.
 - Descriptions of systems historical evolution, and similar ones, should be placed in the *Introduction*. The remaining chapters should contain only technical descriptions, without historical perspectives.
 - The structure of chapters should be in a way that sections and subsections are included, each one containing separate parts of the work. The first section must start at the beginning of the chapter. Do not include sections or subsections with a length less than one page. Do not create only one section (subsection) inside a chapter

(section). In a chapter (section) the text appearing before the first section (subsection) should only describe its contents, and not give an introduction or do any other considerations. Avoid creating subsections with too many levels, since they should be used only up to the 3rd level, e.g., 1.1.1.

- Matters should be addressed in a coherent perspective.
- When performing measurements or simulations, and one describes their results, one should take care in describing also the conditions and assumptions within which they were performed.
- When describing a model, one should take care in including objectives, assumptions, application conditions, input parameters, model description, output parameters, and errors associated with it.
- The inclusion of figures and tables must be followed by their analyses, which should not be limited to a simple reading of numbers.
- One should show figures and tables that explore all analysed parameters.
- For all parameters analysed in figures and tables, one should show, and analyse, the equation relating input and output parameters.
- When one uses results from other authors, one should take care in understanding the assumptions, the conditions for application, and the errors associated with it.
- When routines and/or programs are used to perform mathematical operations (e.g., matrix inversion or eigenvalues calculation), one should reference the source of the routines/programs, indicate the error/precision associated with it, and inform about the required calculation time and memory.
- When comparing two or more curves, functions, models, etc., one should assess that comparison by using numerical parameters (e.g., correlation coefficient, and mean, absolute mean and standard deviation of the error), besides the graphical comparison.
- Any statistical distribution should be defined, at least, by the mean value and the standard deviation.
- Before initiating the programming of a model or simulator, one should fully list the input and output parameters, as well as the relationships among them.
- When developing simulators, one must perform its assessment, namely, by validating the outputs for well-known inputs, and by analysing the sensitivity of the outputs for variations of the inputs. Moreover, tests should be carried out, concerning the establishment of the number of simulations, in terms of error, sensitivity, and standard deviation. In time based simulators, one should be careful in only using results produced after the simulator has achieved stability.
- Any developed model/algorithm/simulator has to be assessed, by comparing results coming from other approaches.
- Before describing a program/simulator, fully describe the theoretical model associated with it.
- Before the analysis of results, the scenarios taken for implementation should be fully described.
- Results should be analysed in both an absolute and relative perspectives, comparing with well known values, and analysing their meaning for the system being studied. Take a critical approach, and don't just read the graphs.
- Your work should pass Len Kleinrock's test: 1) "Conduct the 100 years test", i.e., will your work matter in 100 years from now?; 2) "Don't fall in love with your model", i.e., do look into alternative approaches; 3) "Beware of mindless simulations", i.e., check if they carry any meaning; 4) "Understand you own results", i.e., do a proper

analysis of the results; 5) “Look for “Gee, that’s funny””, i.e., make an effort to look beyond the immediate results you obtain.

- *Conclusions* are supposed to have the main results from the work, presenting numbers for the main results, orders of magnitudes, which techniques or models were the best, a critical analysis of the limitations. It should start by formulating the problem addressed in the work, after which conclusions from the various chapters should be presented, summarising the developed models/algorithms/programs, and it should finish by indicating possible directions for future work.
- *Annexes* contain additional information, that is not the main concern of the work or that is supplementary to the main work (like presenting graphs for other simulated situations, or the derivation of an expression). Annexes should be numbered (with letters) by the order they are referred to in the text.
- General
 - Acronyms must always be defined the first time they are used in the text.
 - Write the report in the present form (except if you are reporting on experiments or measurements)
 - Do not use the first person (either singular or plural), but rather the impersonal, i.e., use “one [does something]” instead of “we [do something]”. For example:
This paper addresses how to write a report. One should not be offended if many of the hints given here are already known.
 - Avoid telegraphic or literary styles of writing, that is to say, sentences should not be too short or too long, and do not use a non-technical way of writing.
 - Do not use shortcuts, like “it’s” and “don’t”, but rather the full wording, like “it is” and “do not”.
 - The plural of abbreviations is done by adding an “s”, without the apostrophe (which is reserved for the possessive case), e.g.,
BSs
instead of
BS’s
 - In English, you have always to put the person in the sentence, e.g.,
It is used in soft handover, ...
instead of
Is used in soft handover, ...
or
A model is used for the evaluation of efficiency performance.
instead of
It is used a model for the evaluation of efficiency performance.
 - When writing in English, be aware of the verbs, e.g.:
 - To associate with (to make a connection between people or things in your mind)
 - To be composed of (to be made or formed from several parts, things or people)
 - To be responsible for (to be the cause of something)
 - To consist of (to be formed from the things or people mentioned)
 - To divide into (to separate or make something separate into parts)
 - To focus on (to give attention to one particular subject)
 - To refer to (to mention or speak about someone or something)
 - To relate to (to make a connection between two or more things)
 - When writing in English, be aware of the order, e.g.:
 - use “in order to [do something]” instead of “to [do something]”.
 - use “to take [something] into account” instead of “to take into account [something]”.

- use “[something] being” instead of “being [something]”.
- Common abbreviations:
 - e.g. (exempli gratia) – for example
 - et al. (et aliae) – and others (for people)
 - etc. (et cetera) – and others (for things)
 - i.e. (id est) – that is to say
- Avoid using adjectives, except when they can be quantified.
- Use the Spelling check from the word processor, before printing the text. When writing in English, use UK Spelling. Do not mix orthographies in the (few) cases where this is not a single one, e.g., use “s” instead of “z” for word endings in “sed”, “sing” and “sation”.
- Paragraphs should be separated from each other, by either additional vertical space before them, or by additional horizontal space at the beginning of each one, but one should not use both.
- When using itemised lists, a coherent perspective should be used, i.e., capital letter at the beginning and a dot at the end, or, small letter at the beginning and a dot and comma at the end.
- The report should have a coherent and homogeneous style.
- Pages should be numbered at the footnote, either at the centre, or alternative at right and left for odd and even pages, respectively.
- Do not include references or defined acronyms in the titles of Chapters, Sections or Subsections.
- Do not leave the title of a section or subsection isolated at the end of a page.
- Do not start a section by referring to its title, i.e., one should not write:

2.2.2. Erlang Model
This model is used in ...
- When an entity of the report is mentioned (i.e., chapters, sections, figures tables, etc.), one should use capital letter for a specific one, and small letter for a general one, e.g.:

Figure 2.1 presents the model under analysis.
One of the figures is not correct.
- Equations and mathematics
 - Equations should not be inserted in the text, but rather put on line for themselves, left justified, and numbered by chapters at the right. For example:

$$c = f \lambda \tag{3.4}$$
 - The mathematical symbols should be written in Italic form, except for the Greek ones. All of them should be written with a font size equivalent to the remainder of the text, except for sub- and superscripts, which should be smaller. Units should not be written in Italic.
 - Always define the symbols after the equations, the first time they are introduced, following the style:

$$P_{EIRP[\text{dBm}]} = P_{t[\text{dBm}]} + G_{t[\text{dBi}]} \tag{2.1}$$

where:

 - P_{EIRP} : equivalent isotropic radiated power
 - P_t : radiated power
 - G_t : transmitting antenna gain
 - Always indicate the units of the parameters (in subscript, not in italic), at least when they are not in their basic ones. For example

$$P_{EIRP[\text{dBm}]} = P_{t[\text{dBm}]} + G_{t[\text{dBi}]} \tag{2.1}$$
 - Use brackets, i.e., [], and not parentheses, i.e., (), for units.

- Do not use the same symbol to signify different entities.
- In the (few) cases where units can be written in more than one way, use a uniform writing, e.g., use either “bps” or “bit/s”, but not both.
- A symbol should always be written in the same form, i.e., with the same font size and type, with the same meaning, etc.
- Symbols should be designated in a coherent way, e.g., probabilities should be of the type P_x , and numbers (quantities) of the type N_x .
- Mathematical entities should be designated by symbols, and not by abbreviations. For example, one should use P_{Tx} instead of Pot_trans.
- Vectors and matrices should be represented by letters in bold, and not by using arrows.
- The symbol for multiplication is “×” (the product symbol), not “x” (letter x) or “*” (asterisk).
- When one has numbers larger than one thousand, one should use a space separating groups of thousands, i.e., one should use 12 345 instead of 12345.
- When using numbers lower than 1, one should always put the zero on the left, i.e., one should use 0.25 instead of .25.
- One should not separate numbers from their units when there is a break in the line, using for that purpose the “nonbreaking space” between the number and the unit.
- An adequate number of significant digits should be used, i.e., one should not use either a low number (e.g., 0.1 km for the width of a street) or a high one (e.g., 1.123456 km for the distance between a user and the base station).
- Refer to equations only by their number, except in the beginning of a phrase. For example:
One can deduce from (2.30) that there is no dependency on the frequency. Equation (3.34) shows the dependency with frequency.
- Do not indicate equation’s number when they appear sequentially in the text. For example, one should write:
 $EIRP$ is given by
$$P_{EIRP [dBm]} = P_e [dBm] + G_e [dBi] \quad (5.12)$$
- Figures and tables
 - There are Figures and Tables, and nothing else (like Graphs, Drawings, ...).
 - If one wishes, one can use the shortcut Fig.
 - Figures and Tables should be numbered by chapter.
 - Figures and Tables should be horizontally centred in the text.
 - In general, numbers should be given with the same accuracy in each table. The accuracy should be defined as a function of the parameter under study, i.e., it should neither be too high (which will carry no meaning) nor too low (which will not be enough).
 - Numbers in tables should not be centred, but aligned by their order of magnitude, so that their different values are easily perceived.
 - Captions’ text must be finished by “.”.
 - In the case of graphs, captions should contain the description of the entity being represented (y axis) and of the variable (x axis), besides the conditions within which results were obtained.
 - Captions must be included, and they should be centred. For example:

Figure 2.1 - Mobile unit.

Table 3.5 - List of parameters.

- Figures' captions should come after them, while Tables' should be located before.
- In the case Figures have multiple graphs (like (a), (b), (c)), the particular caption should be included near the graph, and not together with the general caption. For example,

(a) Urban.

(b) Suburban.

Figure 3.1 – Comparison of blockage for urban and suburban scenarios.

- Additional spacing should be left before and after them.
- The spacing in between a figure and its caption, or between a table and its caption, should be the one of normal text.
- Figures and Tables should be placed in the text only after they have been referenced, which should always happen. References should be done in an explicit way, instead of referring to their position. For example, one should use
Fig. 3.1 shows the behaviour of the signal power as a function of the delay spread.
instead of

The figure below shows the behaviour of the signal power as a function of the delay spread.

- When Figures and Tables do not fit at the end of a page, one should not leave the corresponding space empty, and locate them at the beginning of the next page. Rather, one should continue the text, filling in the space until the beginning of the next page, where the Figures and Tables should be located. Therefore, it is not compulsory to put them immediately after they are referred to in the text.
- Figures showing graphs must have legends in both axes, with the entity that is represented and its units. For example
 P [dBm]
- Scales in graphs in Figures, especially the vertical one, should be chosen so that the represented function is expanded as much as possible, instead of compressing it by using a large scale. The exception occurs when one wants to compare curves in graphics on the same page.
- When the entity in the abscissas' axis is a numerical one, the scale must be ranged numerically.
- Do not define acronyms in Figures or Tables. They should be defined in the text before the Figures or Tables where they are used.
- Captions and scales in Figures, as well as the contents of Tables, should be written with a font size equivalent to the remainder of the text.
- The several curves in a graph should be differentiated through the simultaneous use of colours and symbols.
- Captions of curves in a Figure must be located in a way that they do not superimpose with the curves themselves.
- Do not repeat the title of a graph above it; that information should be in the caption of the Figure.
- When a Table does not fit into a single page, the caption should be used again in the continuing pages, explicitly mentioning continuation, as for example,
Table 4.5 (contd.) – Model parameters.
- When you refer to Figures and Tables in the text, they should not appear between parentheses. For example, one should use:
One can observe that power decays monotonously, Fig. 3.4.
instead of
One can observe that power decays monotonously (Fig. 3.4).

- If you copy Figures and Tables from other authors, refer to them in the caption. For example:

Figure 4.5 - Propagation scenario (extracted from [6]).

- References

- References should be included along the text, when results from other authors are used or referenced. For example:

The results from Meat and Fish [2] have been extensively used since the beginning of mankind.

- It is not usual that you copy full sentences from other authors, but if you need to do it, do put them in between quotation marks (“...”), and do put the reference (or you will be committing plagiarism, a very serious offense!).
- Use only references from a confirmed source, such as books, papers, reports, and others. Internet website references should be avoided, except if they are from a reliable source (e.g., wikipedia type of sites should be avoided).
- References to theses should only be used for their specific results, and not for general aspects that are not the result of the author’s work.
- There are two, alternative, methods to do references:
 - by using numbers, where references should be numbered following the order they appear in the text;
 - using 4 letters and 2 digits, where the 4 letters refer to the authors and the 2 digits refer to the year of publication; in the case of papers by the same authors in the same year, one should add a letter after the digits (a, b, c, d, ...).
- Do not include references that were not quoted in the text.
- One can also include a list of Bibliography, containing papers that were not referenced along the text, but that are important to a better understanding of the work in certain aspects.
- In the text, but never in the list of references, one can use et al. when referring to more than two authors. For example, Okumura et al. [2] performed measurements in a wide range of frequencies.
- References should be given in full and coherent form. The format should be (the two numbering methods are shown, but only one should be used):
 - For a book
 - [1] - [Pars92] - J.D. Parsons, *The Mobile Radio Propagation Channel*, Pentech Press, London, UK, 1992.
 - i.e., author(s)’ name(s), book’s title (in italic), publisher’s name, edition’s location, edition’s country, edition’s year.
 - For a chapter in a book
 - [2] - [MaCo04] - M.G. Marques and L.M. Correia, “A Wideband Directional Channel Model for Mobile Communication Systems”, in S. Chandran (ed.), *Adaptive Antenna Arrays*, Springer, Berlin, Germany, 2004.
 - i.e., author(s)’ name(s), chapter’s title, editor(s)’ name(s), book’s title (in italic), publisher’s name, edition’s location, edition’s country, edition’s year.
 - For a paper in a journal
 - [3] - [TsAP00] - G.V. Tsoulos, G.E. Athanasiadou and R.J. Pichocki, “Low-Complexity Smart Antenna Methods for Third-Generation W-CDMA Systems”, *IEEE Transactions on Vehicular Technology*, Vol. 49, No. 6, Nov. 2000, pp. 2382-2396.
 - i.e., author(s)’ name(s), paper’s title, journal’s name (in italic), edition’s volume, edition’s number, edition’s month (shortened to 3 letters, except for months with 4 letters), edition’s year, pages.

- For a paper in a conference
[4] - [CoFr94] - L.M. Correia and P.O. Francês, "A Propagation Model for the Average Received Power in an Outdoor Environment in the Millimetre Waveband", in *Proc. of VTC'94 - 44th IEEE Vehicular Technology Conference*, Stockholm, Sweden, June 1994.
i.e., author(s)' name(s), communication's title, conference's name (in italic), conference's location, conference's country, conference's month (shortened to 3 letters, except for months with 4 letters), conference's year.
- For a thesis
[5] - [Mock89a] -S. Mockford, *Narrowband Characterization of UHF Mobile Radio Channels in Rural Areas*, Ph.D. Thesis, University of Liverpool, Liverpool, UK, 1989.
i.e., author's name, thesis' title (in italic), thesis' type, thesis' university, university's location, university's country, thesis' year.
- For an internal report
[6] - [CBMF94] -L.M. Correia, J.M. Brázio, S. Mohamed, P.O. Francês, F. Velez and J. Gilliland, *Report on Design Rules for Cell Layout*, RACE-MBS Project, Deliverable R2076/IST/2.2.3/DS/P/044.b1, European Commission - DG XIII/B, Brussels, Belgium, Nov. 1994.
i.e., author(s)' name(s), report's title (in italic), report's origin, report's reference, institution for accessing the report, institution's location, institution's country, report's year.
- For a document from the Internet
[7] - [Mock89b] -S. Mockford, *Narrowband Characterization of UHF Mobile Radio Channels in Rural Areas*, Internal Report, University of Liverpool, Liverpool, UK, 1989 (<http://uliverpool.ac.uk/~radiolab/thesis/doc12.pdf>).
i.e., add the address between parentheses.
- For an Internet site
[8] - [GROW06] - GROW – A Group for Research on Wireless, <http://grow.inov.pt>, Jan. 2006.
i.e., the title or explanation on the content of the website, the address (in this case, the year to be put in the “letters plus digits” method should be the one when the site was visited), and the month and year of the last time it was visited.
- When books, theses, papers in journals and conferences, and reports, are not written in English, their titles should be translated into English, mentioning afterwards the original language in which it was written. For example:
[9] - [Betr00] - S. Betrencourt, *Characterisation of the propagation channel in road and railway tunnels* (in French), Ph.D. Thesis, University Lille, Lille, France, Jan. 2000
- When possible, the internet address of a reference should be put at its end (as in a document form the Internet).
- The list of references at the end of the report should be sorted, either by numbering order or by alphabetic one, according to the case.
- Some word processors have an automatic way to manage references, which one should use, if possible.
- **Before printing the report, verify if it has been written according to these guidelines. Do exercise your self-criticism before giving the text to anyone else to read it.**

1999-02-02

Luis M. Correia

Revised 2017-01-08

(including suggestions from colleagues and students)

Annex I

Prefixes

Multiples	Prefix	Abbreviation
10^{24}	yotta	Y
10^{21}	zetta	Z
10^{18}	exa	E
10^{15}	peta	P
10^{12}	tera	T
10^9	giga	G
10^6	mega	M
10^3	kilo	k
10^2	hecto	h
10	deka	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a
10^{-21}	zepto	z
10^{-24}	yocto	y