

S-38.3215 Special Course on Networking Technology

Fall 2005

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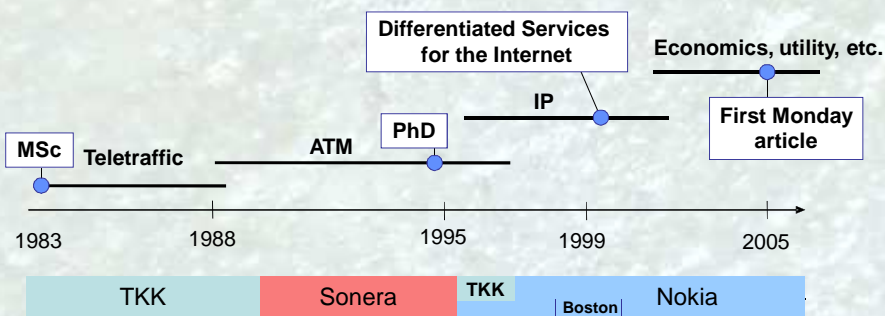
Critical thinking

Content today

- Background
- Practical issues
- Intro to the topic
- Very short summary of First Monday article
- Some more thoughts about
 - different perspectives
 - network evolution

Background

- Kalevi Kilkki



- Now on sabbatical leave, contact
 - kalevi.kilkki@luukku.com "freely available"

Objective

- Critical thinking, Google hits:
 - “Critical thinking”: 14 million
 - “Critical thinking about”: 174 000
 - “Critical thinking about technology“: 866
 - “Critical thinking about media“: 743
 - “Critical thinking about telecommunication“: 0
- Objective of this course:
 - To develop skills in critical thinking about communication networks and services

Course content

- Critical thinking = a skill (more than knowledge)
- Skill must be practiced
 - personal exercise:
“critical assessment of a technology or service”
 - active discussion
- Lessons 2 * 3 hours
 - 9.11. Intro, some tools
 - 16.11. Examples
Selection of topics for personal / group work
(preferably with your own interest – think beforehand)
 - 30.11. Presentations & discussion
 - 7.12. Presentations & conclusion
- Examination or “controlled exercise”

Other issues

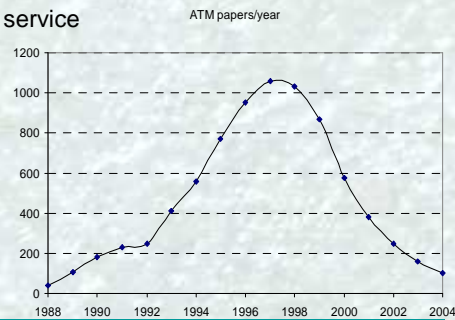
- Assistant / contact person = ?
- Participants
 - Background
 - Motivation
 - Willingness to do exercise
- ECTSs and grade depend on
 - Presentation (~60%)
 - min: slides
 - target: paper submission
 - Final examination (~40%)
 - Course activity (may improve by 1)
- Any other issue?

Material

- Possible readings
 - See course web-page
 - at least look at some of those, read what you think most interesting...
 - First Monday article could be considered compulsory
- Slides will be available
- but, once more, critical thinking is a skill

Motivation...

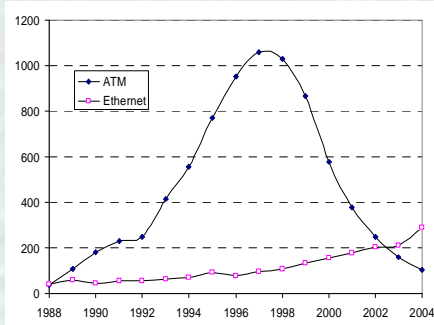
- What is the motivation of the authors (in addition to find the Truth)?
 - Get as many papers as possible published
 - Prove their cleverness or capabilities in a certain specific field
- ⇒ Most papers tend to
 - be uncritical with narrow scope,
 - repeat the old story of the great benefits and prospects of the technology of service
- Very few papers
 - critical toward the current hot topic, or
 - assessing any clear failure
- 100 000 papers can be wrong (ATM)



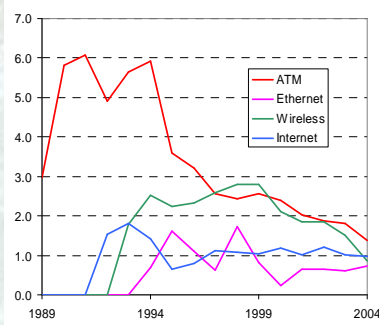
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More statistics



Papers per year with
ATM or Ethernet in abstract



Share of QoS papers
with the keyword
compared to
average share of QoS papers

(More on the 2nd lecture)

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“Sensible design principles for new networks and services”

<http://www.firstmonday.org/>, January 2005

“Sensible design principles for new networks and services”

- Value of a new application or service
- Concentrate on practical uses
 - likely to become everyday routines for majority of customers,
 - instead of seeking special cases with the utmost attractiveness.
- Be critical with methods that
 - are useful only with applications that are not used (almost) every day
 - are not important for majority of users
 - those applications shall affect the general design

“Sensible design principles for new networks and services”

- Development of a new technology must be based on core principles
- Core principles must be able to limit the innate trend toward complexity
- Be cautious with technologies without defined core principles
 - those are often too complex anyway...
- Be particularly critical to methods that
 - are against the core principles of the network
 - particularly, get familiar with Internet principles

“Sensible design principles for new networks and services”

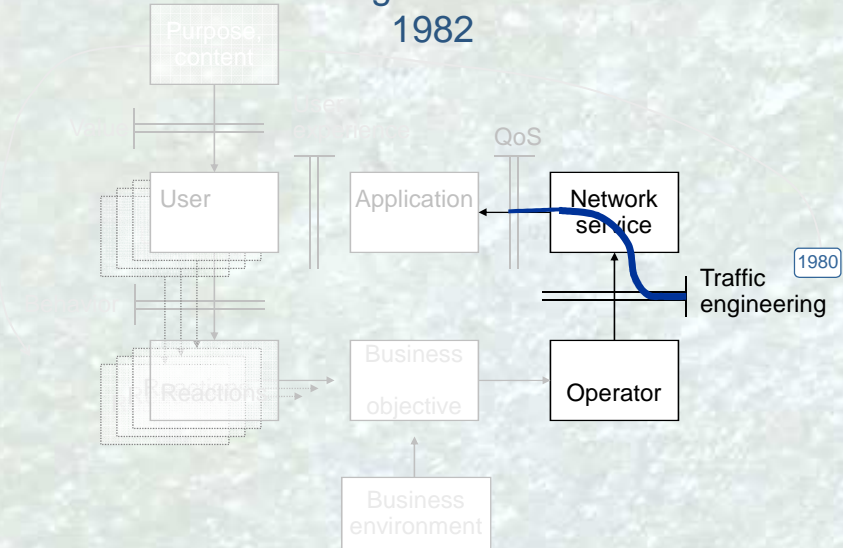
- When a current technology is developed further
 - Look for methods and mechanisms that
 - serve **both** the interest of key stakeholders,
 - and the common good
 - Be critical with methods without clear motivation for key players
 - pure common good is, unfortunately, not enough
 - more about this later...

Summary: How to be more realistic?

- Think
 - Business benefits
 - Operator decisions are business decisions
 - Benefits must be significant compared to risks and additional costs
 - User benefits
 - Particularly related to everyday routines
 - Simple assessment is often easy (e.g. MMS)
 - Different perspectives
 - Network, application, user, business
 - Realistic network evolution
 - The size of gain is not the only issue (game theory)

Perspectives

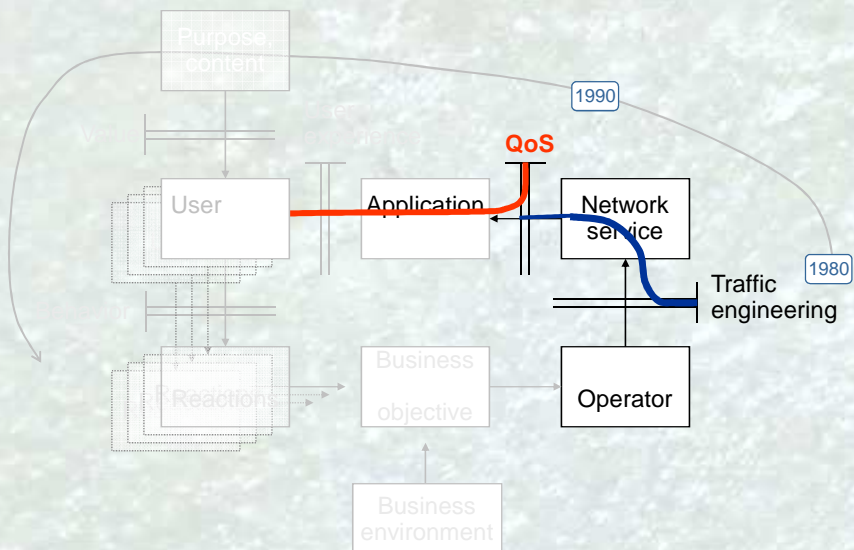
A short History of perspectives to design of telecom networks 1982



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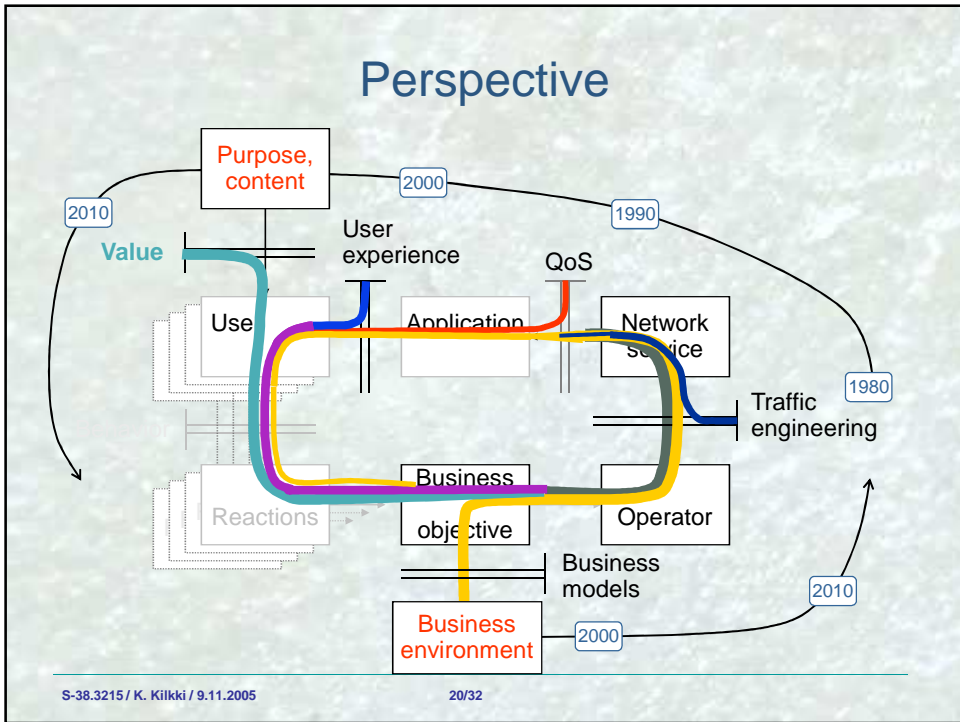
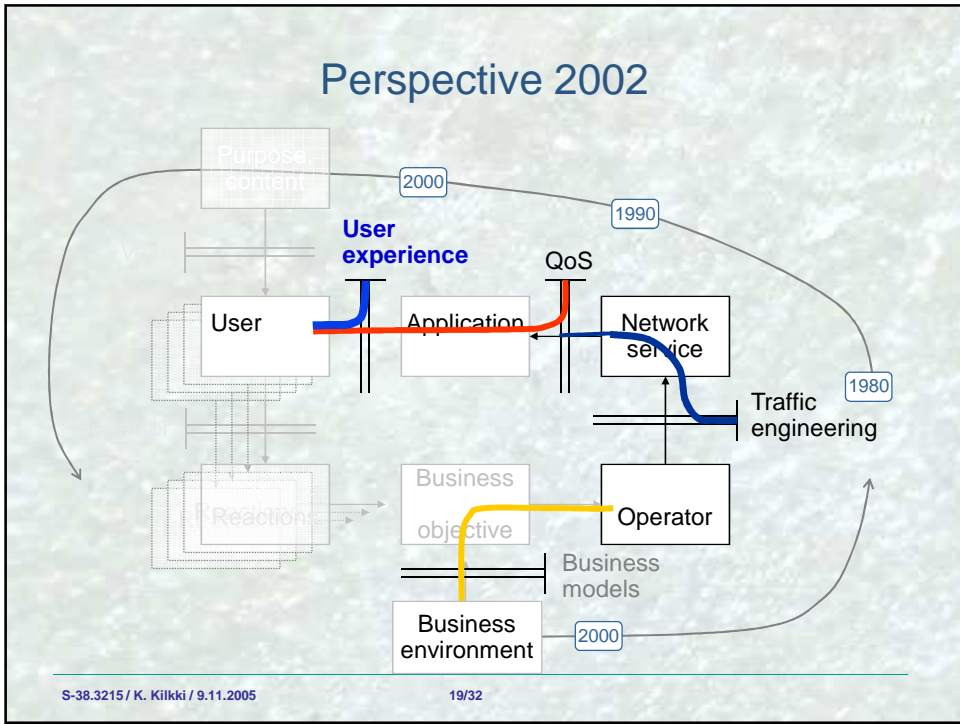
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Perspective 1992

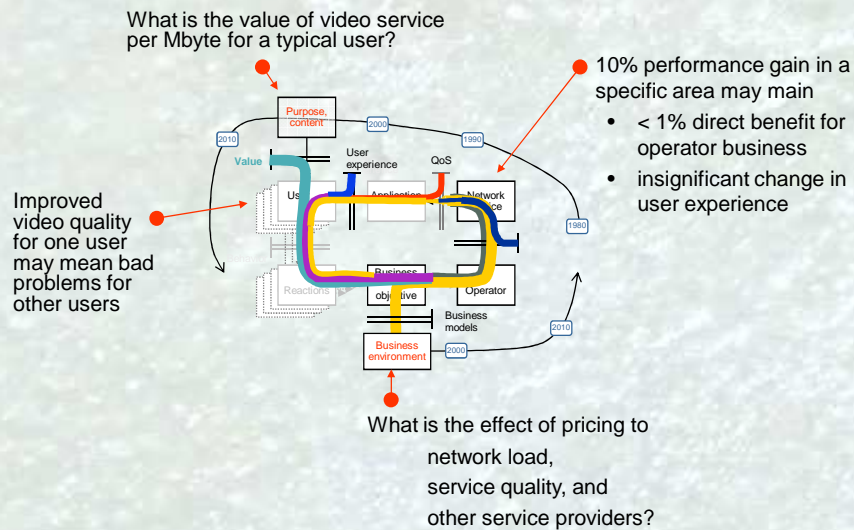


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No separate issues, no one right perspective



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Lessons

- All issues shall be assessed as a part of the whole
 - hard to assess but absolute necessary
 - 10% performance gain is not a meaningful result for a service provider
 - rough guess: 95% of ATM papers had this defect
- At least consider
 - Realistic business effects,
 - both benefits and cost
 - Main effects on user experience, if any
 - not only for the target users, but all other users as well
- Use first your common sense – then some more formal analysis, if needed and possible

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Evolution

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Some basic rules...

- With any new method proposed for communication network
 - Necessary to identify the type of game to which the method leads the competing operators.
 - An analysis of common good (the sum of benefits in the last phase) does not provide a sufficient basis for predicting the success of a new method.
 - Analyze the gain obtainable from the first user of the method and the gains or harms of those operators that are introducing the method later (or never).
- How?

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Methods and evolution

Methods that are beneficial

- 1a. only when **all operators** implement them, and the benefit is **equal** among all operators.
- 1b. only when **all operators** implement them, but the benefit **varies** considerably among operators.
- 2a. for an **individual operator** even when applied only by the operator, and all operators can achieve **similar benefits** by applying it **later**.
- 2b. for an **individual operator** even when applied only by the operator, but the benefit **varies** considerably among operators.
3. for an **individual operator** when applied only by the operator, and are **harmful** for other operators, if they are **not** using the **same** method.
4. for an **individual operator** even when applied only by the operator, but **harmful** for other operators, even when they are using the **same** method.

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Evolution type 1a

Phase Operator	1	2	3	4
C	o	o	o	+
B	o	o	-	+
A	o	-	-	+

- Beneficial only for an **individual operator** even when applied only by the operator, and all operators can achieve **similar benefits** by applying it **later**.
- Very problematic, but common!
 - many QoS systems
 - possible with strong common regulatory body, like ITU (earlier)
- Examples?

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Evolution type 1b

Phase Operator	1	2	3	4
C	o	o	o	o
B	o	o	-	+
A	o	-	-	+++

- Beneficial only when **all operators** implement them, and the benefit **varies** among all operators.
- Even if phase 4 were somehow reached, operator C has an incentive to return to phase 3 (due to competition)
 - practically impossible to reach phase 4, even with great gains for some operators

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Evolution type 2a

Phase Operator	1	2	3	4
C	o	o	o	+
B	o	o	+	+
A	o	+	+	+

- Beneficial for an **individual operator** even when applied only by the operator, and all operators can achieve **similar benefits** by applying it **later**.
- Temporary benefits during middle phases
 - still there is a business risk for early adopters (because the real outcome is difficult to predict)
 - strong motivation for patenting!

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Evolution type 2b

Phase Operator	1	2	3	4
C	o	o	o	o
B	o	o	+	+
A	o	+++	+++	+++

- Beneficial for an **individual operator** even when applied only by the operator, but the benefit **varies** considerably among operators.
- Due to large temporary benefits during middle phases, evolution will likely be rapid
 - but stops to some middle phase

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Evolution type 3

Phase Operator	1	2	3	4
C	o	-	--	+
B	o	-	+	+
A	o	+	+	+

- Beneficial for an **individual operator** when applied only by the operator, and are **harmful** for other operators, if they are **not** using the **same** method.
- Due to large temporary benefits during middle phases, evolution will likely be very rapid
 - even a small gain is sufficient
 - patenting very beneficial

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Evolution type 4

Phase Operator	1	2	3	4
C	o	-	--	-
B	o	-	o	-
A	o	+	o	-

- Beneficial for an **individual operator** even when applied only by the operator, but **harmful** for other operators, even when they are using the **same** method.
- Extremely problematic: evolution tend to lead to harmful result for everyone!
 - Note: every separate move of each operator is reasonable!
 - Need for common regulator!

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Lessons

- ?

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Critical thinking

To develop systematic skills in critical thinking
about communication networks and services

Course content

- Lessons 2 * 3 hours
 - 9.11. Intro, some tools
 - 16.11. Selection of topics for group work
 - Some thoughts about ATM & 3G
 - “history”
 - different perspectives
 - network evolution
 - 30.11. Presentations & discussion
 - 7.12. Presentations & conclusion
 - x.12. Examination or “controlled exercise”

Other issues

- Assistant
 - Timo Smura timo.smura@tkk.fi
- ECTSs and grade depend on
 - Presentation (~60%)
 - min: slides
 - target: paper submission
 - Final examination (~40%)
 - Course activity (may improve by 1)
- Any other issue?

Possible topics for critical evaluation

- Networks
 - Ad-hoc
 - Sensor
 - 4G
 - ...
 - Services
 - Mobile TV
 - Mobile music
 - PoC
 - ...
 - Tools / Methods
 - Policy control
 - Optimization
 - ...
-
- (possible) Approach
 - Select some “typical”, non-critical papers about the topic
 - Make a brief analysis
 - Motivation and goal of the authors
 - Do they authors think themselves?
 - How they select and mix “facts” and opinions
 - etc.
 - Make an own critical, multi-perspective analysis

(Repetition) What to consider

- **Business benefits**
 - Operator decisions are business decisions
 - Market potential, business model
 - Cost factors
- **User benefits**
 - How often, in which situation, what additional value?
 - Simple, rough but illustrating assessment is often easy
- **Different perspectives**
 - Network, application, user, business
- **Realistic network evolution**
 - The size is of (final) gain is not the only issue (game theory)
- **Lessons from history (see Odlyzko)**

Lessons from the fate of ATM

“Asynchronous transfer mode, why and how”

- Carsten Rasmussen (Copenhagen Telephone Company)
 - NTS-9, 1990 (brief, typical, but still a reasonable article)
- Main alternative for ATM
 - Fiber to the home & optical switching
 - not in this century (< 2000)
- Need for broadband
 - Probably first for business sector
 - “If someone invents a service, that is really interesting for private users, the market could suddenly explode ... such as
 - Dial up your favorite Fellini
 - Get your grandchildren right into your living room, or
 - a multimedia encyclopedia where a subject is demonstrated optimally on a combination of words, sound and interactive video”

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Rasmussen and many others continue

- High quality video below 2 Mbit/s seems difficult
 - some services need more, some less
 - multiplexing several bit rates into the same network is necessary
- NOTE
 - Comparison only between circuit switching and ATM, without mentioning IP, why?
 - video, not data
 - business model (telecom)
- Rasmussen continues
 - “The network and the services are waiting for each other. Some one must take the decision to create large scale broadband network before real services will come.”
- GSM became a success
 - but the need and service were already known (NMT)

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Blind spots?

- Network service
 - Access vs. a point to point connection
 - Detailed control
- Business model
 - Flat rate vs. each connection paid separately
 - Detailed control
- User need
 - Underestimated
 - Text messaging (SMS, E-mail)
 - Free access to any information (Web)
 - Overestimated
 - Video
 - Technical requirements related to network service

Content

- See also Odlyzko, e.g.
 - http://firstmonday.org/issues/issue6_2/odlyzko
 - Content certainly has all the glamor.
 - What content does not have is money.
- US revenues, \$ billions (1997)

• Telephone industry	256
• consumer spending on phone services	85
• US postal	58
• Advertising	187
• Motion pictures	63
• Television	37
• Radio	13
• Video rental & purchase	20
• Recorded music	15

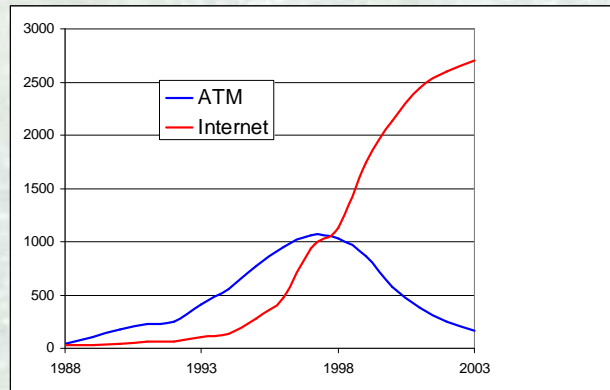
IP

- From telecom perspective, IP was very disruptive
 - always difficult to adopt by incumbents
- Was IP in any way a realistic choice for Telecom operators before 1995?

Process

- ATM development effort
 - HUGE...maybe 200 000 papers
 - abundant funding because of popularity
 - popular because of available funding
- Before any real life experience!
 - Always tend to lead to excessive complexity and control
 - Abundant resources expedite this process
- Real needs are often limited
 - ATM: network management (not consumer service)
 - maybe 90% of development toward wrong goal, even harmful

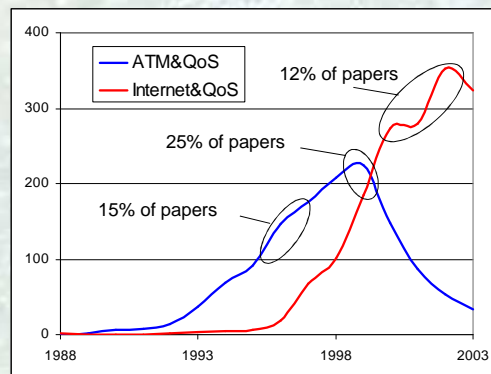
Papers / year (IEEE)



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QoS in abstract



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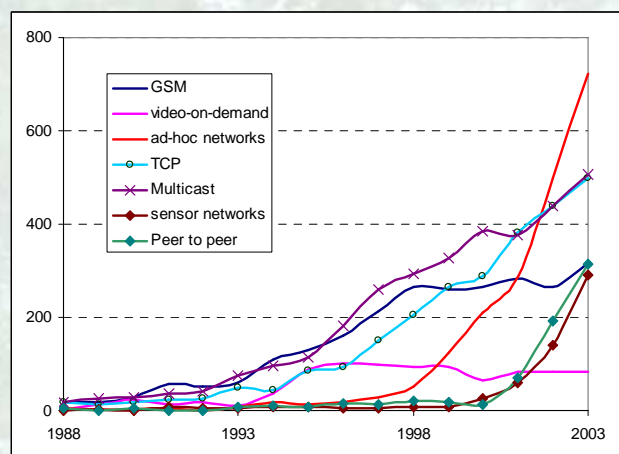
“Economic” in abstract (IEEE)

	ATM	Internet		
1988	3	0		
1989	3	0		
1990	6	0	ATM: 1.5%	
1991	2	1	Internet: 1.7%	
1992	9	1		
1993	8	0		
1994	10	1		
1995	7	2		
1996	16	16		
1997	17	22		
1998	10	20		
1999	10	30		
2000	7	49		
2001	3	40		
2002	4	42		
2003	4	36		

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Other papers/year (IEEE)



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Core principles

“Sensible design principles for new networks and services”

- Development of a new technology must be based on core principles
- Core principles must be able to limit the innate trend toward complexity
- When a current technology is developed further
 - Look for methods and mechanisms that
 - serve **both** the interest of key stakeholders,
 - and the common good
 - Be critical with methods without clear motivation for key players
 - pure common good is, unfortunately, not enough

(ATM vs.) Internet

- RFC 1958 Architectural Principles of the Internet
 - Fortunately, nobody owns the Internet, there is no centralized control, and nobody can turn it off. Its evolution depends on rough consensus about technical proposals, and on running code. Engineering feed-back from real implementations is more important than any architectural principles.
- General Design Issues
 - 3.1 **Heterogeneity is inevitable** and must be supported by design.
 - 3.2 If there are several ways of doing the same thing, choose one. If a previous design has successfully solved the same problem, choose the same solution unless there is a good technical reason not to.
 - 3.3 All designs must scale readily to very many nodes per site and to many millions of sites.
 - 3.4 Performance and cost must be considered as well as functionality.
 - 3.5 **Keep it simple.**
 - 3.6 Modularity is good. If you can keep things separate, do so.

Internet design

- 3.7 In many cases it is better to adopt an almost complete solution now, rather than to wait until a perfect solution can be found.
- 3.8 **Avoid options and parameters** whenever possible.
- 3.9 Be strict when sending and tolerant when receiving.
- 3.10 Be parsimonious with unsolicited packets, especially multicasts and broadcasts.
- 3.11 Circular dependencies must be avoided.
- 3.12 Objects should be self describing (include type and size), within reasonable limits
- 3.13 All specifications should use the same terminology and notation, and the same bit- and byte-order convention.
- **3.14 And perhaps most important: Nothing gets standardised until there are multiple instances of running code.**

“The elements of modelling”

In the spirit of “The Elements of Style” by W. Strunk and E.B. White

Elementary principles of composition:

12. Choose a suitable design and hold to it

- A basic structural design underlies every kind of writing (modelling).
- Writing, to be effective, must follow closely the thoughts of the writer, but not necessarily in the order in which those thoughts occur.
- The first principle of composition, therefore, is to foresee or determine the shape of what is to come and pursue that shape.

13. “Make the paragraph the unit of composition (module)

- After the paragraph has been written, examine to see whether division will improve it.
- Paragraphing calls for eye as well as logical mind.

The elements of style and modelling

16. Use definite, specific, concrete language

- Start modelling by carefully defining who or what makes the concrete choices.

17. Omit needless words

- Vigorous writing is concise.

19. Express coordinate ideas in similar form

20. Keep related words together

Chapter V. An approach to Style

- **Place yourself in the background**
 - ... attention to the sense and substance
- **Work from suitable design**
 - “But to write a biography the writer will need at least rough scheme; he cannot plunge in blindly and start ticking off fact after fact about his man, lest he miss the forest for the trees and there be no end to his labors”
- **Revise and rewrite**
 - Revising is part of writing.
 - Do not be afraid to seize whatever you have written and cut it to ribbons.

Chapter V. continues

- **Do not overstate**
 - “A single overstatement, whenever or however it occurs, diminishes the whole, and a single carefree superlative has the power to destroy, for the reader, the object of the writer’s enthusiasm.”
- **Make sure that the reader knows who is speaking**
- **Be clear**
 - Although there is no substitute for merit in writing (modelling), clarity comes closest to being one.
 - Clarity, clarity, clarity.
- **Do not inject opinion**
- **Do not take shortcuts at the cost of clarity**

Possible topics for critical evaluation

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 - Sensor
 - 4G
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- Lessons from history (see Odlyzko)

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