

5th GLOBAL TECH MINING CONFERENCE  
October 16th, 2015  
ATLANTA

*An in-depth analysis of patent  
thickets:*

*A case study of lithium ion  
accumulators*

RAMESHKOUMAR JP, FLAMAND M, VAN DER POL J



RÉGION  
AQUITAINE

université  
de BORDEAUX

# Patent thickets: Definition

Patent thicket definitions :

- “A dense web of overlapping intellectual property rights that a company must hack its way through in order to actually commercialize a new technology” (*Shapiro, 2001*)
  - “Numerous patents that protect components of a **modular and complex technology**” (*Hall, 2012*)
- ➔ **Situation where a firm needs to use many complementary patents owned by other firms in order to produce its own product**

# Patent thickets: Issues

Recently, there has been a widespread and growing concern about the patent thicket and its impacts (Ex. Shapiro, 2001; von Graevenitz et al., 2011, Fischer and Ringler, 2015)

Intrinsically links to phenomena of patent surge, patent wars and patent quality

The patent thicket changes patenting behavior of many firms

➔ ***Patent thicket maintains its own growth***

Concerns & problems:

- **Barriers to entry** : *Patent Thickets* obstruct entry to some markets (ex. Hall, 2012)
- **Barriers to innovation** : *Patent Thickets* impede innovation (ex. Ian Hargreaves, 2011)
- **Failure property rights/ patent system** (ex. Bessen and Meurer, 2008) : “if rights are so highly fragmented that the costs of negotiating the rights needed to make an investment become prohibitive”. Substantial bargaining costs

# Methodology for patent thicket identification

Methodology developed by **von Graevenitz et al., 2011** based on the **fragmentation of ownership between applicants**

- Builds on patent citation :

## **X and Y references, called critical references**

Critical references – also known as X and Y citations – point to prior art that jeopardizes the novelty or inventive step of the claimed invention

Usefull for identification of blocking relation

- **Patent thickets evaluated at applicant level**

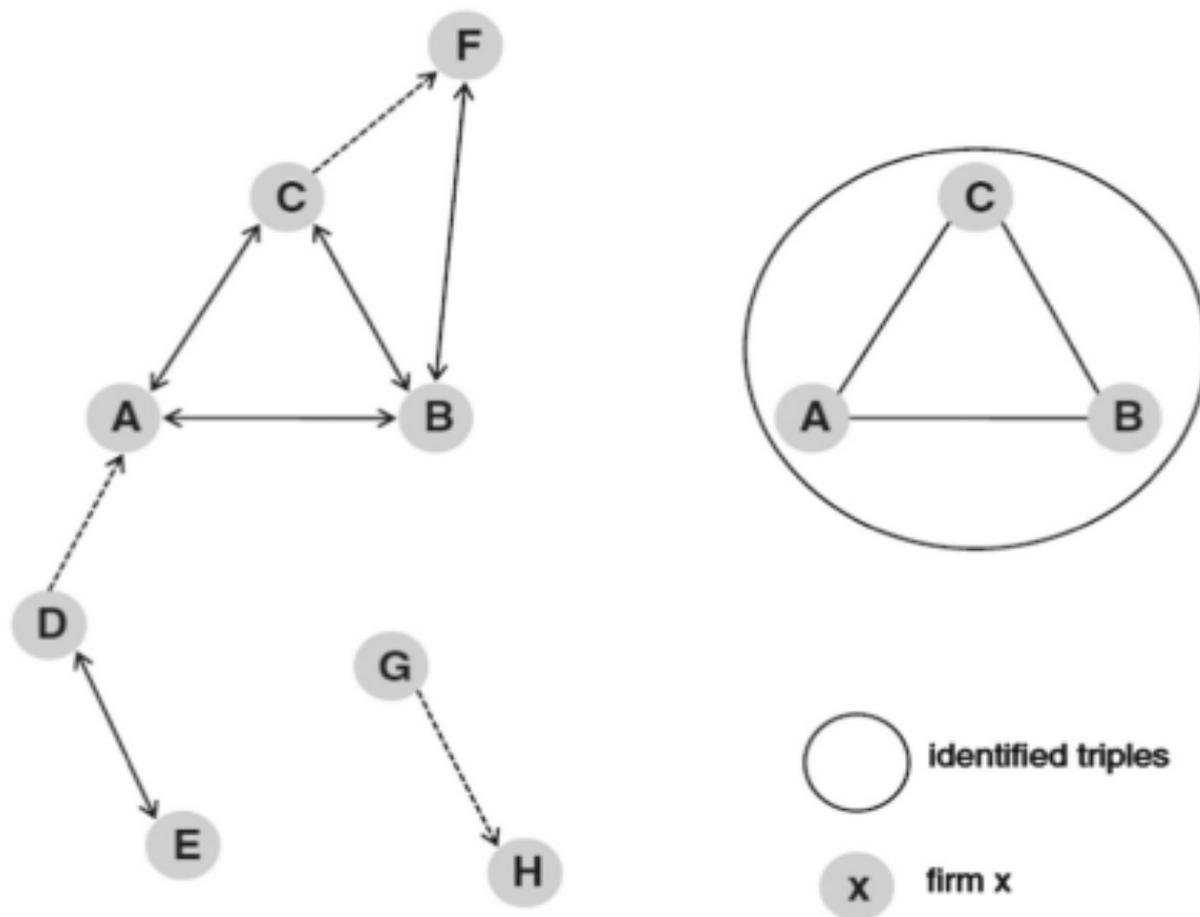
**Detection of TRIPLES** = a groupe of three firms in which each firm has critical prior art limiting claims on recent patent applications of each of the other two firms

Usefull for identification of mutual blocking relations

# Analyzing the patent thickets & methodologies of construction

Figure 1: Illustration of the structure of unilateral, bilateral and multilateral blocking relationships between patent holders

- **Existing structure**
  - > unilateral reference
  - > bilateral reference
- **Identified structure**
  - mutual blocking relation



# Technology study : Lithium Ion battery

- **Complex Technologies**

Figure 2 : Value chain of lithium ion accumulators in the car industry



Different competences used : electrochemistry, material sciences, electrical engineering, electronics and software development

- **Applications for several industries**

Mainly car industry, electric transportation, consumer electronics

- **A technology in an era of technological emergence (ex. Car)**

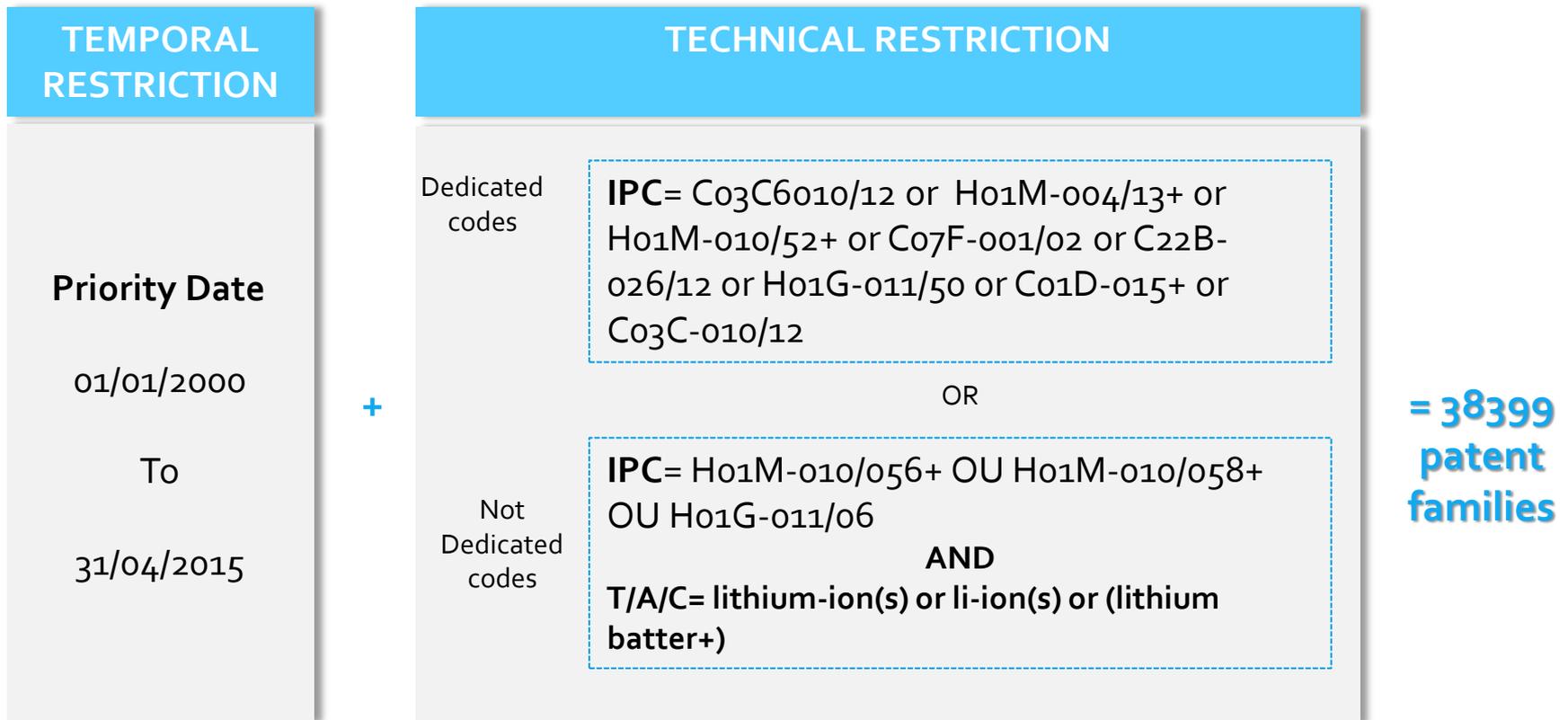
Change, experimentation and uncertainty

In the large family of Li-ion technology, different solutions compete

# Construction of the patent portfolio

Use of the **Questel patent database** : - international database  
- patents grouped by family

Combination of **patent technical classes** (ICP Classes) and **key words**

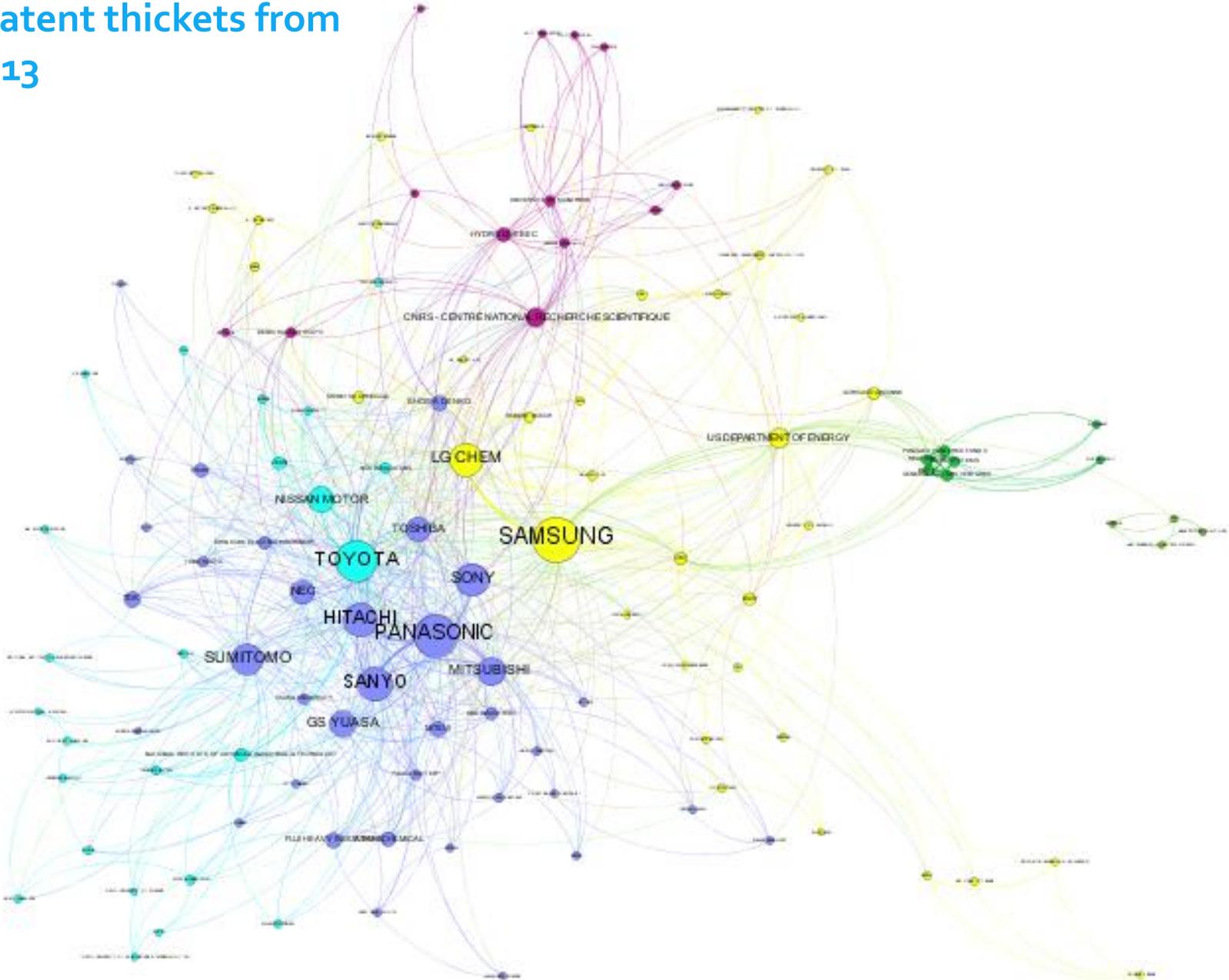


**PART 1 -**

# Static analysis of the Patent thicket:

Li-Ion Patent thickets from 2000-2013

# Li-Ion Patent thickets from 2000-2013



MAIN APPLICANTS	TOTAL PATENT	NUMBER OF PATENTS CITED in X and Y CAT.	%	NUMBER OF PATENTS CITING in X and Y CAT.	%
SAMSUNG SDI	2155	463	21	314	15
LG CHEM	1775	260	15	419	24
PANASONIC	1740	538	31	259	15
TOYOTA	2166	349	16	365	17
SONY	1375	445	32	117	9
SANYO	1250	374	30	150	12
NISSAN	768	214	28	148	19
mitsubishi	1048	371	35	111	11
HITACHI	1423	336	24	76	5
TOSHIBA	502	154	31	68	14
NEC	499	142	28	170	34
ROBERT BOSCH	449	23	5	156	35
ZEON	353	91	26	68	19
AMPEREX TECHNOLOGY	530	8	2	3	1
SUMITOMO	726	184	23	163	22
GSYUASA	285	83	29	60	21
SHIN KOBE ELECTRIC MACHINERY	275	41	15	30	11
TDK	259	67	26	15	6
BYD	250	46	18	38	15

## Methodology Limited

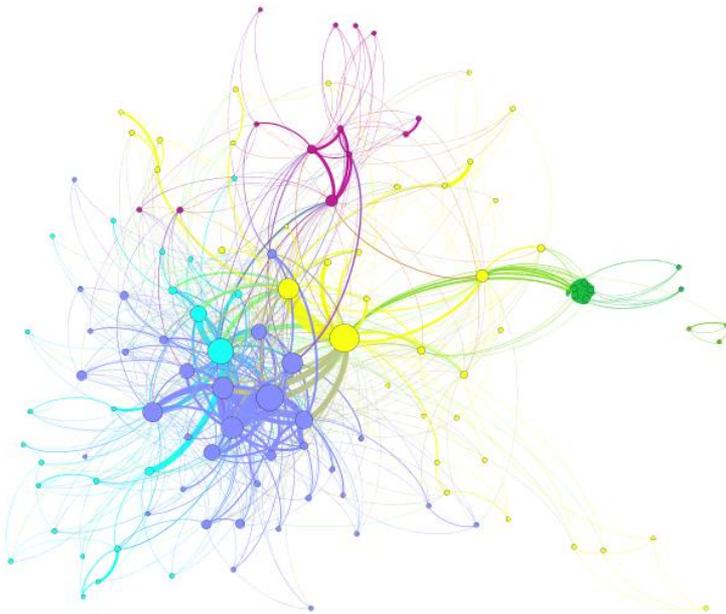
*Chinese patents and all others patents from offices which don't use X, Y citations are not covered*



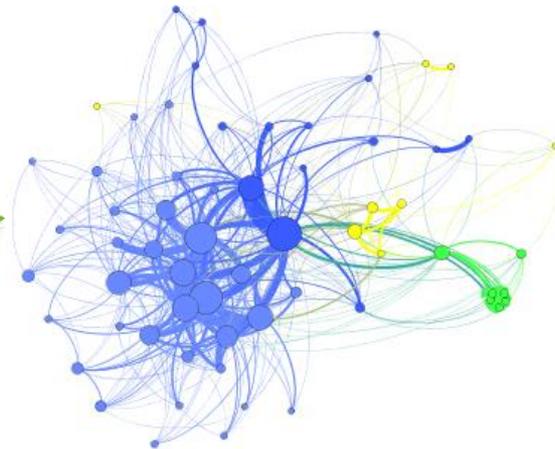
# Triple (3 applicants) and more ?

Patent thicket = 3 actors mutually blocking. But, what happens if the criteria is increased : i.e 3 and more actors concerned?

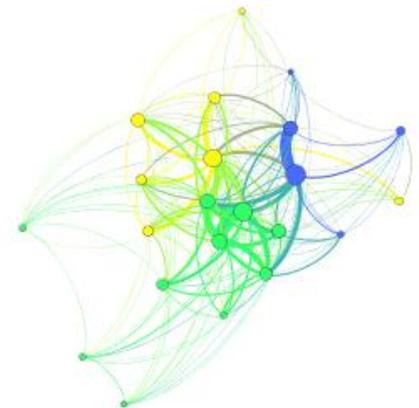
In the portfolio, we identified networks with 7 fully interconnected applicants



*Patent-thicket*  
With **triple : 3** applicants  
concerned  
150 applicants (70% total)



*Patent-thicket*  
With **5** applicants  
concerned  
44 applicants (23% total)



*Patent-thicket*  
With **7** applicants  
concerned (max)  
18 applicants (10% total)

# Patent thicket core

## Main applicants integrated in the more dense patent ticket :

### Battery material specialist :

- Mitsui

### Battery specialists (modules and components):

- Hitachi (mainly for car industry)
- Panasonic (mainly for car industry, consumer electronics)
- Sanyo (mainly for car industry, consumer electronics)
- Gs Yuasa
- Samsung (mainly for car industry, consumer electronics)
- Toshiba (mainly for car industry, consumer electronics)
- Sony (mainly for consumer electronics)
- Mitsubishi (mainly for car industry, consumer electronics)
- Lg Chem (mainly for car industry, consumer electronics, power grid)
- NEC (mainly for car industry)
- Sumitomo

### Application domain specialist :

- Toyota
- Nissan



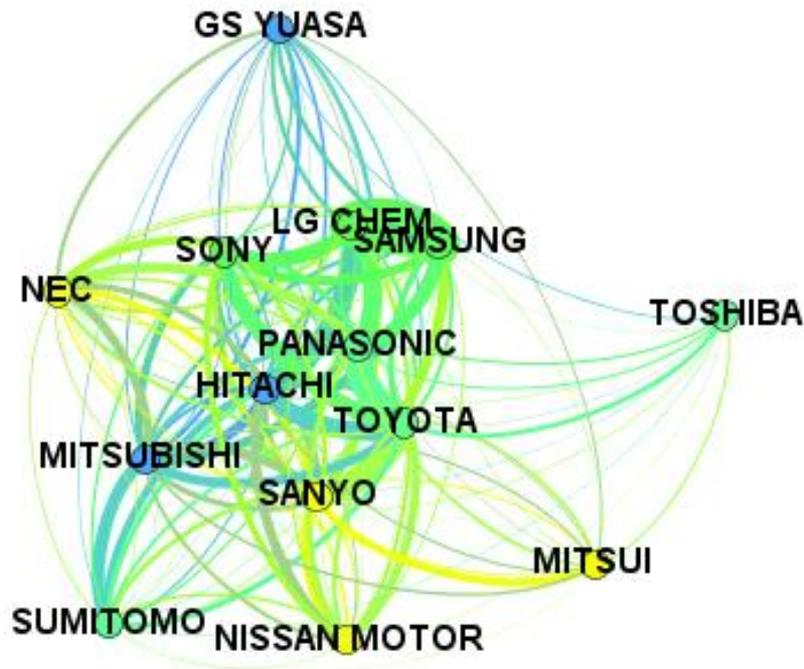
*Only two carmakers integrated in the core of the patent thicket.*

*Confirm the focus of these two carmakers in storage energy technologies*

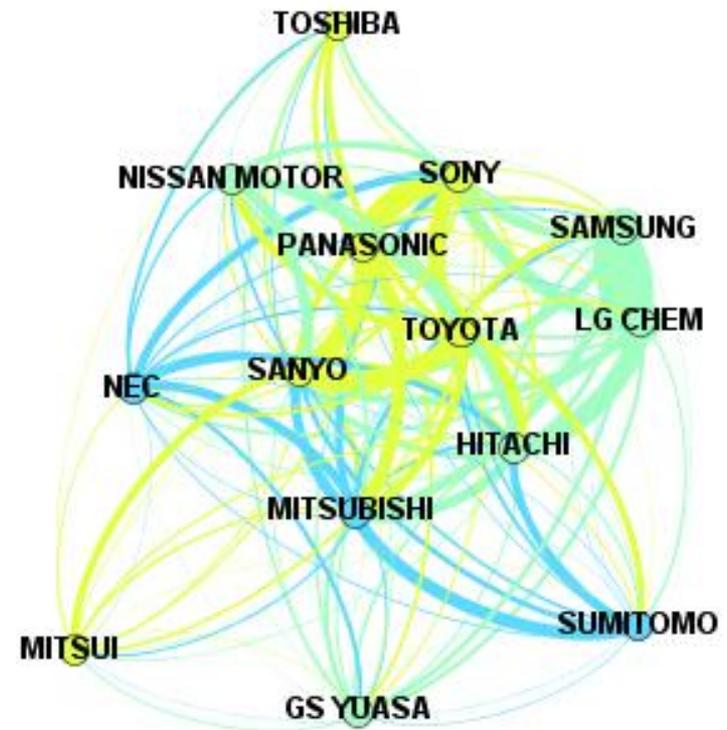
# Patent thicket core

## Main applicants integrated in the more dense patent ticket :

Hitachi, Panasonic, Sanyo, Mitsubishi, Sony, GS Yuasa, Toshiba, Nissan Motor, NEC, Mitsui, Samsung, Toyota, LG Chem & Sumitomo



Network from Citing patent

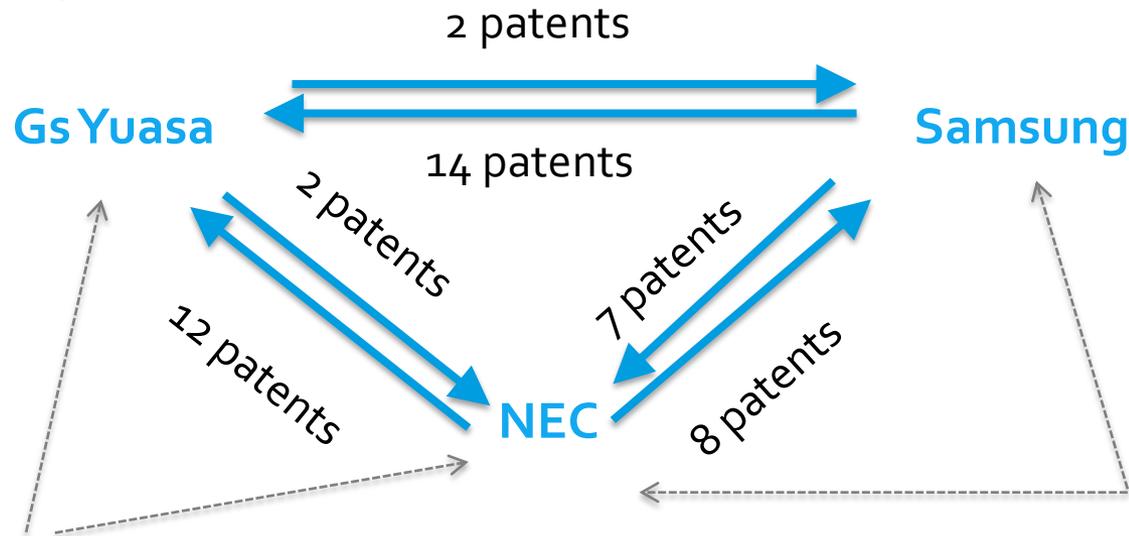


Network from Cited patent

# Patent thicket core

In bilateral relationships : **strong asymmetries between citing / cited applicant**

For instance,



« **Asymmetric/  
unilateral  
dependence** »

« **Bilateral/mutual  
dependence** »

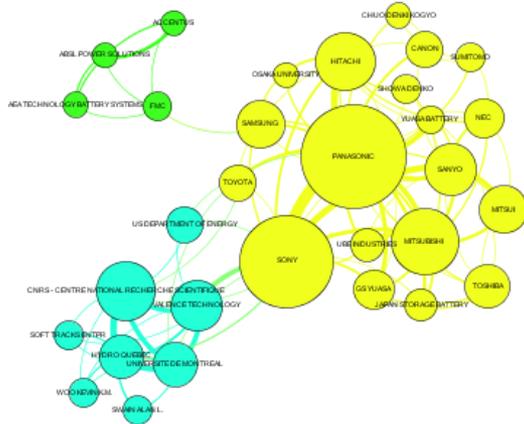
PART - 2 -

## Dynamic analysis of the patent thickets:

5 year window analysis from 2000-2013

# Resultat 1- Analysis of the position of actors in the thickets over time.

## Li-Ion Patent thickets from 2000-2004

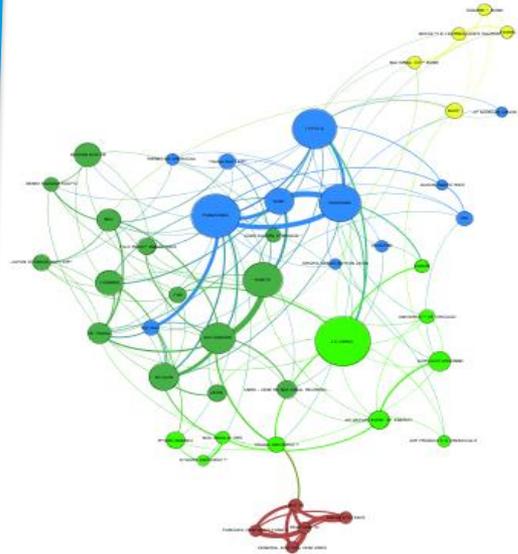


Nodes = 31  
 Links = 37  
 Density = 0,209  
 Modularity = 0,374  
 Clustering coefficient = 0,707  
 Main applicants (number of triples) =  
 - Panasonic  
 - Sony  
 - Mitsubishi

Thicket with 5 applicants  
 10 applicants concerned : Hitachi, Panasonic, Sanyo, Mitsubishi, Sony, GS Yuasa, Toshiba, Japan Storage Energy, NEC, Mitsui

New applicant  
 Applicant out

## Li-Ion Patent thickets from 2004-2009

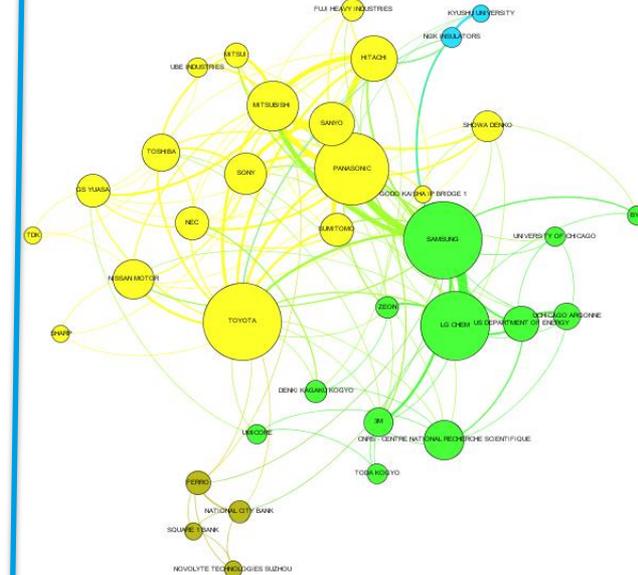


Nodes = 51  
 Links = 152  
 Density = 0,119  
 Modularity = 0,527  
 Clustering coefficient = 0,413  
 Main applicants (number of triples) =  
 - Panasonic  
 - GS Yuasa  
 - LG Chem and Toyota

Thicket with 5 applicants  
 14 applicants concerned: (Hitachi, Panasonic, Sanyo, Mitsubishi, Sony, GS Yuasa, Toshiba, Japan Storage Energy, NEC, Samsung, LG Chem, TDK, Toyota, Mitsui)

New applicant  
 Applicant out

## Li-Ion Patent thickets from 2010-2014



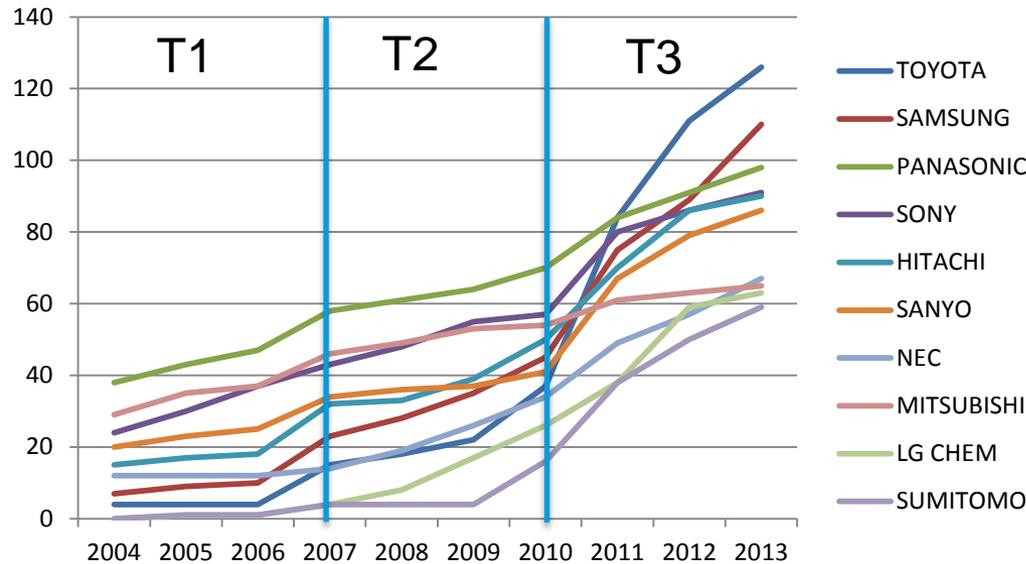
Nodes = 45  
 Links = 156  
 Density = 0,158  
 Modularity = 0,462  
 Coefficient de clustering = 0,67  
 Main applicants (number of triples) =  
 - Panasonic  
 - Toyota  
 - Mitsubishi

Thicket with 6 applicants  
 15 applicants concerned : Hitachi, Panasonic, Sanyo, Mitsubishi, Sony, GS Yuasa, Toshiba, Japan Storage Energy, NEC, Samsung, LG Chem, TDK, Toyota, Mitsui, Nissan, Motor, Sumitomo, 3M, Showa Denko

New applicant  
 Applicant out

# Indicator dynamics (1): Number of triangles & number of links

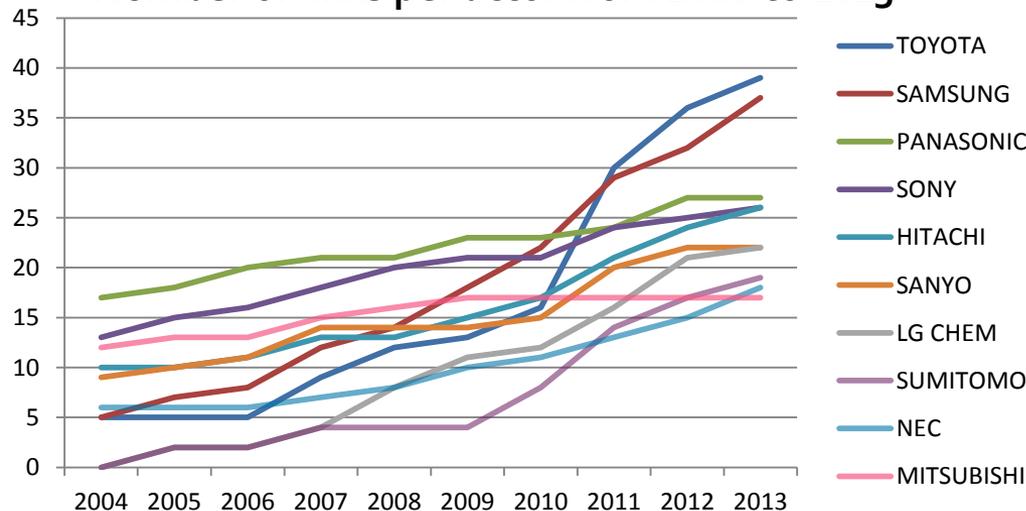
Triangle number per actor from 2000 to 2013



2 actors have the same dynamic when it comes to thicket created along the period

	T1	T2	T3
SUMITOMO	4,00	4,00	3,69
TOYOTA	3,75	2,47	3,41
SAMSUNG	3,29	1,96	2,44
LG CHEM	4,00	6,50	2,42
SANYO	1,70	1,21	2,10
NEC	1,17	2,43	1,97
HITACHI	2,13	1,56	1,80
SONY	1,79	1,33	1,60
PANASONIC	1,53	1,21	1,40
MITSUBISHI	1,59	1,17	1,20

Number of links per actor from 2000 to 2013



Evolution of links

Important Increase

Toyota, Samsung, Sumitomo, LG Chem

Increase

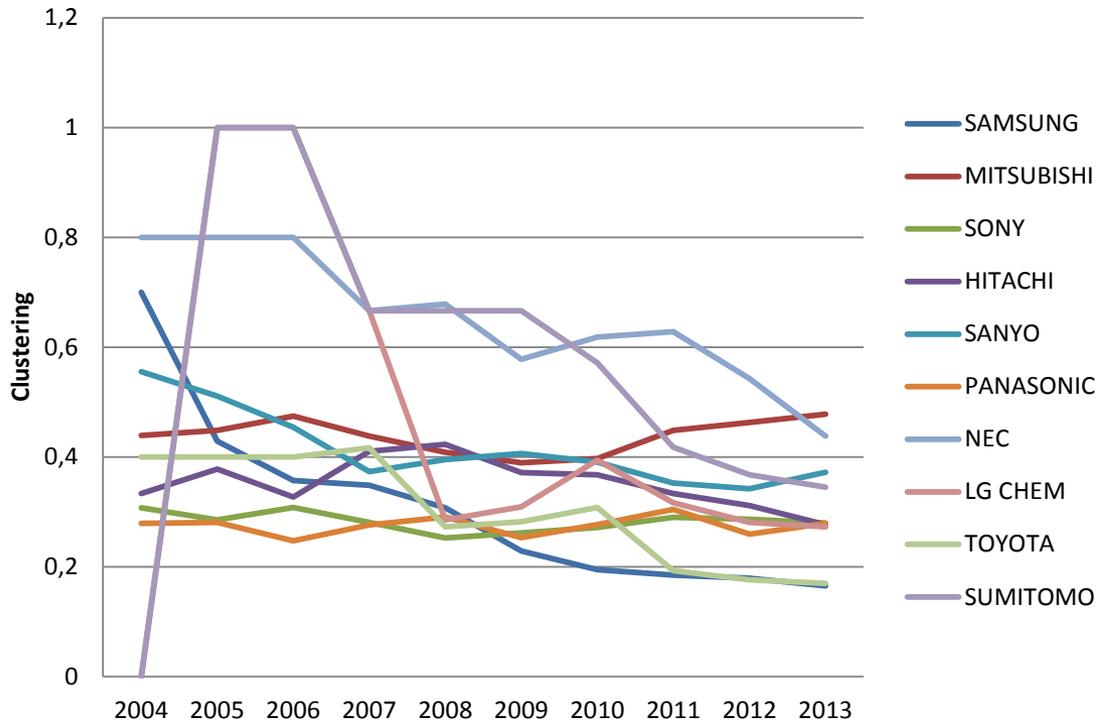
Sanyo, Sony, NEC, Hitachi

Stabilisation

Panasonic, Mitsubishi

# Indicator dynamics (2): clustering

Evolution of the clustering coefficient from 2000 to 2013



Evolution of clustering

Increase:  
**Mitsubishi**

Stable:  
Panasonic, hitachi, Sony, LG Chem, Sanyo

Decrease:  
NEC, Sumitomo

Important decrease:  
**Toyota, Samsung,**

# Perspectives

## Three main ways of improvement :

- Take into account the **weight of bilateral relationship**

Important asymmetries if relationships are observed on a case-by-case basis.  
Methodological challenges for it to be taken into account in the whole data portfolio.

*aim: To attain a better measure and assessment of the global patent thicket*

- Take into account **precisely the technologies concerned**

Applicants must be positioned on several technological elements (for instance in our case study : components, BMS, material, ...)

*aim: Go further into detail on trilateral blocking relationships in order to see if the competition covers exactly complementary or substitutable technologies*

# Perspectives- next

- For the moment, all patents have been considered. A choice in favor of a full perception of competition about lithium-ion batteries

➡ **Next step, study the patent status** (Patent granted : yes/no?  
Patent renewed : if yes, how long?)

*aim: determine if applicants keep alive strategic, blocking patent or not  
(understimation of the power of patents).*

## Any Questions ? Thank you for your attention

Jean-Paul Rameshkoumar

*jean-paul.rameshkoumar@u-bordeaux.fr*

Johannes Van Der Pol

*johannes.van-der-pol@u-bordeaux.fr*

Marina Flamand

*marina.flamand@u-bordeaux.fr*

