



1



**Prof. Carles Puente i Baliarda**

Barcelona-Tech, UPC  
Founder, CTO-IP, FRACTUS  
Founder, SVP Innovation, IGNION  
carles.puente@upc.edu

*Scientist:*

- Telecom Engineer, (UPC)
- MSc., Urbana-Champaign (UoI)
- Ph.D. Telecom, (UPC)
- +100 Scientific Papers and Conference Proceedings

*Inventor:*

- +100 Granted Patents
- IST European Grand Prize, 1998
- Technology Pioneer, WEF, 2005
- Finalist European Inventor Award, 2014
- '20 European Inventors You Should Know' – European Comission, 2022

*Entrepreneur:*

- Co-founder, Fractus
- Co-founder, Ignion
- Partner, Quside
- Partner, CAPSA

*Professor:*

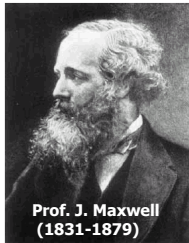
- Barcelona Tech (1994-1999; 2008-2023)
- Penn-Wharton (2013)
- ESADE (2015-2023)
- University of Strasbourg (2014-2023)

2

## Evolution of Antenna Technology (1)



**fractus**  
Optimised Antennas  
for Wireless Devices



Prof. J. Maxwell  
(1831-1879)

$$\nabla \cdot \vec{E} = \frac{\rho}{\epsilon}$$

$$\nabla \cdot \vec{H} = 0$$

$$\nabla \times \vec{H} = j\omega\epsilon\vec{E} + \vec{J}$$

$$\nabla \times \vec{E} = -j\omega\mu\vec{H}$$

From the unified theory of  
electromagnetic waves  
(1873, Maxwell equations) ....



... to the First demonstration of  
electromagnetic waves :  
1886, THE FIRST ANTENNA



Prof. H. Hertz  
(1857-1894)

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3

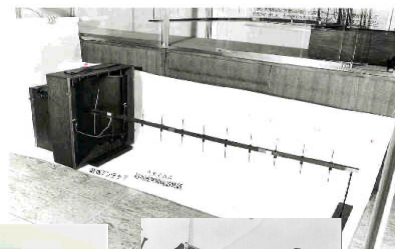
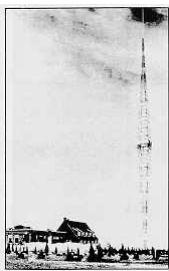
3

## Evolution of Antenna Technology (2)



**fractus**  
Optimised Antennas  
for Wireless Devices

**1900-1950** First wire antennas (radio broadcast), first directive  
Antennas (yagi, horns, reflectors)



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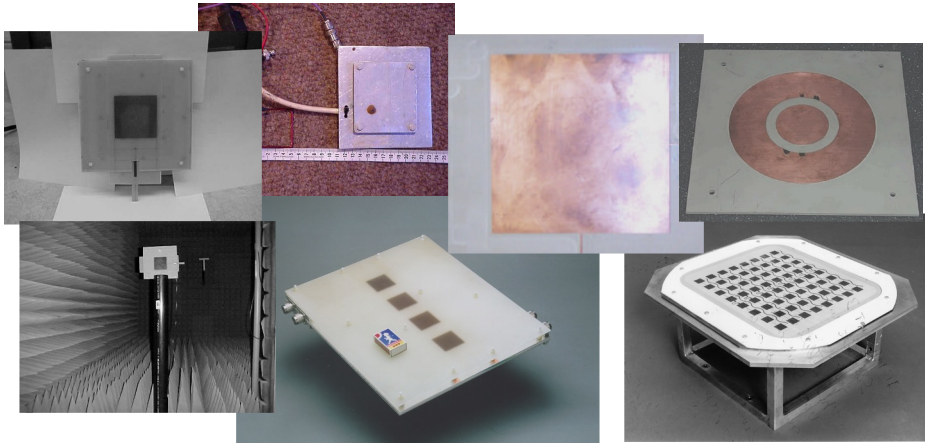
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## Evolution of Antenna Technology (4)



**fractus**  
Optimised Antennas  
for Wireless Devices

**1970's** First single band microstrip patch antennas (Euclidean geometries: square, rectangular, circular, triangular) and antenna arrays



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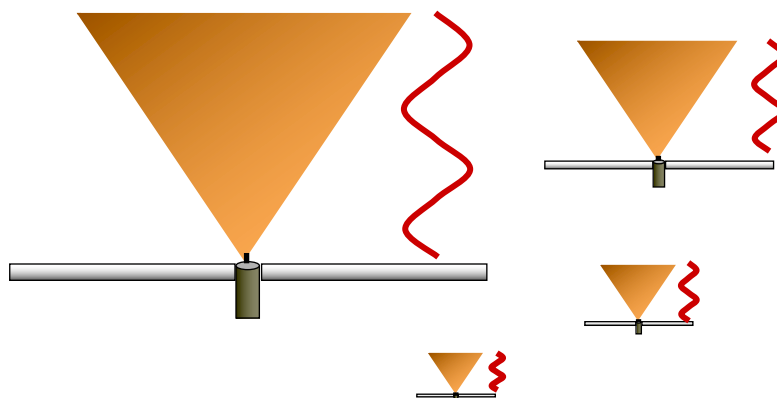
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## Fundamental Principle in Antenna Science



**fractus**  
Optimised Antennas  
for Wireless Devices

**Antenna size is determined by wavelength**



**Same antenna / Multiple Wavelengths?**

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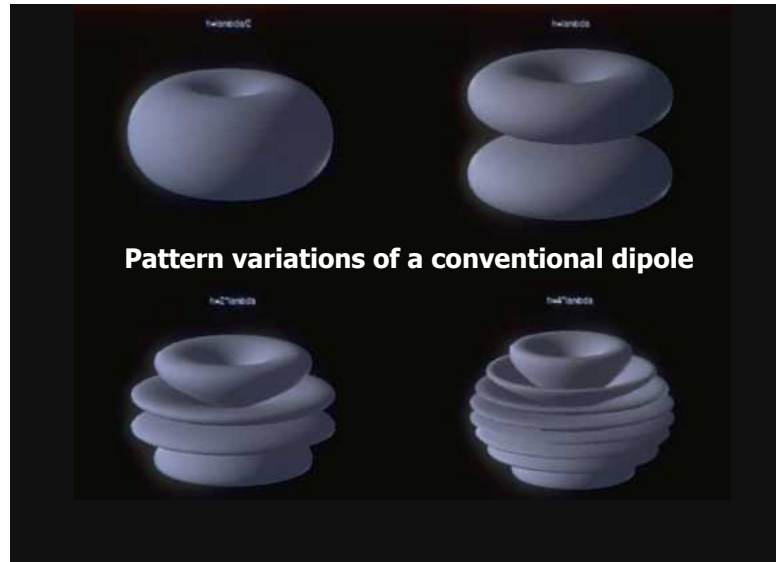
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6

6



## Multiband Operation ?



Copyright 2005

7

7


## The Fractal Antenna<sup>®</sup> Solution



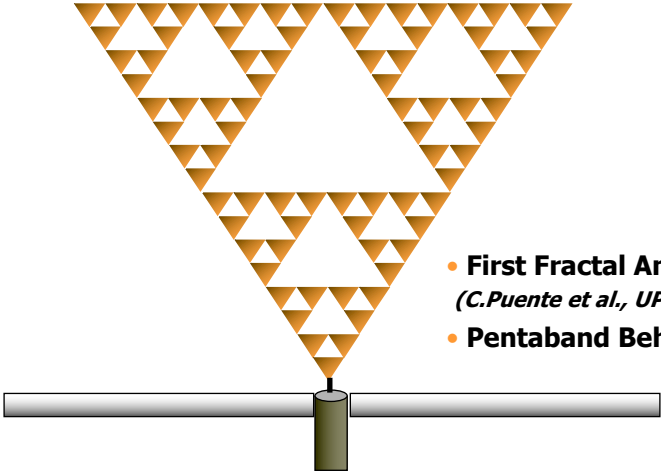
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8

Multiband Fractal Antennas®



### The Sierpinski Monopole



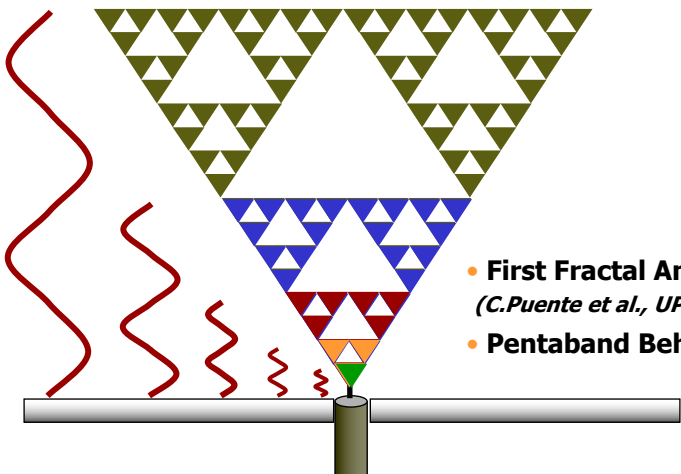
- **First Fractal Antenna®**  
*(C.Puente et al., UPC, 1995)*
- **Pentaband Behavior**

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9

Multiband Fractal Antennas®


### The Sierpinski Monopole



- **First Fractal Antenna®**  
*(C.Puente et al., UPC, 1995)*
- **Pentaband Behavior**

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10

Multiband Fractal Antennas®


### The Sierpinski Monopole



- **First Fractal Antenna®**  
*(C.Puente et al., UPC, 1995)*
- **Pentaband Behavior**


The Technology of Nature®

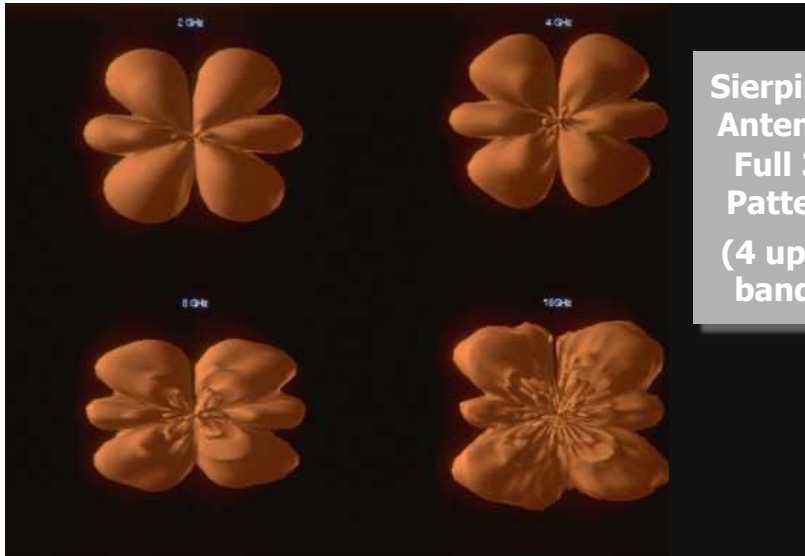
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11

11

Multiband Fractal Antennas®




Sierpinski  
Antenna,  
Full 3D  
Patterns  
(4 upper  
bands)

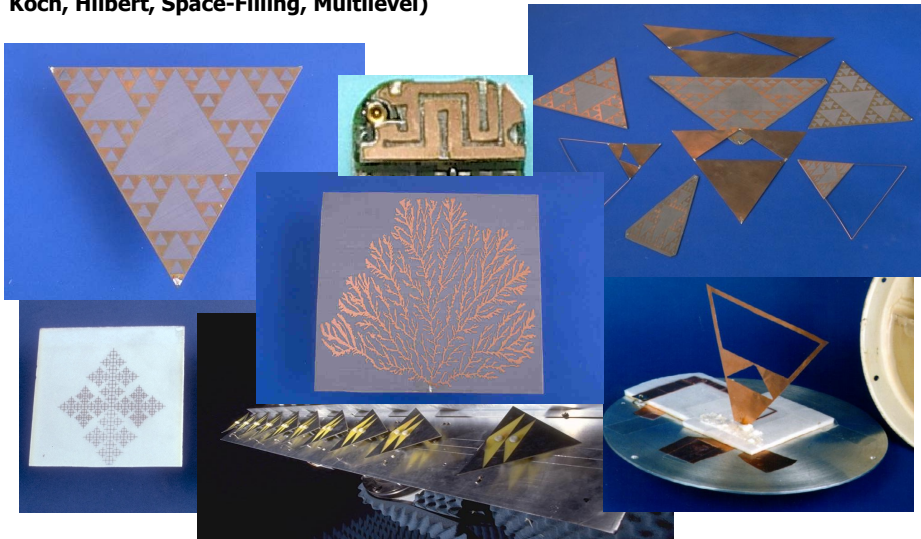
Co. . . . .

12

12

## Evolution of Antenna Technology (5) **fractus** Optimised Antennas for Wireless Devices

**1990's** Development of **Fractal Antenna** technology and applications (Sierpinski, Koch, Hilbert, Space-Filling, Multilevel)



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13

## History of Fractal Technology


 **fractus**  
Optimised Antennas  
for Wireless Devices
 

THE EUROPEAN  
INFORMATION  
TECHNOLOGY  
PRIZE  
*Grand Prize  
Winner*



**EUROPEAN  
INVENTOR  
AWARD 2014**  
CELEBRATING  
THE SPIRIT OF  
INVENTION  
17 JUNE  
BERLIN



2004 FROST & SULLIVAN  
Technology Innovation Award




WORLD  
ECONOMIC  
FORUM

2005 Tech Pioneer

14



## Fractus BTS Antennas

**fractus**  
Optimised Antennas  
for Wireless Devices

**Fractus Cantor-02  
GSM1800+UMTS**

**Siemens Dual-Band  
SLIMPOLE**

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15

15

## Fractus Automotive Antennas

**fractus**  
Optimised Antennas  
for Wireless Devices

**Space-Filling Antennas**

**Space-Filling and  
Multilevel Antennas**

**Multiwave™  
Mirror**

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16

16



# Fractus Handset Antennas

Development of multiband, miniature **Multilevel** and **Space-Filling** antennas for handsets.

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17

17

# Fractus Wireless Antennas

ReachXtend™

FracWave™ on IPAD™

AiP™

ReachXtend™

AiP™

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18

## About Fractus' Business Model ...

- Fractus creates and delivers multi-band and miniature antenna technology to its customers via antenna products, engineering services and technology and patent licenses.



### PRODUCTS & SERVICES

- Cellular Telephony
- Short-Range Wireless
- Antenna in Package
- DVB-H
- Medical Devices



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19

## Fractus Patent Investment

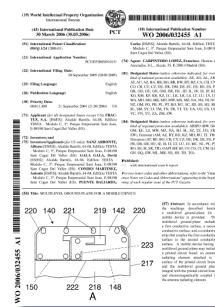


- 1<sup>st</sup> Spanish Company in US Patent Grantings (2007-2012, src. USPTO).**
- 1<sup>st</sup> Spanish entity in US Patent Grantings (2007-2012, src. USPTO).**

The following table displays first-named assignees and counts of their associated patents, as distributed by the year of patent grant.

First-Named Assignee	2008	2009	2010	2011	2012	Total
~INDIVIDUALLY OWNED PATENT	22	28	34	36	52	172
HEWLETT-PACKARD DEVELOPMENT COMPANY, L.P.	21	13	15	15	34	98
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS	14	14	10	9	13	60
FRACTUS S.A.	13	9	4	15	19	60
AIRBUS ESPANA, S.L.	6	9	14	14	8	51
AIRBUS OPERATIONS, S.L.	0	0	8	7	31	46
INTERNATIONAL BUSINESS MACHINES CORPORATION	8	7	10	10	8	43
LABORATORIOS DEL DR. ESTEVE SA	4	5	4	11	19	43
GAMESA INNOVATION & TECHNOLOGY, S.L.	1	5	6	11	12	35

U.S. Patent and Trademark Office  
Electronic Information Products Division - PTMT



Spanish Entities

20

## About Fractus' Business Model

- Fractus creates and delivers multi-band and miniature antenna technology to its customers via antenna products, engineering services and technology and patent licenses.



### PRODUCTS & SERVICES

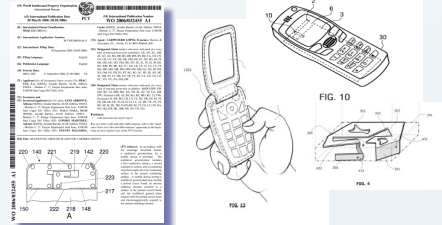
- Cellular Telephony
- Short-Range Wireless
- Antenna in Package
- DVB-H
- Medical Devices



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### TECH & IP LICENSING

- Mobile Handsets
- Short Range-Wireless
- Base Station
- Automotive
- Other Markets



21

## Patent Licensing Business



The New York Times

### Business

WORLD | U.S. | N.Y. / REGION | BUSINESS | TECHNOLOGY | SCIENCE | HEALTH | SPORTS | OPINION | ARTS

#### Motorola Agrees to License Technology From Fractus

By THE ASSOCIATED PRESS  
Published: April 7, 2010

Filed at 12:23 p.m. ET

NEW YORK (AP) -- Fractus S.A., a Spanish company that makes antennas for mobile phones, said Wednesday it has reached a deal to license its technology to Motorola Inc.

The company said the agreement is not exclusive and covers all Motorola products. Financial terms were not disclosed.

Fractus, a privately held company, said it has filed patent infringement claims against 10 cell phone manufacturers in U.S. district court in Texas, though Motorola is not involved in the litigation.

Shares of Motorola, which is based in Schaumburg, Ill., were down 3 cents to \$7.25 in morning trading.

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☐ PRINT



Electronic Information Products Division - PTMT

22



## Patent Licensing Business



### Fractus S.A. Sues Ten Cell Phone Manufacturers for Patent Infringement on Nine Different Patents

May 06 2009 at 04:19 PM

HOUSTON, TX and BARCELONA, SPAIN - On Tuesday, May 5, 2009, Fractus S.A. of Barcelona, Spain sued cell phone manufacturers Samsung, LG, RIM, Pantech, Kyocera, Palm, HTC, Sharp, UTStarcom, and Sanyo for infringing nine different patents held by Fractus.

Fractus is an early pioneer in developing internal antennas for cellular phones and other industries. Founded in 1999, Fractus set out to meet the challenge of delivering antennas small enough to fit inside a cell phone yet powerful enough to support today's multiband cell phones. Fractus has been, and remains, an active supplier of antennas and has shipped millions of antennas worldwide.

Among the numerous awards and honors the company has received for its innovative work, Fractus has been named a 2005 Davos World Economic Forum Technology Pioneer and one of Red Herring's top innovative companies for 2006. It has also won the 2004 Frost & Sullivan award for technological innovation and the 2007 Elektra European Electronics Industry R&D Award.

Fractus holds over 80 patents worldwide, including over 30 United States patents. "We are grateful that Fractus has chosen us to represent them in enforcing these patents," said Max Tribble of Susman Godfrey L.L.P., lead lawyer for Fractus. "It is very brave of Fractus to fight against these cell phone companies, many of whom knew about Fractus and its technology yet still continued to infringe. Fractus's inventions have added tremendous value to both the cell phone user and manufacturer."

IPotential, LLC, has been retained by Fractus as its licensing business advisor.

Fractus is represented by Max Tribble and Justin Nelson of Susman Godfrey L.L.P. and Michael Heim of Heim, Payne & Chorush, L.L.P. The case was filed in the Eastern District of Texas, Tyler Division, Case No. 6:09-cv-203.

23

## Patent Licensing Business



Portfolio Media, Inc. | 860 Broadway, 6th Floor | New York, NY 10003 | www.law360.com  
Phone: +1 646 783 7100 | Fax: +1 646 783 7161 | customerservice@law360.com

### Samsung Hit For \$23M In Fractus Antenna Patent Fight

By Roxanne Palmer

Law360, New York (May 24, 2011) -- A federal jury in Texas on Monday found that Samsung Electronics Co. infringed four Fractus SA patents for cell phone antenna technology, and ordered the electronics giant to pay \$23 million.

Barcelona, Spain-based Fractus had asked for a royalty of 1 cent per phone, but the jury awarded the company more than 35 cents per phone, and found that Samsung had willfully infringed Fractus' patents, according to Susman Godfrey LLP, which represents Fractus.

"We're extremely proud of the job we did for Fractus, and delighted that the jury vindicated their rights to their intellectual property in such a hard-fought case," lead Susman Godfrey attorney Max Tribble told Law360 on Tuesday.

The jury only deliberated for two hours, which is unusual, according to Tribble.

"I think it may have been the fastest plaintiff verdict in the Eastern District of Texas," Tribble said.

24

# Patent Licensing Business






July 31, 2012 06:00 AM Eastern Daylight Time

## Fractus Awarded \$41M in Patent Infringement Suit

BARCELONA--(BUSINESS WIRE)--Fractus, S.A. today announced another win in its years-long battle with Samsung Electronics Co. In his Final Judgment, U.S. District Judge Leonard Davis awarded Fractus over \$23 million in damages for Samsung's infringement, and, deeming the infringement willful, an additional \$15 million in enhanced damages. Including costs and interest, the combined award totals more than \$41 million.

In addition to the \$41 million award against Samsung, Fractus has negotiated settlements worth nearly \$70 million with major cell phone manufacturers including LG, HTC, RIM, Motorola, Sanyo, Pantech, Sharp, Palm, and UTStarcom.

"Fractus regularly licenses its patents and innovative technologies to its partners," said Rubén Bonet, President and CEO of Fractus. "This judgment is an important milestone that shows our commitment to our licensing efforts in the wirelessly connected devices in the consumer electronics industry."



Fractus originally filed suit in 2009 against ten mobile phone companies, nine of which opted out of court. At trial with Samsung, Fractus proved that the company willfully infringed on four of Fractus' U.S. patents which cover the internal multiband antennas common in cell phones, tablets, laptops, navigation devices and other wireless portable devices. The Barcelona-based company has shown its dedication to executing its licensing strategy, having challenged in court some of the biggest names in the global technology sector.

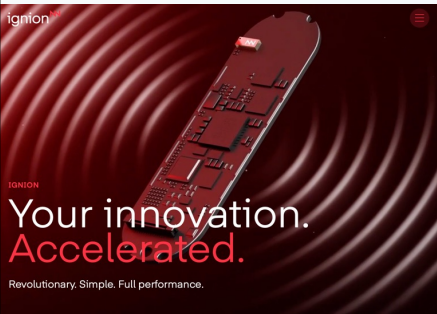
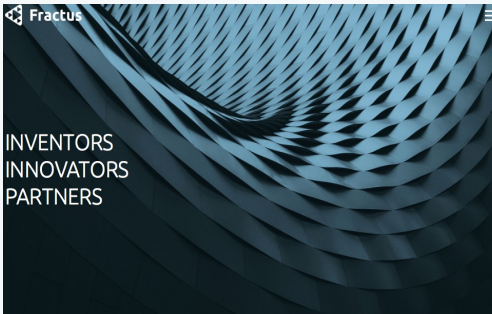
Fractus has made itself a world leader in antenna IP and licensing, with more than 200 patents and patent applications worldwide, and over 50 in the United States.

"Fractus regularly licenses its patents and innovative technologies to its partners"

25

## 2021 - Fractus and Ignion

- Ignion** delivers *antenna products* to over +1.500 mobile **IoT** and wireless OEMs worldwide, promoting the new *Virtual Antenna Technology*.
- Fractus** licenses *antenna technologies and patents* to the major **mobile** and wireless OEMs worldwide based on its proprietary *fractal-based* MLV and SFC technologies.

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26

## A Technology Company: Art+Com

FILM

NETFLIX

### 'The Billion Dollar Code': A David vs Goliath Battle That Shows the Tech World's Evil Side

Two young entrepreneurs take on Google for stealing their idea for software that will map the entire world.



© 2009, Carles Puente Ballada

<https://thewire.in/film/the-billion-dollar-code-netflix-review>

27

27

## An Entrepreneurship Story ...



**Fractus, el ave fénix**

La trepidante historia de un largo viaje emprendedor

**RUBÉN BONET**

**Libros de Cabecera**  
Libros de empresa y economía

@librosdecabecera  
@libroscabecera



#### ¡Never surrender!

Si tienes una startup o quieres embarcarte en un proyecto emprendedor, tienes mucho en común con Fractus.

Las cosas pueden tornarse complicadas, pero con dedicación y esfuerzo puedes llegar a convertirte en líder de tu sector.

*Fractus, el ave fénix*, es una historia real narrada en forma de thriller que te demostrará cómo un pequeño David puede vencer a grandes Goliats de la industria.

#### ¿Por qué leer?

- Sorpréndete de la intrigante historia de Fractus, de la mano de su CEO Rubén Bonet
- Adéntrate en el tumultuoso mundo de los negocios globales de las grandes marcas
- Inspírate para afrontar las vicisitudes empresariales con entereza
- Descubre cómo funciona el sistema judicial norteamericano en defensa de la verdad

<https://www.amazon.es/FRACTUS-AVE-FENIX-2ªED-emprendedor/dp/8412504240>

28



