OPAL-RT TECHNOLOGIES

WWW.OPAL-RT.COM

OPAL-RT TECHNOLOGIES

2023
OPAL-RT founded in Warsaw, Poland
Winner of the **2023 Mercuriades Awards**

2021
Founding of **OPAL-RT Brazil**

2020
Launch of the
OP1420 Microgrid PHIL Test Bench

2019
OPAL-RT STI founded in Lyon, France

2018
Winner of the 2018
"PRIX INNOVATION PME" award

2017
OPAL-RT TECHNOLOGIES' 20th anniversary

2016
Launch of the **OP4200** simulator for power electronics, electric drive and other real-time applications
Winner of the **2016 Mercuriades Awards**

2012
HYPERSIM – Hydro-Quebec agreement
ISO 9001:2008, quality management systems
OPAL-RT India Private Limited founded
OP7000 Multi-FPGA Platform

2011
Modular **M**ultilevel **C**onverter-based HVDC simulator, with 3300 I/O ch in 25us / 40kHz
OP5600 HIL platform

2010
RT-LAB 10 with Eclipse based interface
ARTEMiS State-**S**pace **N**odal solver

2009
OPAL-RT EUROPE founded
Wanda BOX with OP5142 (Spartan 3)

2008
RT-LAB BERTA Test Bench
Real-Time 2008: the 1st annual OPAL-RT international user conference

2007
eMEGAsim real-time power grid simulator

2005
RT-XSG FPGA development system
Electric **H**ybrid **V**ehicle project with Denso

2004
OPAL-RT Corporation (USA) founded
OP6000 TestDrive for automotive ECU testing
1st **E**lectric **H**ybrid **V**ehicle project with Toyota 10us / 100kHz

2002
1st **OPAL-RT FPGA**-based (VirtexII) I/O cards

2001
ARTEMIS 50us
1st contract with **G**eneral **E**lectric

2000
Flight simulation model for the Embraer 170 Jet

1999
RT-EVENTS
FORD engine simulation

1998
RT-LAB 1.0, Canada Arm 2 simulator for Canadian Space Agency

1997
OPAL-RT TECHNOLOGIES founded by Jean Bélanger & Lise Laforce
7 employees

Democratize Real-Time Simulation

OPAL-RT's "raison d'être" since its founding is to democratize real-time simulation. We continue to work towards that goal today.

FOREWORD BY JEAN BÉLANGER

Our clients perform testing of electric drives, electronic controllers and power distribution networks in a variety of industries including automotive, aerospace, electric ships, power generation, rail, and industrial manufacturing.

Our vision, when Lise Laforce and I founded OPAL-RT in 1997, was that a real-time simulator will be on every engineer's desk due to the rapid progression of commercial processing technologies. We pioneered the use of standard commercial computer and operating systems for real-time simulation and fifteen years later, I am proud to see that this vision is becoming a reality.

The ease of use, combined with costs for the customer, are key in our process of making simulation accessible to all.

We have the ability to assist clients who must design complex and fast dynamic systems by using parallel calculations. In fact, that's how we got the name OPAL-RT: "Ordinateur Parallèle, Applications Logicielles Temps-Réel." Our unique technological approach integrates parallel, distributed computing with commercial-off-the-shelf technologies.

Over the years, OPAL-RT has become a world leader in power electronics real-time simulation used in automotive, aerospace and industrial markets by supplying open and powerful simulation systems that make use of the latest commercial technology.

To maintain this leadership, customers are the center of our concerns. In this sense, OPAL-RT works with them to solve their technology challenges related to the design, prototyping and testing of complex systems, even though these challenges may seem impossible at first sight.

This challenge is represented in our slogan: "From Imagination… to Real-Time." We are working hard toward our vision of providing accurate and affordable simulators so that "imagination will be the only real limit of complex system design".

Jean Bélanger, Co-Founder, CEO of OPAL-RT TECHNOLOGIES

Our Vision

OPAL-RT WAS FOUNDED WITH THE GOAL OF "DEMOCRATIZING REAL-TIME SIMULATION".

- A real-time simulator will be on every complex dynamic system engineer-designer's desk.
- These simulators will be interconnected and able to work together to design large systems.
- Imagination will be the only real limit to complex system design.

FROM IMAGINATION... TO REAL-TIME

"Our vision and mission are ambitious and require the use of several technologies and highly skilled engineering. We hire the best experts in software, electronics, FPGA and real-time simulation to ensure we reach our goals and achieve the best quality in our products."

LISE LAFORCE, VPE

Our Mission

- Help its customers reduce their costs and delays for complex mechanical and electrical system design, prototyping and testing,
- By providing high-performance simulation systems that are open and easy-to-use, utilizing commercial technology optimized for parallel computing,
- With the ultimate goal of making real-time simulation efficient, precise and accessible to all.

"Real-time simulation is indispensable for engineer-designers. Our mission is to make it accessible to all."

JEAN BÉLANGER, CEO

Our Corporate Values

AT OPAL-RT, WE BELIEVE IN OUR VALUES, HOLD TRUE TO THEM AND ACT ACCORDINGLY. THEY COME FROM OUR PHILOSOPHY ABOUT WHO WE ARE AND WHAT WE DO FOR PEOPLE, BOTH WITHIN AND OUTSIDE OF THE COMPANY.

PERFORMANCE

We give you the freedom to simulate complex systems with ever increasing precision and execution speed by offering open products and our technical and organizational know-how, in combination with products available on the market.

FAST INNOVATION

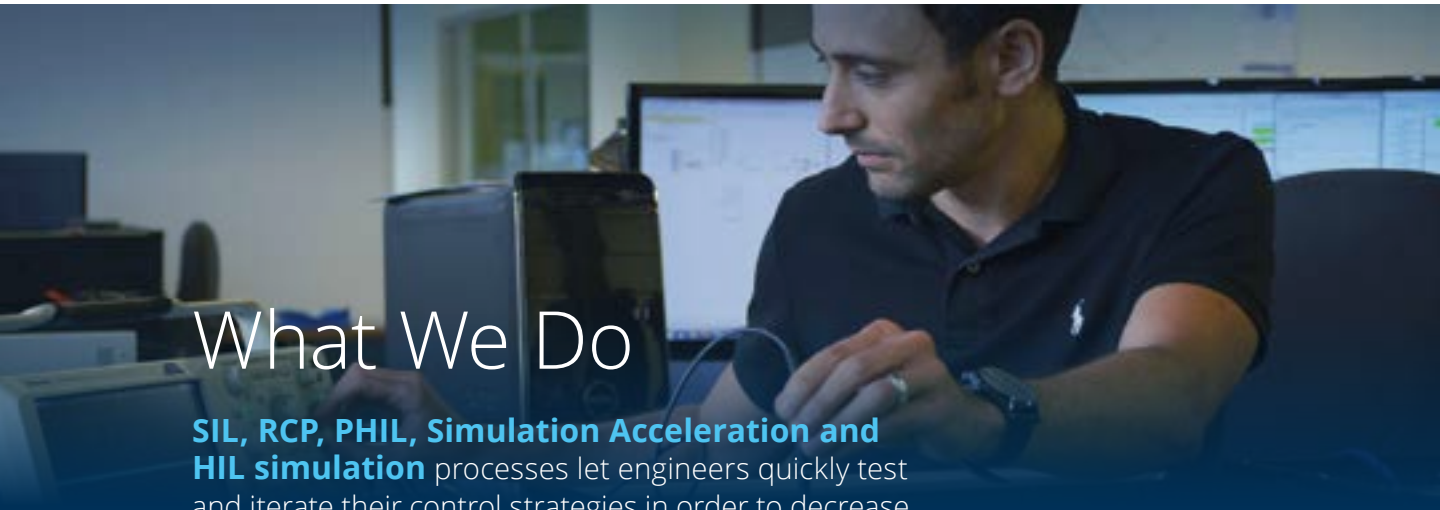
Our creativity and innovation push us to research and build solutions that meet even the most complex of your needs. We are proactive and always ready to take on challenges that our competitors would turn down.

COOPERATION

We concentrate on solutions that ensure your success by working with you from the beginning to the end of the project. We work as a team to ensure your satisfaction with our win-win approach.

OPENNESS

We are open and so is our equipment. Our flexibility allows us to offer you custom solutions.



What We Do

SIL, RCP, PHIL, Simulation Acceleration and HIL simulation processes let engineers quickly test and iterate their control strategies in order to decrease development costs and time. These processes, used by all industries, allow corrections to be made early in the product development. Thus, mistakes can be corrected and optimizations can be made while they are still inexpensive.

HARDWARE-IN-THE-LOOP

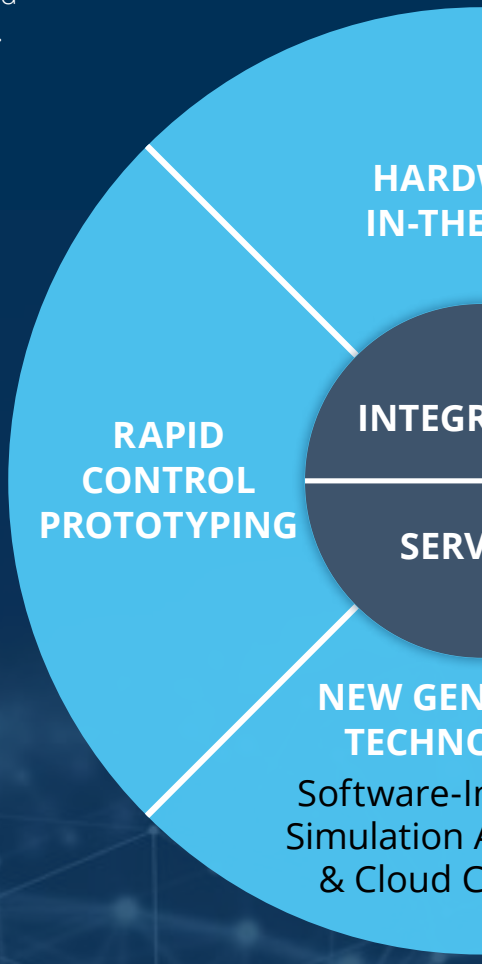
Physical test benches cannot always be used to design and test control systems due to excessive cost, security or simply the unviability of physical models. This is the case for aircraft and large power grid applications in which physical prototypes are replaced by accurate digital real-time simulators, which are interfaced with prototype controllers.

Built using optimized cost and commercial-off-the-shelf components, our solutions are scalable, accurate and powerful. Our added-value lies in our unique simulation models and algorithms optimized for parallel computation on standard multi-core computers as well as on fast field programmable gate array (FPGA) chips to achieve maximum accuracy.

RAPID CONTROL PROTOTYPING

OPAL-RT RCP solutions enable control specialists to implement their control algorithms on powerful real-time computer emulating their final controller hardware. Control algorithms can then be tested by interconnecting the prototype controller hardware to physical test benches, emulating the behavior of actual systems being controlled, like the automotive engine and power electronic motor drives used in several applications.

We provide cost-effective and scalable RCP solutions to all industries including power system and power electronic markets. Because of the versatility of the technology, we can adapt this generic product to specific needs.



APPLICATIONS

INTEGRATION

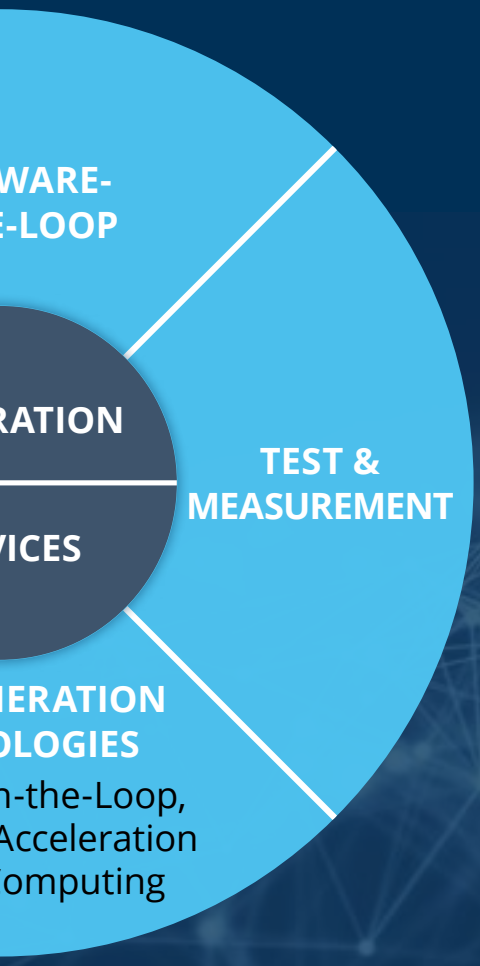
In engineering, system integration is the bringing together of the component subsystems into one system.

Engineers require a robust partner, such as OPAL-RT, capable of designing and constructing a fully customized test bench. This ensures our customers can stay focused on the test itself rather than the construction process. We are committed to going the extra mile, fostering a collaborative partnership to ensure the success of both parties.

SERVICES

From design to commissioning, consulting, training and maintenance, OPAL-RT can help you all the way through your real-time project, ensuring its success.

We offer professional services to address all levels of engineering, simulation and rapid prototyping challenges in aerospace, automotive design, robotics, advanced control, process control and electromechanical systems.



TEST & MEASUREMENT

Test and measurements help and guide engineers who test, measure, and inspect electronic devices, components, and systems.

OPAL-RT has been investigating forward-looking concepts for gaining greater value from our measurement tools integrated with our simulators. Our simulators can be used as high-tech and customizable laboratory and portable test systems. Our measurement and control systems are flexible enough to allow special conditioning, signal processing using Simulink and FPGA tools, data recording and test scenarios to ensure continual improvements.

NEW GENERATION TECHNOLOGIES

Software-in-the-Loop simulation (SIL) is the inclusion of compiled production software code into a complete simulation model enabling to optimize and perform tests of the final controller code in full simulation mode prior performing HIL tests with the actual controller hardware and to prepare commissioning tests. Our simulators take advantage of commercial and open technologies to facilitate SIL implementation.

Our simulators offer a natural way to **accelerate the simulation** of very large and complex systems by using parallel processing on standard multi-core processors or on super computers available in the laboratory or, on cloud systems. Simulation cases requiring several hours of computation can often be simulated in less than a few seconds, which allows more tests to be done in less time, even for large systems.

Cloud computing is Internet-based computing, whereby shared resources, software and information are provided to computers and other devices on demand, like the electricity grid. Several OPAL-RT softwares, such as HYPERSIM, are readily compatible with this technology.

Who We Serve

ELECTRICAL

We offer the most complete, open and high-performance power systems real-time simulation solution on the market. Not only does it cover every need for traditional power grid and power electronics simulation, it also offers an unsurpassed level of scalability to design, simulate and test complex new generation power systems.

APPLICATIONS

Protection system testing, control system testing, large scale simulation, research, training and power grid maintenance.

OUR CLIENTS (partial list)

ABB Schweiz, Alstom Grid UK, Bharat Heavy Electricals Ltd, CEPRI, Delta Electronics, EPGH Singapore, Fraunhofer IWES, GE Energy, GE India Technology Centre, Hitachi, Indian Central Power Research Institute, Hydro-Quebec, MELCO, Mitsubishi, Nari-Relays Electric, Panasonic, Repower System AG, Rockwell Automation Canada, Sandia National Laboratories, TMEIC Japan, XJ Group China.

AUTOMOTIVE

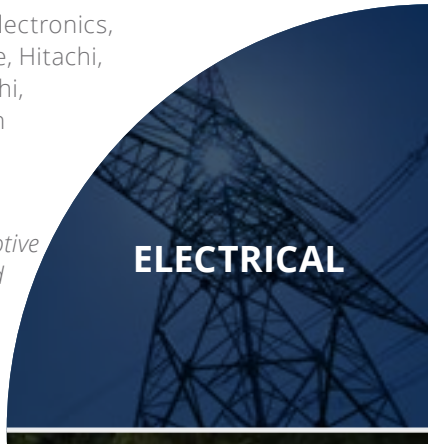
We apply pioneering high-fidelity simulation technologies for all types of automotive RCP and HIL simulation projects around the globe. Providing an economical and innovative complement to dynamometer testing, our simulators are deployed at most automotive OEMs and their suppliers, for ECU development of traditional vehicles, off-highway equipment, train traction systems, and in most electrical hybrid vehicles development.

APPLICATIONS

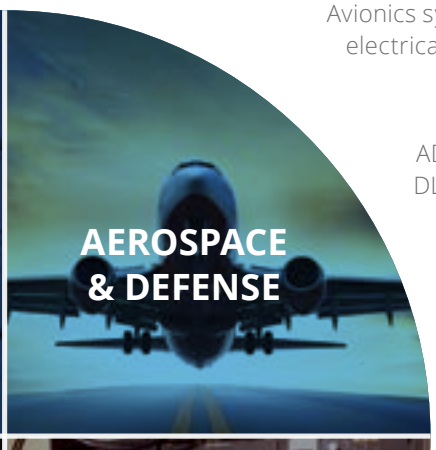
ECU fast prototyping development, ECU Function testing and system testing, electric motor ECU testing, ECU communication testing, research, training and production test validation. Additionally, OPAL-RT offers a tailored simulation platform for autonomous vehicle development, addressing intricate sensor arrays and complex algorithms. Providing a flexible 3D environment, it supports various scenarios and seamless integration with Hardware-in-the-Loop simulations for engineers in both on and off-highway autonomous systems.

OUR CLIENTS (partial list)

A*Star, AISIN Japan, BYD Auto China, Delphi, EATON, Daimler-Chrysler USA, DENSO, FORD, IAV Automotive Engineering, Jaguar Land Rover, John Deere, General Motors, Hitachi Automotive Systems, HYUNDAI KIA Motors, Mahindra, Mercedez-Benz Hybrid, Renault, Scania, Tata Motors, TM4, Toyota, Valeo, Volvo Westport Innovations, among others.



THROUGH LEADING-EDGE DEVELOPMENT, backed by the expertise of complex system simulation using parallelism, OPAL-RT continues to lead the way for next-generation real-time simulation solutions accessible to the greatest number of people. We assist customers who have complex and very fast simulation requirements by using parallel computing.
Our solutions are customized by industries and provide high performance, scalability and affordability.



AEROSPACE & DEFENSE

We assist avionics system suppliers in testing avionics integration by providing simulators that will allow all parties involved to supply interrelated high-quality, reliable and tested solutions. For sea, land, air and space applications, we provide real-time simulation solutions that deliver ROI, time-saving and quality improvement to the most sophisticated aerospace and defense projects.

APPLICATIONS

Avionics systems development, space and defense system development, large-scale electrical energy generation, distribution and active load control development and integration testing.

OUR CLIENTS (partial list)

ADE, Agency for Defense, Development Korea, ARDE, Canadian Space Agency, DLR, EADS, GE Aviation, Hamilton Sundstrand, Honeywell Aerospace, Liebherr Aerospace, Messier-Bugatti, NASA, NSTL, Pratt & Whitney, RCI India, Safran Electronics, Samsung Techwin, Thales Alenia Space.

ACADEMIC & RESEARCH

We work closely with academia to ensure that teachers and researchers benefit from the most innovative technology on the market. Our equipment is easily scalable, and can thus be reused for multiple projects. We are recognized for our willingness to collaborate with universities as well as contributions to research.

OUR CLIENTS (partial list)

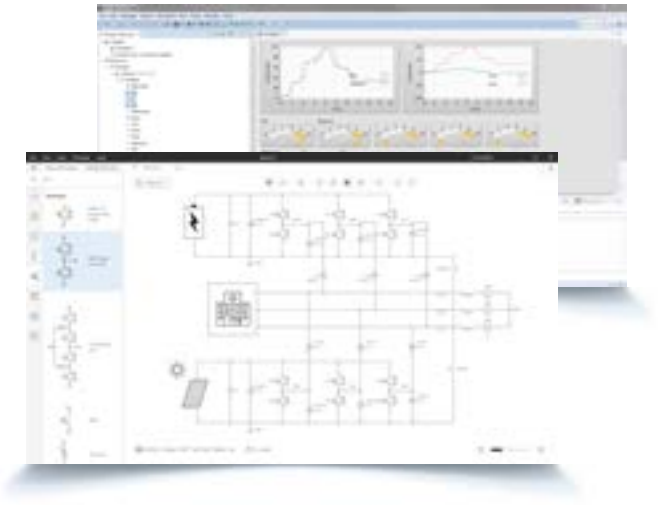
Ecole Polytechnique Montréal, EPFL (Switzerland), HUST (China), Incheon University (Korea), Indian Institute of Technology Jodhpur, KFUPM (Saudi Arabia), KTH Royal Institute of Technology (Sweden), Nagoya Institute of Technology (Japan), National Tsing Hua University (China), UFCG (Brazil), Université de Lille (France), NWPU (China), Ohio State University (USA), University of Alabama (USA), University of Nottingham (UK).

BRING MICROGRID SIMULINK® MODELS TO REAL TIME WITH RT-LAB

RT-LAB

Fully integrated with MATLAB/ Simulink®, RT-LAB enables Simulink models to interact with real world in real time. This makes RT-LAB ideal for engineers to rapidly develop and validate their applications in real time, regardless of their complexity.

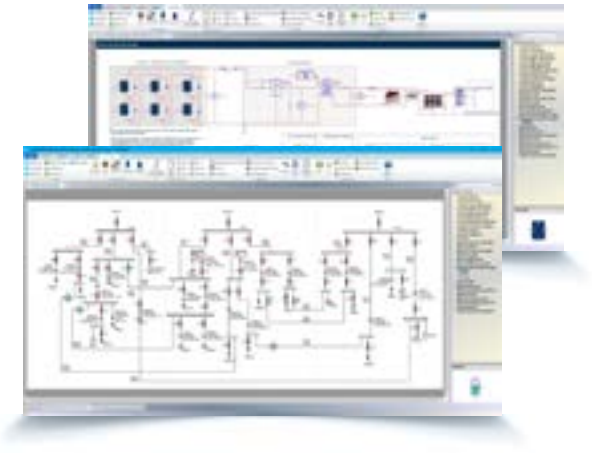
MATLAB & SIMULINK



THE POWER SYSTEM SIMULATOR OF TOMORROW

HYPERSIM

With its efficient signal processing and powerful test automation capabilities, HYPERSIM helps engineers to model their microgrid simulation project in one tool. Run accelerated simulations for in depth EMT analysis on their personal computer and going to real-time for large-scale Hardware-in-the-Loop (HIL) testing.



HARDWARE

Backed by 16 years of expertise in the development of innovative hardware solutions, OPAL -RT's unique approach integrates parallel, distributed computing with commercial-off-the-shelf technologies, to offer an unmatched combination of performance, openness and affordability. All simulators are based on a modular and flexible design and can be fully customized to meet specific I/O requirements.

OUR PRESENCE WORLDWIDE

OPAL-RT products are also sold and supported by a global network of distributors based in Brazil, Canada, USA, Mexico, Colombia, Chile, France, Germany, Poland, China, Japan, Korea, Ukraine, Russia, Turkey, Egypt, Israel, Jordan, Qatar, The United Arab Emirates, Oman, Pakistan, India, Singapore, Thailand, and Australia.

We have technical support centers in Europe (France), USA (Michigan & California) and China (Beijing).

OPAL-RT CORPORATE HEADQUARTERS

1751 Richardson, Suite 1060 | Montréal, Québec, Canada | H3K 1G6
Tel: 514-935-2323 | Toll free: 1-877-935-2323 | Fax: 514-935-4994

U.S.A.
OPAL-RT Corporation
2532 Harte Dr
Brighton, MI
48114, USA
Phone: 734-418-2961
Toll free: 1-877-935-2323
Fax: 1-866-462-5120

EUROPE
OPAL-RT Europe S.A.
196 Houdan Street
Sceaux, Hauts-de-Seine
92330, France
Tel: +33 1 75 60 24 89
Fax: +33 9 70 60 40 36

GERMANY
OPAL-RT Germany GmbH
N.Office
Pretzfelder Strasse 15
90425 Nuremberg
Germany

INTELLIGENT TRANSPORTATION SYSTEMS
OPAL-RT Intelligent Transportation Systems
10 Boulevard Vivier Merle
Lyon
Auvergne-Rhône-Alpes
69393, France
Tel: +33 7 60 80 36 14

INDIA
OPAL-RT Technologies India Pvt. Ltd.
1048, 4th B Cross Rd,
1st Block, HRBR Layout,
Banaswadi, Bengaluru,
Karnataka 560043
Tel: +91-80-2520.0305

BRAZIL
OPAL-RT Brazil
Alameda Rio Negro
503. 23º andar
Barueri, São Paulo
06454-000, Brazil
Tel: +55 11 2110-1833

U.S.A.
OPAL-RT Corporation USA – Colorado:
10200 W 44th Avenue,
Suite 239
Wheat Ridge, Colorado
80033, USA
Tel: +1 877 935 2323

POLAND
OPAL-RT Poland
E. Plater 28, 00-688 Warsaw,
Poland
Tel: +48 12 429 41 01

CHINA
OPAL-RT China
Unit 608, 6/F Zhongyu Mansion
No. 6 North Workers' Stadium Road,
Chaoyang District,
Beijing 100027, China
Tel. 0086 10 56617026

WWW.OPAL-RT.COM