


# HIGH PERFORMANCE IT

IBM @ RED BULL RACING

# WELCOME

RED BULL RACING

Red Bull RACING
FORMULA ONE TEAM

"RED BULL RACING
IS MORE THAN JUST A JOB FOR US,
IT'S A WAY OF LIFE"

Christian Horner



# ON-TRACK SUCCESS

WORLD CHAMPIONS IN 6 SEASONS







**238** Races

**53** Race Wins

**3750.5** Points

**58** Pole Positions

**143** Podiums

**13** Seasons

# OUR DRIVERS

COLLEAGUES / COMPETITORS / CUSTOMERS

MAX VERSTAPPEN

20 Years Old
57 Races in F1
2 Win in F1
10 Podiums in F1
1 Fastest Laps
362 Points







DANIEL RICCIARDO

28 Years Old
126 Races in F1
5 Win in F1
27 Podiums in F1
1 Pole in F1
9 Fastest Laps
808 Points

# PARTNERS

SIMULATING THE COMPETITIVE EDGE




A working relationship for over 10 years

Adoption of IBM Infrastructure Products in 2005

Adoption of GPFS for CFD in 2006

Innovation Partners since 2008

# CHALLENGES

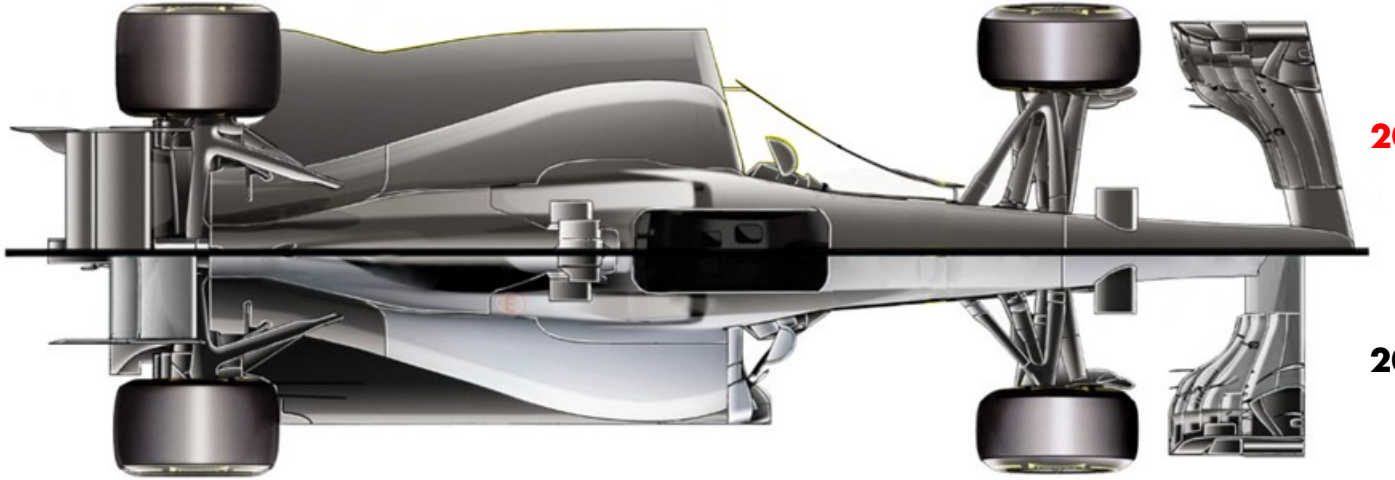
# A GLOBAL SPORT

## 2017 F1 CALENDAR



# REGULATIONS

2017 – A REVOLUTIONARY YEAR



**2017**

**2016**

20 Races

4 Power Units per Driver (was 5)

No Engine Token Restrictions

2 Pre-Season tests

Min Weight 728Kg (was 702Kg)

| | |
|---|---|
| Wider Cars: | Track 2000mm (was 1800mm) |
| Wider Tyres: | Front 305mm (was 245mm) |
| | Rear 405mm (was 345mm) |
| Wider Front Wings: | 1800mm Swept Back (was 1650mm) |
| Wider & Lower Rear Wings: | 950mm wide & 800mm high (was 750mm wide & 950mm high) |

Higher Grip – Higher Downforce – Higher Cornering Speeds – FASTER!

# TEAM FOCUS

## PERFORMANCE & RELIABILITY IN ALL AREAS

# PERFORMANCE & RELIABILITY

TO FINISH FIRST – FIRST YOU MUST FINISH







| | | | | |
|---|---|---|---|---|
| 0-100-0 (mph) = | 4.8 s | | Weight | 728 Kg | (100Kg < a Smart car) |
| Accel | 1.5 G | | Engines | 15,000 rpm | 900 BHP |
| Braking | 6-7 G | | Downforce @ top speed | x3 weight of car |
| Corners | 5.5 G | | | |

# CONTINUOUS IMPROVEMENT

THE EVOLVING PROTOTYPE




**100k** Components in PLM database

**7.5k** Unique Parts in a Car

**30k** Design Changes in a Season

**1,000** Designs/wk

**~ 1mil** Parts Manufactured

**100%** Inspection

Design

Refine

Race

Repeat

# INNOVATION

PUSHING BOUNDARIES



"RACES ARE WON LONG BEFORE WE REACH THE RACE TRACK"

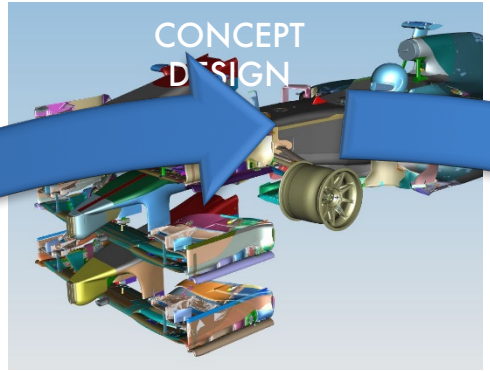
# THE SPEED OF CHANGE

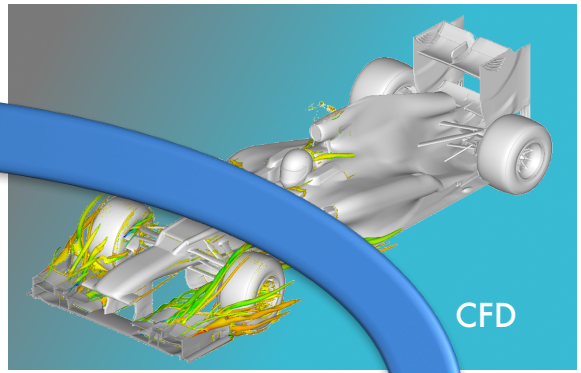

Nothing is left to chance

# CONTINUOUS DESIGN ITERATION

THE DEVELOPMENT LOOP







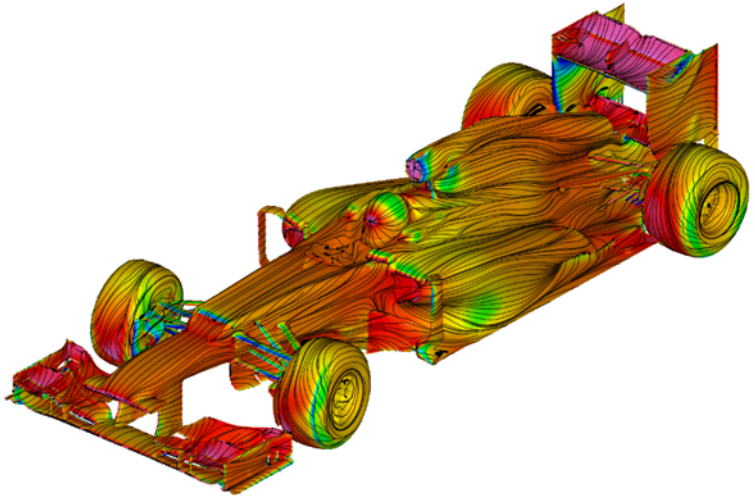





# SIMULATION PERFORMANCE

# END TO END CFD PROCESS

HIGH COMPLEXITY DATA HANDLING



200 process steps for each simulation. Many scripts and programs are required.

Hundreds of millions of equations are solved for each job.

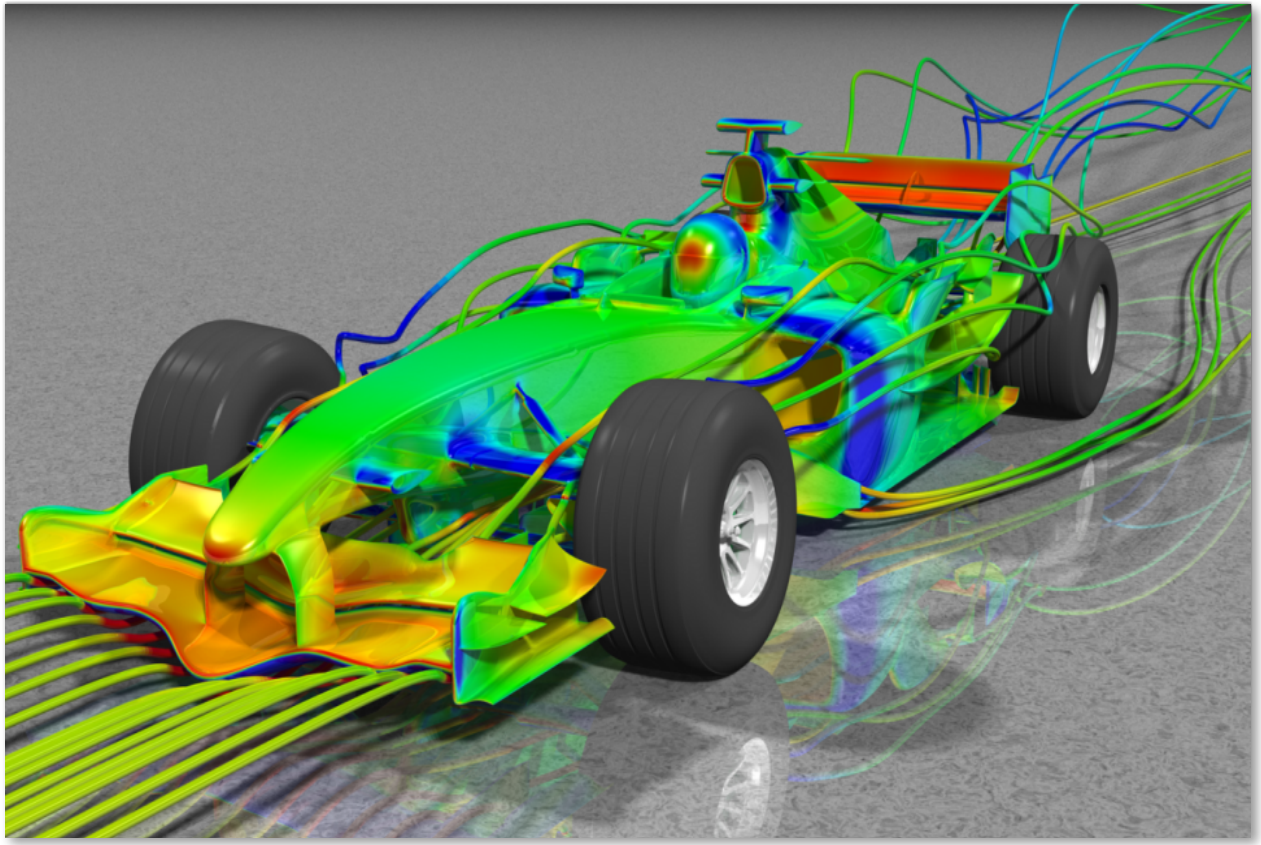
Specialised hardware is required for various process steps.

Highly variable load on hardware

**GOAL:**
Let engineers focus on the car instead of IT

CAD → MESHING → SETUP → SOLVE → POST PROCESS → EVALUATE

# SIMULATION KPIs



- 100's Simulations Every Week
- 100's Million/Billion DOF/Sim
- 100's Separate Processes *(CAD to Results)*
- 10's Different Software Apps/Sims
- 100's MB/s 24/7/365
- 10's TB of Data Generated Every Day
- 1's PB managed storage

# IBM SPECTRUM ECOSYSTEM

AT RED BULL RACING

**Spectrum Scale / Protect**

- Core Simulation Infrastructure
- Fast, Robust, Automatic, Truly Parallel
- Reducing storage costs

**Spectrum Computing LSF**

- Fully managed workflows
- Good workflow visibility
- Automated and fault tolerant

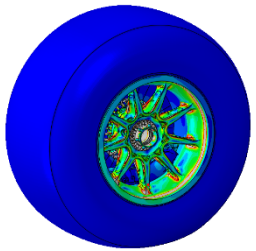
**Spectrum Symphony**

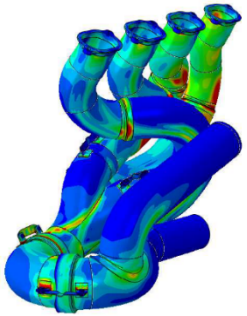
- Managed grid computing for improved performance
- Scalability & capacity

**IBM Aspera**

- Faster file transfers between track and factory
- Enables quicker decisions

- IBM solutions enable 30% to 50% improvement in workload throughout
- Accelerates decision making and/or allows for more iterations
- Enables more complex algorithms that provide higher fidelity
- Automation enables Engineers to focus on car performance rather than computing resource management





# The Job Mix - Demands

Used by multiple groups throughout RBR/RBT/RBAT

- CFD
- Finite Element
- Race sims
- Machine Learning
- General repository

# Spectrum Scale Environment – The Front Line

- SS 4.2.2-3
  - Circa 800 RDMA clients, 50 IP clients and 200 protocol clients
  - DMAPI enabled, but not used
- Backed by DDN 14KX
  - 4.7PB usable
  - Single filesystem
  - Direct connection to 2 x Mellanox SX6036 gateways
  - MediaScaler nodes to provide other protocols
  - VM+Connect-X 4 predicated move to connected mode
- 'Migrated' from DDN 12k
  - Not really a migration – wished/needed to raise the base filesystem level – hence recovery from backup / copy




SFA14KX

# Spectrum Scale Environment - Backup

- 2 x ESS installations
  - 2xGS6+GS4
  - 3.7PB per ‘site’
  - Backup/Replication via multiple 10gigE
  - 8TB/hr
- Replaced tape (IBM3584+LTO4) as the primary backup repository
- GNR *usually* a blessing



# Spectrum Scale
# Environment – The Loose Change

- Old DDN S2A6620s
  - Leftovers from previous HPC facility architecture
  - For PoC storage
  - For ephemeral data
  - For walled gardens



# Current Challenges

- Security
  - RB structural change
  - Mini HPC-hosting for multiple projects – F1 walled garden… but permeable walls
  - SS-side Auditing – can 5.0 help?
  - At-rest encryption
- Capacity
  - 12k sitting around – AFM, fileset, or air-gapped namespace
  - Can't keep paying for faster – are we at Object Storage scale?
  - Archives offloaded to COS?
- Performance
  - More IOPs, throughput's fine for now – 5.0, flash appliance?
- Technologies
  - Cloud
  - Heterogeneous interconnects

# GOING RACING

# ON-TRACK TESTING

CAR EVALUATION & OPTIMISATION



# CONNECTIVITY

AT&T TRACKSIDE TELEMETRY (GARAGE)



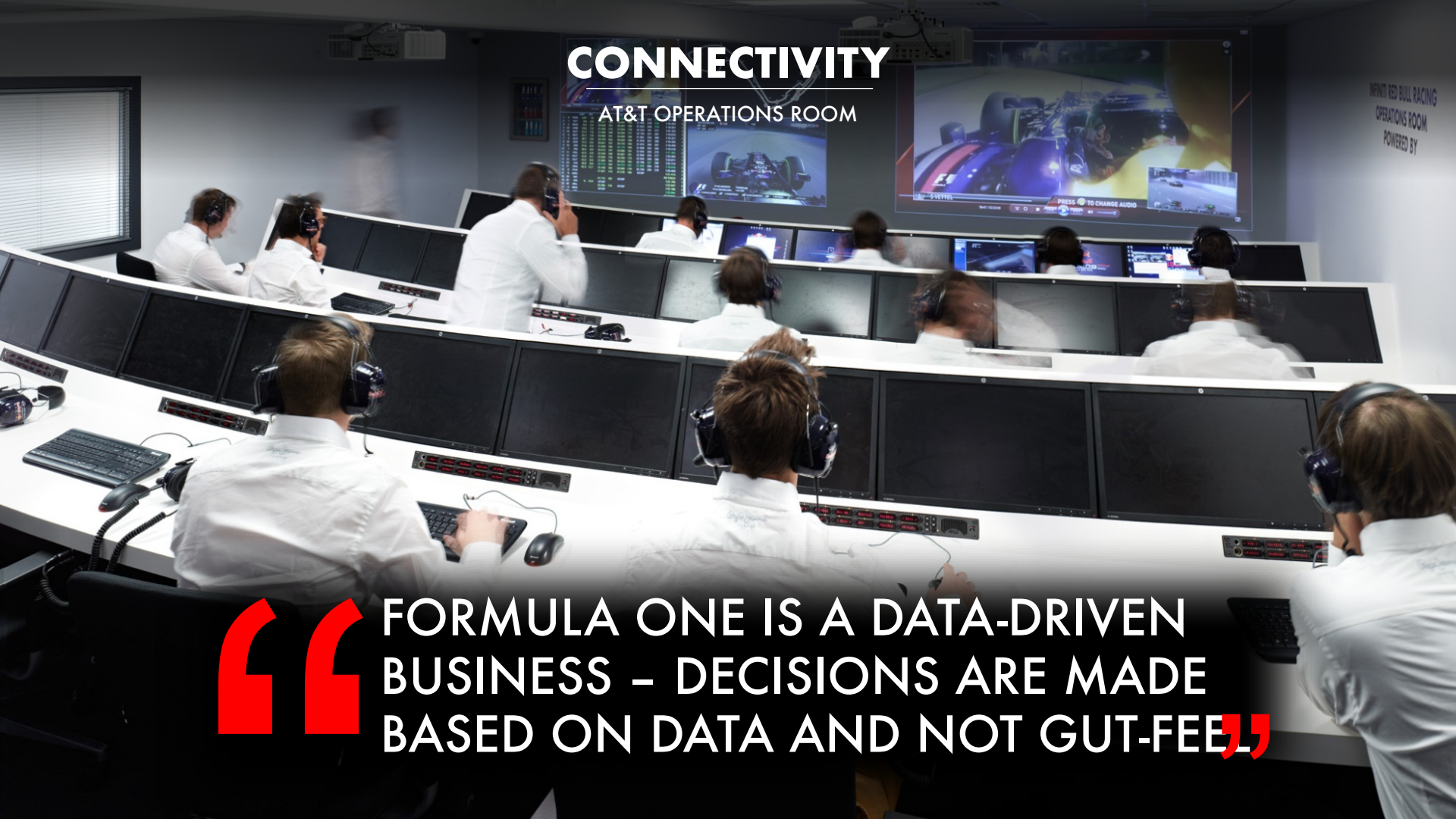
# CONNECTIVITY

ENGINEERING OFFICE (TREEHOUSE)



# CONNECTIVITY

AT&T OPERATIONS ROOM




"FORMULA ONE IS A DATA-DRIVEN BUSINESS – DECISIONS ARE MADE BASED ON DATA AND NOT GUT-FEEL"

# WHAT NEXT?

KEEP PUSHING BOUNDARIES




- Improve Cars
- Improve Operational Efficiency
- Invest in Our People
- Win Races and World Championships

> “WE’RE PROUD TO HAVE PARTNERS WHO SHARE A LIKE-MINDED APPROACH TO INNOVATION”




# THANK YOU

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