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# Le protocole 1-Wire et iButtons

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# Principales utilisations

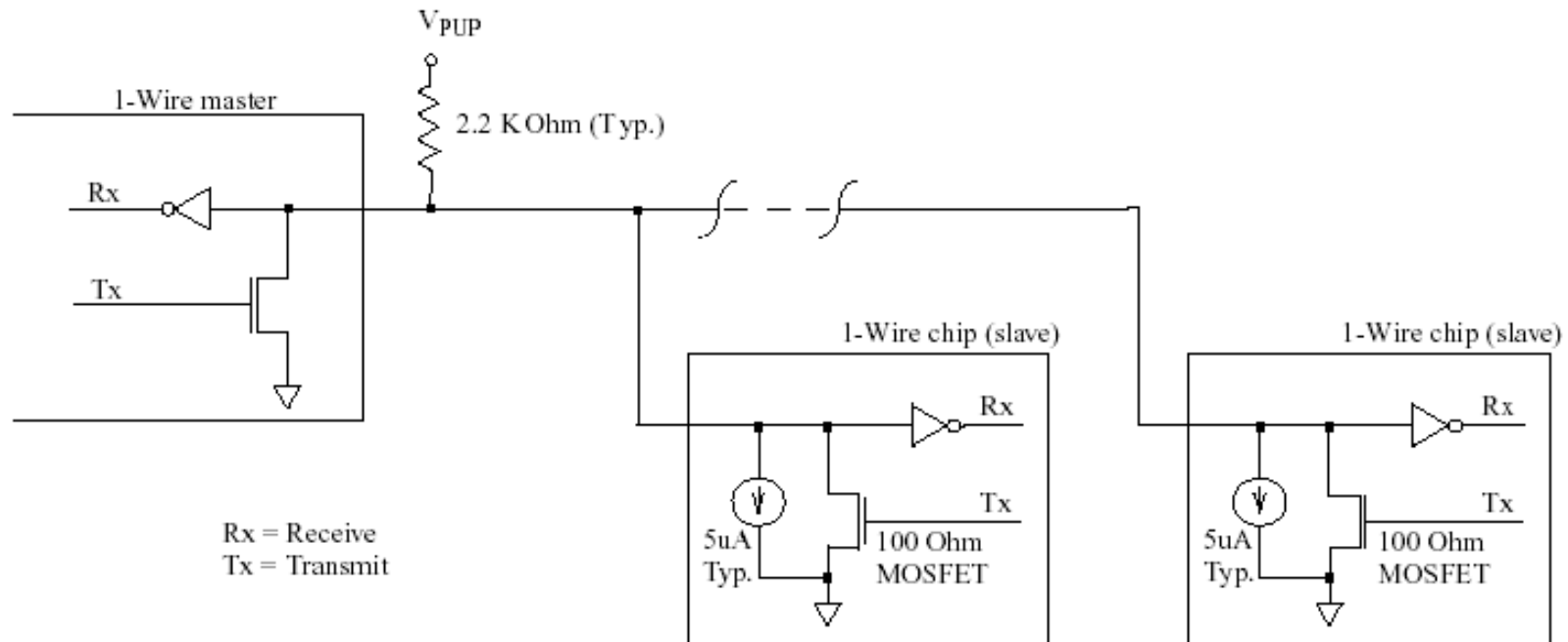
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- Tracabilité
  - Chaîne du froid, Suivi de lot/produit en vrac ...
- Domotique
  - Température
  - Weather station
- Sécurité
  - Ronde de garde, Accès physique et logique
  - Porte-Monnaie Electronique
- Divers
  - Limitation des recharges de batterie de téléphone portable
  - Interdiction des recharges de toner à faible coût
  - ...

# 1-Wire (Dallas Semiconductor)

<http://www.ibutton.com/ibuttons/standard.pdf>

- Data and power sent over single wire
  - Data rates : 16.3Kbs (regular mode) and 144Kbs (overdrive mode)
  - One single master and multiple slaves
    - Master typically a microprocessor serial port (Serial, Parallel port, USB)



# 1-Wire Address and Protocol

- Device Address (64bits)
  - CRC (8bits) + unique Device Id (48bits) + Family ID (8bits)
    - Family determines the services provided by the device (0x21 temperature logger)
- Protocol
  - Each 1-Wire transaction contains three phases:
  - 1. Initialization
    - Master transmit a reset to all devices on network
    - Devices respond with a presence pulse
  - 2. Addressing
    - Select device by broadcast its unique 64-bit address
  - 3. Data Exchange
    - Device dependent
- Finding Devices
  - 1-Wire protocol provides a device discovery and selection feature

# 1-Wire Master

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- Adapters
  - RS232 to 1-Wire
  - Parallel to 1-Wire
  - USB to 1-Wire
- Several form factors
  - iButton
    - Clips
    - Probe
    - Contact
    - ...
  - ...



# 1-Wire Device List

## Sensors & Actuators

### ■ Dallas Products

- packaged or not as a iButton (capsule étanche en métal)
  1. DS1990A/DS2401(01) 1-Wire Address only
  2. DS1991/DS1425 (02) Secure memory device
  3. DS1994/DS2404 (04) 4K NVRAM memory and clock/timer/alarms
  4. DS2405 (05) single addressable switch
  5. DS1993 (06) 4K NVRAM memory
  6. DS1992 (08) 1K NVRAM memory
  7. DS1982/DS2502 (09) 1K EPROM memory
  8. DS1995 (0A) 16K NVRAM memory
  9. DS1985/DS2505 (0B) 16K EPROM memory
  10. DS1996 (0C) 64K NVRAM memory
  11. DS1986/DS2506 (0F) 64K EPROM memory
  12. DS1920/DS1820/DS18S20 (10) temperature and alarm trips
  13. DS2406/DS2407 (12) 1K EPROM memory, dual switch
  14. DS1983/DS2503 (13) 4K EPROM memory
  15. DS1971 (14) 256bit EEPROM memory and OTP register
  16. DS1955/57 (16) Java Powered Cryptographic iButton
  17. DS1963S (18) 4K NVRAM memory and SHA-1 engine
  18. DS1963L (1A) 4K NVRAM memory with write cycle counters
  19. DS2423 (1D) 4K NVRAM memory with external counters
  20. DS2409 (1F) dual switch, coupler
  21. DS2450 (20) quad A/D
  22. DS1921 (21) Thermochron temperature logger
  23. DS1973 (23) 4K EEPROM memory
  24. DS2438 (26) temperature, A/D
  25. DS18B20 (28) adjustable resolution temperature
  26. DS2760 (30) temp, current, A/D



### ■ Autres

- LCD Display Panel, PinPad, ...

# 1-Wire device

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- Identifiant unique
  - DS1990A/DS2401(01) 1-Wire Address only
- Mémoire à inscription unique
  - Compteur d'usage, ...
  - DS1982/DS2502 (09) 1K EPROM memory
  - DS1983/DS2503 (13) 4K EPROM memory
  - DS1985/DS2505 (0B) 16K EPROM memory
  - DS1986/DS2506 (0F) 64K EPROM memory
- Mémoire (en bloc) à accès protégé par mot de passe
  - DS1991/DS1425 (02) Secure memory device
- Mémoire non volatile
  - DS1993 (06) 4K NVRAM memory
  - DS1992 (08) 1K NVRAM memory
  - DS1995 (0A) 16K NVRAM memory
  - DS1996 (0C) 64K NVRAM memory
  - DS1971 (14) 256bit EEPROM memory and OTP register
  - DS1973 (23) 4K EEPROM memory
  - DS1963L (1A) 4K NVRAM memory with write cycle counters
  - DS2423 (1D) 4K NVRAM memory with external counters



# 1-Wire device

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- Mémoire avec signature sécurisée
  - Porte Monnaie Electronique, Signature de transaction
    - DS1963S (18) 4K NVRAM memory and SHA-1 engine
    - DS1961S, DS2432, EEPROM with SHA-1 Engine' family type 33 (hex)
      - 1128 bits of 5V EEPROM memory partitioned into four pages of 256 bits, a 64-bit write-only secret and up to 5 general purpose read/write registers.
      - On-chip 512-bit SHA-1 engine to compute 160-bit Message Authentication Codes (MAC) and to generate secrets.
      - Write access requires knowledge of the secret and the capability of computing and transmitting a 160-bit MAC as authorization.
      - Secret and data memory can be write-protected (all or page 0 only) or put in EPROM-emulation mode ("write to 0", page0)
- Switch
  - Récupère l'état d'une bascule
    - DS2405 (05) single addressable switch
    - DS2406/DS2407 (12) 1K EPROM memory, dual switch
    - DS2409 (1F) dual switch, coupler

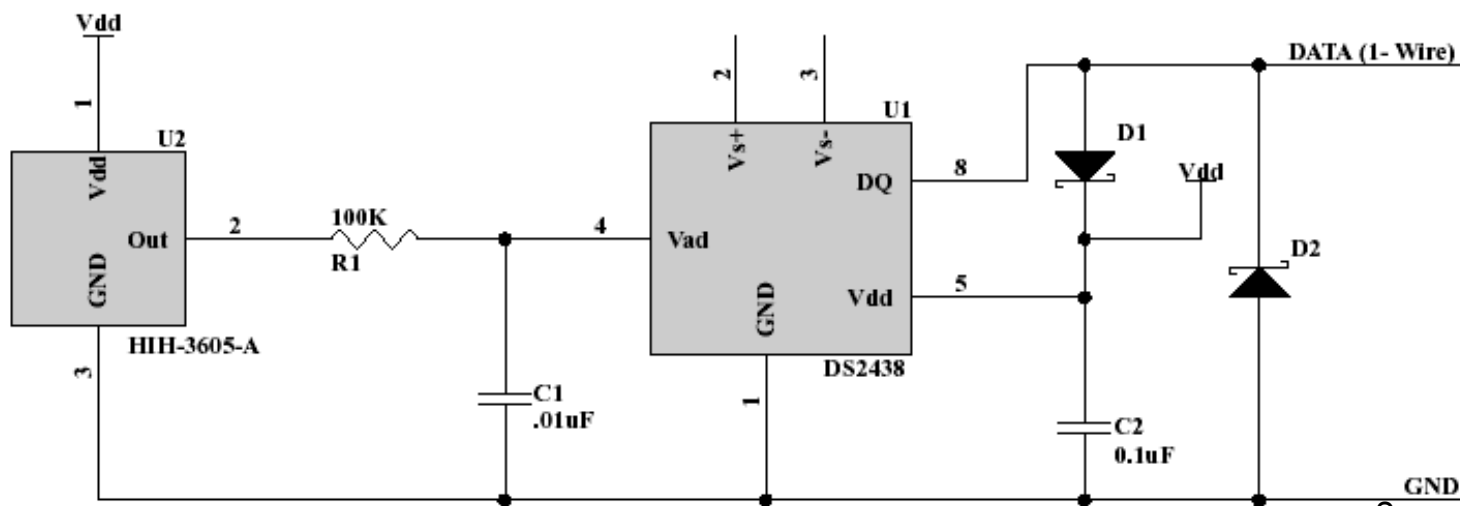
# 1-Wire device

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- Horloge temps réel et timer
  - DS1994/DS2404 (04) 4K NVRAM memory and clock/timer/alarms
    - Pages mémoire
    - Horloge
    - Timer accumulant le temps passé lors de la mise sous tension
    - Date d'expiration programmable
  - DS1904, DS2415 (24) Real-Time-Clock (RTC)
    - Famille 04 + 1 second resolution
  - DS2417 Real-Time Clock with Interrupt (27)
    - similar to the DS2415 with the addition of a hardware interrupt pin
    - Programmable interrupt output for system wakeup

# 1-Wire device

- **Convertisseur A/D**
  - Permet de connecter tout capteur à un bus 1-Wire
    - DS2450 (20) quad A/D (Four high-impedance inputs )
    - DS2438 (26) temperature, A/D
    - DS2760 (30) temperature, current, A/D
- **Exemple d'usage (Capteur d'humidité)**
  - <http://www.ibutton.com/weather/humidity.html>



# 1-Wire device

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## ■ Capteur Température

- DS2438 (26) temperature, A/D
- DS2760 (30) temperature, current, A/D
- DS1920/DS1820/DS18S20 (10) temperature and alarm trips
- DS18B20 (28) adjustable resolution temperature

## ■ Capteur Température avec Journal

- DS1921 (21) Thermochron temperature logger
  - Journalisation+Histogramme des mesures de température
    - périodique et/ou sur dépassement de seuil
  - Contient un horloge temps réel
  - Fonctionnement autonome (contient une batterie)
  - Application : contrôle de la « chaîne du froid »

# 1-Wire device

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- Capteur de température et humidité avec Journal
  - DS1923 (23) Hygrochron Temperature/Humidity Logger
    - Journalisation+Histogramme des mesures de température et d'humidité (8 Ko)
      - périodique (1sec à 273 heures) et/ou sur dépassement de seuil
    - Contient un horloge temps réel
    - Fonctionnement autonome (contient une batterie)
    - Sécurisé par mots de passe
    - Applications : environnement, industrie agro-alimentaire, surveillance d'entrepôt ...

# 1-Wire device

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- Potentiomètre (Actionneur)
  - DS2890, 1-Wire Digital Potentiometer (2C)
    - Single element 256-position linear taper potentiometer

# 1-Wire device

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- Moniteur de batterie
  - DS2760, High Precision Li-ion Battery Monitor (30)
    - Li-ion safety circuit
    - Overvoltage protection
    - Overcurrent/short circuit protection
    - Undervoltage protection
    - Two sense resistor configurations
    - Internal 25 mOhm sense resistor
    - External user-selectable sense resistor
    - 12-bit bi-directional current measurement
    - Current accumulation
    - Voltage measurement
    - Direct-to-digital temperature measurement
    - 32 bytes of lockable EEPROM
    - 16 bytes of general purpose SRAM

# Java-Powered iButton (DS1955 et DS1957)



- Packaging : capsule étanche en métal
  - Peut-être monté sur bague (cf « La nuit des temps » de René Barjavel)
- Communication : 1-Wire
  - Un fil pour les échanges et l'alimentation
  - Débit : 16,6 Kbit/s et 144 Kbit/s
- Horloge temps réel (Secure timestamping)
- Mémoire
  - 64Ko de ROM (OS+JVM)
  - 6Ko à 135Ko de NV-RAM à 100 ns (Non Volatile RAM : 10 ans)
- API JavaCard 2.0 (voir cours « JavaCard » et cours « Cartes à Puce »)
  - Entiers 32 bits
  - javacardx.crypto : Crypto SHA-1, RSA DES, 3DES
- Coté terminal
  - OCF, OneWireContainer
  - PKCS#11, MS CSP, X509, Win2000 log on



# 1-Wire API

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- Provides a abstract of the protocol (Adapter) and of the device low-level command (Container)
  - See : chapter 4 in Don Loomis, « The TINI™ specification and developer's guide », June 2001, ISBN 0-201-72218-6, free download on the [www.ibutton.com](http://www.ibutton.com)
- Languages : C, C++, Java, ...
- Operating System : Win32/COM, Unix, TINIOS, ...

# Processus d'utilisation

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- 1. Get an adapter instance
- 2. Get exclusive use of the 1-Wire network
- 3. Find a 1-Wire device
- 4. Perform operations through the device's container
- 5. End exclusive use of the 1-wire network
- 6. Free the port when ending application

# Exemple de programmation en Java

## Lister les esclaves

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```
// get the default adapter
DSPortAdapter adapter = OneWireAccessProvider.getDefaultAdapter();
System.out.println("Adapter: " + adapter.getAdapterName()+ " Port: " + adapter.getPortName());
// get exclusive use of adapter
adapter.beginExclusive(true);
// clear any previous search restrictions
adapter.setSearchAllDevices();
adapter.targetAllFamilies();
adapter.setSpeed(adapter.SPEED_REGULAR);
// enumerate through all the 1-Wire devices found
for (Enumeration owd_enum = adapter.getAllDeviceContainers();
     owd_enum.hasMoreElements(); ){
    owd = ( OneWireContainer ) owd_enum.nextElement();
    System.out.println(owd.getAddressAsString());
}
adapter.endExclusive(); // end exclusive use of adapter
adapter.freePort(); // free port used by adapter
```

# Exemple de programmation en Java

## Lecture de mesures

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```
// device setup
```

```
byte[] state = owd.readDevice();  
owd.setResolution(OneWireContainer20.CHANNELA, 16, state);  
owd.setResolution(OneWireContainer20.CHANNELB, 8, state);  
owd.setRange(OneWireContainer20.CHANNELA, 5.12, state);  
owd.setRange(OneWireContainer20.CHANNELB, 2.56, state);  
owd.writeDevice();
```

```
// device read
```

```
owd.doADConvert(OneWireContainer20.CHANNELA, state);  
owd.doADConvert(OneWireContainer20.CHANNELB, state);  
double chAVoltage = owd.getADVoltage(OneWireContainer20.CHANNELA, state);  
double chBVoltage = owd.getADVoltage(OneWireContainer20.CHANNELB, state);
```

# Exemple de programmation en Java

## OneWireViewer *(fourni dans le SDK)*

The screenshot displays the OneWireViewer application window. The title bar reads "OneWireViewer - 69254000025AD21 DS1921L-F52". The menu bar includes "File", "View", "Tools", and "Help".

The main interface is divided into several sections:

- Device List:** A list of connected devices, each with a unique ID and a model number (e.g., DS1995, DS1963L, DS1990A, DS1921L-F, DS1982, DS1973). The device with ID "69254000025AD21" is highlighted.
- Command Section:** Contains three buttons: "Refresh Mission Results", "Start New Mission", and "Disable Mission". Below these buttons are radio buttons for "Fahrenheit" (checked) and "Celsius".
- Status Section:** Includes tabs for "Status", "Temperatures", "Histogram", and "Alarm Log". The "Temperatures" tab is active, showing a line graph of temperature data over time. The y-axis ranges from 50.9 to 121.8. The graph shows a highly fluctuating signal with sharp peaks and troughs.
- Status Bar:** At the bottom, it displays "52 Devices {DS9097U} COM2" and "Done Setting up viewer".

## Livres et Web

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- Don Loomis, « The TINI™ specification and developer's guide », June 2001, ISBN 0-201-72218-6, free download on the [www.ibutton.com](http://www.ibutton.com)
- <http://www.ibutton.com>