



## A circular inset showing a hand holding a credit card, symbolizing financial transactions or credit.

1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 26

# The File Manager



- § File system implemented in non-volatile RAM and Flash
- § Files may be accessed in RAM or Flash using a drive prefix
  - **I:** RAM File System (default)
  - **F:** Flash File System
- § Files are assigned to groups (0-15) with access control
- § Groups can span both RAM and Flash
- § Files are added to the directory in the order they are created
  - Downloading
  - Creating a new file

# The Verix File Manager



- § Groups are not specified as part of filenames
- § Group 1 tasks are allowed to change their effective group
  - `set_group( )`      Allows access to files in other groups
  - `get_group( )`      Retrieves the current group setting
- § Any task can change its group to 15
- § Group 15 files can be accessed by a slash(/) prefix to the filename
  - `/batch.dat`      Access “batch.dat” in Group 15 RAM
  - `F:/cardlist`      Access “cardlist” in Group 15 Flash

# Files in Flash



§ Limit the use of the Flash file system to files that rarely or never change

- \*.out files
- Font files
- Message files

# Files and Memory



- § Memory manager attempts to recover unused memory space
- § Design file management routines to minimize the need to increase or decrease the file size
  - Reuse record space to improve performance

# Files and Memory



## § File extension feature allows specification of maximum file size

- Called “Memory Padding”
- Declare maximum size (in bytes) of file v/s writing blank records and overwriting
- Required space is immediately claimed
- Future operations on the file do not disturb other files in the system
- `get_file_max()`                    `^ get_file_attributes()`
- `set_file_max()`                    `^ set_file_attributes()`
- `get_file_size()`                   `^ reset_file_attributes()`

# File Naming & Handles



## § File Naming

- 32 characters, maximum
- Must be NULL terminated
- Not case sensitive

## § File Handles

- 30 file handles available
- Up to 30 files may be open at any one time
- System files are not counted in the 30 file limit
- A single file may have multiple file handles
- Can change the maximum number of file handles
  - \*FILE in config.sys (Group 1)
- Only one flash file can be opened with write access at any time

# File Types



- § Binary (Generic)
- § Variable Length Record (VLR)
- § Compressed Variable Length Record (CVLR)
- § Keyed



# Generic Files



- § May contain any type of data
- § Data accessed by byte address within the file
- § Normally each record is of fixed length defined by the size of a data structure

# Variable Length Record (VLR) Files



- § Implemented as a counted string - transparent to user
- § Allows data to be stored and accessed as records
- § Data is accessed by record number
- § Requires the file be processed from the beginning
- § Suited for chronologically sequenced records with little or no random access requirements
- § Limited to 254-byte records

# Compressed Variable Length Record (CVLR) Files



- § Same as VLR...Plus...
- § File system compresses/decompresses records
- § Compression technique:
  - Numeric characters compressed to 1/2 byte
  - Lower case characters converted to upper case equivalent.
  - Byte values greater than 0x5F cannot be correctly translated  
-- should not be used.
  - Byte boundaries ignored
- § File space saving noticeable

# Keyed Files



§ Paired File

§ Double CVLR file

- Uses two records for each record
  - A key
  - Associated data value

§ Slowest

- Requires two reads
- Comparison of the key

§ Not index sequential

§ Ordered at time of creation

§ Config.Sys is an example

# Opening/Closing Files



§ Opening a File: `hFile = open(filename, attributes);`

§ Attributes:

- `O_RDONLY` Read access only
- `O_WRONLY` Write access only
- `O_RDWR` Read/write access
- `O_APPEND` Opens with file pointer at EOF
- `O_CREAT` Creates a new file
- `O_TRUNC` Opens file & truncates length to 0
- `O_EXCL` Error value for `O_CREAT`

§ Once a file has been opened, set the seek pointer to the appropriate location before attempting to read or write

§ Closing a File: `status = close(hFile);`

# Suggested Way of Opening Files



§ To prevent overwriting data in an existing file,  
instead of `O_CREAT` | `O_RDWR` use

```
while((FileHdl = open("data.bat", O_RDWR)) < 0)
{
    hFile = open("data.bat", O_CREAT);
    close(hFile);
}
```

§ Another method

```
hFile = open("trans.dat", O_WRONLY|O_APPEND);
if (hFile < 0)
{
    hFile = open("trans.dat", O_CREAT);
    close (hFile);
}
```

# File Positioning



## § Setting the read/write pointer:

```
lseek  
position = seek_vlr(hFile, offset, origin);  
seek_cvlr
```

## § Offset:

- Long integer

## § Origin is where to begin searching:

- Beginning of file: **SEEK\_SET**
- Current point location: **SEEK\_CURRENT**
- End of file: **SEEK\_END**

# File Positioning



Beginning of File

SEEK\_SET



SEEK\_CURRENT

SEEK\_END

End of File



# Read / Write



## § Reading from a file:

```
read
bytes_read = read_vlr(hFile, buffer, len);
read_cvlr
```

## § Writing to a file:

```
write
bytes_written = write_vlr(hFile, buffer,
len);
write_cvlr
```

# Insert / Delete



## § Inserting a record to a file:

```
insert
bytes_read = insert_vlr(hFile, buffer,
len);

insert_cvlr
```

## § Deleting a record from a file:

```
delete
bytes_written = delete_vlr(hFile, buffer,
len);

delete_cvlr
```

# File Utilities



## § Deleting a file:

```
status = _remove("filename");
```

- File must be closed before it can be removed
- All file handles must be released

## § Renaming a file:

```
status = _rename("old_name", "new_name");
```

## § Lock/Unlock a file:

```
status = lock(hFile, 0, 0);
```

```
status = unlock(hFile, 0, 0);
```

# File Utilities



- § Calculate file checksum and compare to file header
  - `SVC_CHECKFILE( )`
- § Get the checksum for a file
  - `dir_get_checksum( )`
- § Date of last file modification
  - `get_file_date( )`
  - `dir_get_file_date( )`
- § Attach a date to a file (downloaded using `SVC_ZONTALK()`)
  - `dir_put_file_date( )`

# File Utilities



§ `dir_get_file_size( )`

- Returns the size of the file

§ `dir_get_file_sz( )`

- Returns the number of data bytes in the named file

§ `dir_get_attributes( )`

- Access file attribute bits associated with a file

§ `dir_set_attributes( )`

- Turns on one or more attribute bits for a specified file

§ `dir_reset_attributes( )`

- Turns off one or more attribute bits for a specified file

# File Utilities



## § SVC\_RAM\_SIZE ( )

- Amount of RAM memory installed in the device

## § SVC\_FLASH\_SIZE ( )

- Amount of Flash memory installed in the device

## § dir\_get\_sizes ( )

- Number of files in the directory
- Amount of memory used by the file system
- Amount of free memory remaining

# File Utilities



§ `dir_flash_coalesce_size()`

- Returns the number of bytes to reclaim with a coalesce

§ `dir_flash_coalesce()`

- Erase all files marked for deletion and reclaim unused memory

§ `dir_get_first()`

- Returns the name of the 1st file in the directory

§ `dir_get_next()`

- Used after `dir_get_first()`
- Provides the name of the next file in the directory

# Config.sys



- § Contains system options and parameters
- § Configure the system environment
- § Double CVLR file maintained as a “keyed” file.
- § Entries stored in pairs of variable length records: key=data
  - key  $\leq$  32 bytes (7 bytes if Zontalk)
  - data  $\leq$  128 bytes





§ Values of keys preceded with \* or # are preserved during full downloads.

\* System variables only

#Application variables

Examples:

\*GO=myapp.out

\*SMDL=1

#MNAME=MY IMPORT SHOP

# Config.sys



- § There can be up to 15 config.sys files
- § One for each file group in use
- § System properties are maintained in file group 1
  - Apps in other file groups can not change the system properties



## § Access config.sys in three ways:

- System Mode
- Download
- Application

# Config.sys API



§ `int get_env(key, data, num_bytes);`

**Retrieves the value of an environment value**

§ `int put_env(key, data, num_bytes);`

**Stores and environment variable and data in config.sys**

# LAB Exercise



## LAB9: File Access

Get parameter's value from config.sys and update the value

For example:

Give a entry to update parameter #PRNLOGO

#PRNLOGO=1 :print out logo

#PRNLOGO=0 :don't print out logo